United States Department of Agriculture

Chugach National Forest Land Management Plan

Draft Environmental Impact Statement

Forest Service Chugach National Forest 2018

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Cover Photo: Copper River Delta, Chugach National Forest by Ron Niebrugge.

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Draft Environmental Impact Statement
Alaska

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Abstract: The Forest Service proposes to revise the 2002 Land and Resource Management Plan (Forest Plan) for the Chugach National Forest. Plan revision would provide an updated Forest Plan for the Chugach National Forest that would guide management of National Forest System (NFS) lands within the forest boundary for approximately the next 15 years. The proposal updates the management direction for approximately 5,415,148 acres of NFS lands in southcentral Alaska by describing desired conditions, goals, objectives, suitable uses, standards and guidelines and monitoring requirements. In accordance with the National Environmental Policy Act of 1969, the Forest Service has prepared a Draft Environmental Impact Statement (DEIS) for the Draft Forest Plan. The DEIS analyzes the consequences of four alternatives, including a "no action" alternative, which would continue management under the 2002 Forest Plan, as amended. Alternatives C and D are fully embodied in the Draft Forest Plan.

The Forest Service will use the "pre-decisional administrative review process," also referred to as the "objection process" described in the 2012 Planning Rule (36 CFR 219 Subpart B). This process gives an individual or entity an opportunity for an independent Forest Service review and resolution of issues before a final plan is approved. Subpart B identifies who may file objections to a plan revision, the responsibilities of the participants in an objection, and the procedures that apply to the review of the objection. Section 219.53 of the Planning Rule describes who may file an objection. Individuals and entities who have submitted substantive formal comments related to this plan revision during the opportunities for public comment for this decision may file an objection.

Comments: It is important that reviewers provide their comments at such times and in such a way that they are useful to the preparation of this environmental impact statement. Therefore, comments should be provided prior to the close of the comment period and should clearly articulate the reviewer's concerns and contentions. The submission of timely and specific comments can affect a reviewer's ability to participate in subsequent administrative review or judicial review. Comments received in response to this solicitation, including names and addresses of those who comment, will be part of the public record for this proposed action. Comments submitted anonymously will be accepted and considered; however, anonymous comments will not provide the respondent with standing to participate in subsequent administrative or judicial reviews. Comments on the DEIS should be specific and should address the adequacy of the environmental impact statement or the merits of the alternatives discussed or both (40 CFR 1503.3).

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Preface

This draft environmental impact statement (DEIS) was prepared in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This DEIS and its supporting documents are on file at the forest supervisor's office of the Chugach National Forest in Anchorage, Alaska. Electronic copies are also available on the Chugach National Forest Web site. This DEIS is organized as follows.

Chapter 1. Purpose of and Need for Revising the Chugach National Forest Land Management Plan

This chapter discusses the background of the proposal, explains the purpose and need for revising the land management plan (forest plan or plan), and briefly describes the Forest Service's proposal for achieving the purpose and need. It summarizes public participation in the plan revision process and lists significant issues identified during the scoping period.

Chapter 2. Alternatives

This chapter discusses a range of reasonable alternatives, including the no action alternative. These alternatives are based on significant issues raised by the public and other agencies. This chapter also explains why other alternatives were dismissed from further consideration. It includes a summary comparison of the environmental consequences associated with each alternative that defines the issues and provides a clear basis for choice among the alternatives.

Chapter 3. Affected Environment and Environmental Consequences

This chapter describes the environmental effects of implementing the alternatives. It describes the affected environment, by resource areas, as a baseline against which the impacts of alternatives are compared. The description of the affected environment is followed by disclosure of the potential direct, indirect, and cumulative effects of implementing each of the alternatives.

Chapter 4. Consultation and Coordination

This chapter lists the credentials of those who prepared this DEIS and identifies the agencies, Alaska Native Tribes and Corporations, and government officials consulted during the development of the DEIS.

Glossary

This section provides definitions of terms.

Literature Cited

This section reports full citations for the sources cited in the text.

Appendices

The appendices provide more detailed information to support the analyses presented in the DEIS. They include:

- Appendix A Chugach National Forest Wilderness Area Inventory and Evaluation
- Appendix B Relevant Agreements and Memoranda of Understanding

Maps (see separate folder)

- Management Areas by Alternative
- Recreation Opportunity Spectrum by Alternative
- Wilderness Area Recommendation by Alternative
- Geographic Areas
- Vegetation
- Game Management Units
- Land Status

Executive Summary

Introduction

The Forest Service proposes to revise the 2002 Land and Resource Management Plan (2002 forest plan) for the Chugach National Forest. The revised forest plan would guide management of National Forest System (NFS) lands within the forest boundary for approximately the next 15 years. The revised forest plan will update the management direction for approximately 5,415,148 acres of NFS lands in southcentral Alaska by describing desired conditions, goals, objectives, suitable uses, standards and guidelines, and monitoring requirements. In accordance with the National Environmental Policy Act of 1969, the Forest Service has prepared a draft environmental impact statement as part of the plan revision process. The draft environmental impact statement analyzes the consequences of four alternatives. Alternative A, the no action alternative, would continue management under the 2002 forest plan, as amended.

The Draft Environmental Impact Statement

Purpose and Need for Revising the Forest Plan

This action is being undertaken to meet the legal requirements of the National Forest Management Act and the provisions of the 2012 Planning Rule. There is a need to provide management direction that addresses changing social and environmental conditions. There is a need to consider new information from monitoring and scientific research, and public involvement.

The 2002 forest plan has been amended five times over the plan period. While much of the 2002 forest plan as amended remains relevant, public comments and updated information from the assessment phase of forest plan revision revealed areas where the 2002 forest plan needs to change to better manage and protect the resources in anticipation of a changing climate while keeping up with changes in forest use.

The need for plan revision is directly related to six overarching needs for change identified in the assessment and through public involvement. Although much of the existing management direction in the 2002 forest plan is adequate to provide sustainable, integrated resource management, several emphasis areas of management direction potentially needing change were identified.

Significant Issues

In addition to the need for change emphasis areas, two significant issues identified during scoping were used to develop the alternatives.

Wilderness Area Recommendation

With each revision of the land management plan, the Forest Service identifies and evaluates lands that may be suitable for inclusion the National Wilderness Preservation System and determines whether or not to recommend any such lands for wilderness area designation. The Forest Service made wilderness area recommendations for the Chugach National Forest in 1984 and 2002. Of concern is how much area should be recommended for wilderness area designation.

The Nellie Juan-College Fiord Wilderness Study Area was established in 1980 through passage of the Alaska National Interest Lands Conservation Act (ANILCA) and is managed to preserve the area’s character and potential for inclusion in the National Wilderness Preservation System. Most people who commented during scoping would like to see more than the 2002 proposal of 1.4 million acres within the wilderness study area recommended for wilderness area designation. Approximately 1.9 million acres are available today for recommendation, considering recent land conveyances.

For areas outside of the wilderness study area, some people want to increase opportunities for solitude and remote recreation experiences by increasing the amount of recommended wilderness area designation. Others are concerned that any increase in the recommended wilderness area could affect the amount of area available for non-wilderness uses.

Recreation Opportunity Spectrum

Since the early 1980s, the recreation opportunity spectrum has been used as a framework for identifying, classifying, planning, and managing a range of recreation settings. Six distinct classes have been identified: urban, rural, roaded natural, semi-primitive motorized, semi-primitive non-motorized, and primitive are defined using specific physical, managerial, and social criteria.

The Chugach National Forest is recognized as a place for world class, nature-based outdoor recreation. Demand for recreation opportunities continues to increase and diversify. Of concern is where various recreation opportunities and classes should occur and to what condition they should be managed. Some people would like the recreation opportunity spectrum map to reflect the desired conditions and settings that are to be managed for; others would like the map to reflect current conditions and existing decisions.

Some people want to maximize protections of the existing wilderness character within the Nellie Juan-College Fiord Wilderness Study Area by increasing the amount of the primitive recreation class assigned to the study area; while others are concerned that such an increase could limit opportunities for outfitters and guides and other permitted uses (commercial fishing, nature filming, recreation events, etc.).

Significant issues were combined with the need for change emphasis areas to create revision topics used in the draft environmental impact statement to organize the features of the alternatives and to compare and contrast the differences between alternatives. The following revision topics represent broad concepts relating to the public preferences and resource management that need to be addressed in revising the forest plan for the Chugach National Forest.

Revision topics 1 and 2 respond to the significant issues, and revision topics 3 and 4 respond to other need for change elements and to public comments that were not identified as significant issues.

Revision Topic 1 Land Allocations

There is a need to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System and determine whether or not to recommend any such lands for wilderness area designation. There is a need to identify and provide management direction for rivers eligible and suitable for inclusion into the National Wild and Scenic River System. There is a need to provide management direction for inventoried roadless areas (IRAs) and national scenic and national historic trails. There is a need to revise management areas consistent with the 2012 Planning Rule.

Revision Topic 2 Recreation Opportunities

There is a need to provide diverse recreation opportunities in cooperation with partners, while also protecting the natural, cultural, and scenic environment for present and future generations. Integrated plan components are also needed to address the uncertainties associated with a changing climate and the timing and location of recreation opportunities and associated infrastructure.

Revision Topic 3 Ecological Sustainability

There is a need to manage or maintain key ecosystem elements, such as, air, soil, water, and vegetation. There is a need to maintain terrestrial and aquatic ecosystem functions across the landscape (e.g., riparian, upland, alpine, and near shore ecosystem types). There is a need to provide management direction that promotes ecosystem resilience in a changing climate. There is a need to maintain habitats consistent with natural ecosystem processes at a landscape scale that will provide for the persistence of a diversity of native plant and animal species.

Revision Topic 4 Social, Economic, and Cultural Sustainability

There is a need to provide plan components that will guide the plan area’s contribution to the social, economic, and cultural sustainability of communities within the plan area. There is a need to acknowledge the values and interests in the Chugach National Forest held by Alaska Native Tribes and Corporations.

Alternatives

Four alternatives are considered in detail. At this time, the agency has not identified a preferred alternative.

Alternative A No Action

This alternative is the 2002 Forest Plan. The 2002 forest plan includes 21 management areas with management area prescriptions that include desired conditions, suitability determinations, and standards and guidelines. This alternative recommends 1,387,510 acres (72 percent) of NFS lands in the Nellie Juan-College Fiord Wilderness Study Area for wilderness area designation.

Alternative B

This alternative is the draft forest plan released as the proposed action for public scoping in 2015. The wilderness area recommendation is the same as in alternative A. Some of the 21 management areas in the 2002 forest plan were consolidated; the draft forest plan in alternatives B, C, and D includes eight management areas, each with associated plan components.

Recreation opportunity spectrum settings in alternative B are the same as in alternative A for the Prince William Sound and Copper River Delta geographic areas. In the Kenai Peninsula Geographic Area, alternative B incorporates the changes to recreation classes necessary to make classes consistent with the Kenai Winter Access Project Record of Decision (2007). This was a travel management decision that did not include a forest plan amendment to modify recreation classes to align with the decision. The Kenai Winter Access Project only affected the Seward Ranger District within the Kenai Peninsula Geographic Area.

This alternative incorporates plan components that respond to the needs for change related to ecological sustainability and social, economic, and cultural sustainability.

Alternative C

This is the modified proposed action developed in response to consultation and scoping comments. This alternative represents our proposal for revising the forest plan.

Most of the wilderness study area would be recommended for wilderness area designation (1,819,700 acres, 94 percent). In the Kenai Peninsula Geographic Area, the backcountry management area would increase by approximately 65,355 acres between alternatives B and C. This change responds to public comments that front country management area boundaries were too broad.

In addition to the recreation opportunity spectrum changes described for alternative B, this alternative proposes recreation class changes forestwide. Changes include shifting nearly all of the Prince William Sound Geographic Area to the primitive recreation class. Most of the changes were proposed to bring the national forest into better alignment with desired management direction and visitor use patterns.

Alternative C responds to public comments by adding plan components that strengthen language for collaboration and partnerships with stakeholders and clarify access and uses of NFS lands near private inholdings. It also responds to public comments by adding and strengthening plan components for ecosystem integrity.

Alternative D

This alternative responds to public comments advocating a larger area recommended for wilderness designation and a larger area in the primitive recreation class.

Alternative D would increase the amount of recommended wilderness area over what is proposed in alternative C. Almost the entire wilderness study area would be recommended for wilderness area designation (1,884,200 acres, 97 percent). In the Kenai Peninsula Geographic Area, the backcountry management area would increase by approximately 3,896 acres between alternatives C and D, for a total increase of approximately 69,251 acres between alternatives B and D.

Recreation opportunity spectrum settings in the alternative would be the same as alternative C except that all NFS lands within the wilderness study area would be in the primitive recreation class, an increase of approximately 43,070 acres over alternative C. This change would address public comments that indicated a desire to see the entire wilderness study area managed in the primitive recreation class. Winter snowmachine use would still be allowed within the wilderness study area as provided for by ANILCA Section 1110(a).

As in alternative C, this alternative responds to public comments through the addition of plan components that strengthen language for collaboration and partnerships with stakeholders and clarifies access and uses of NFS lands near private inholdings. It also responds to public comments by adding and strengthening plan components for ecosystem integrity.

Decision to Be Made

The responsible official for this proposed action is the forest supervisor of the Chugach National Forest. After reviewing the analysis in the final environmental impact statement, the responsible official will issue a record of decision that will:

- Disclose the decision (identify the selected alternative) and reasons for the decision.
- Discuss how public comments and issues were considered in the decision.
- Discuss how all alternatives were considered in reaching the decision, specifying which one is the environmentally preferable alternative (defined in 36 CFR 220.3).

Approval of the revised forest plan will identify management areas and will include recommendations for areas that can only be designated by statute, such as wilderness areas.

Comparison of Alternatives

Comparison of alternatives by significant issues and management areas

Plan Attribute	Alternative A No Action	Alternative B	Alternative C	Alternative D
Wilderness area recommendation [significant issue 1]	1,387,510 acres	1,387,510 acres	1,819,700 acres	1,884,200 acres
Wilderness study area recommended for wilderness area designation [significant issue 1]	72 percent	72 percent	94 percent	97 percent
Recreation opportunity spectrum [significant issue 2]	2002 recreation opportunity spectrum map	2002 recreation opportunity spectrum map with Kenai Winter Access Project changes	2016 recreation opportunity spectrum changes across all geographic areas; fringe of semi-primitive non-motorized class in wilderness study area in higher recreation use areas	2016 recreation opportunity spectrum changes; entire wilderness study area is in primitive class
Management areas	21 management areas	8 management areas	8 management areas; slight increase in backcountry and decrease in front country from alternative B	8 management areas; slight increase in backcountry and decrease in front country from alternative C

Forestwide recreation opportunity spectrum classes, by alternative

Recreation Opportunity Spectrum Class	Alternative A Acres (percent)	Alternative B Acres (percent)	Alternative C Acres (percent)	Alternative D Acres (percent)
Primitive	2,498,666 (46)	2,498,665 (46)	2,899,932 (54)	2,943,228 (54)
Semi-primitive non-motorized	1,535,709 (28)	1,557,772 (29)	840,944 (16)	797,819 (15)
Semi-primitive non-motorized (winter motorized allowed)	704,998 (13)	692,316 (13)	1,134,683 (21)	1,134,550 (21)
Semi-primitive motorized	583,284 (11)	574,556 (11)	449,129 (8)	449,151 (8)
Roaded natural	85,810 (2)	85,730 (2)	89,992 (2)	89,931 (2)
Roaded	6,681 (<1)	6,110 (<1)	469 (<1)	470 (<1)

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Chapter 1. Purpose of and Need for Revising the Chugach National Forest Land Management Plan

Introduction

We, the U.S. Department of Agriculture, Forest Service, are proposing to revise the land and resource management plan, as amended, for the Chugach National Forest. This draft environmental impact statement has been prepared in compliance with the National Environmental Policy Act and its implementing regulations. This draft environmental impact statement discloses the potential effects of a revision of the Chugach National Forest Land and Resource Management Plan (USDA 2002).

The Plan Area

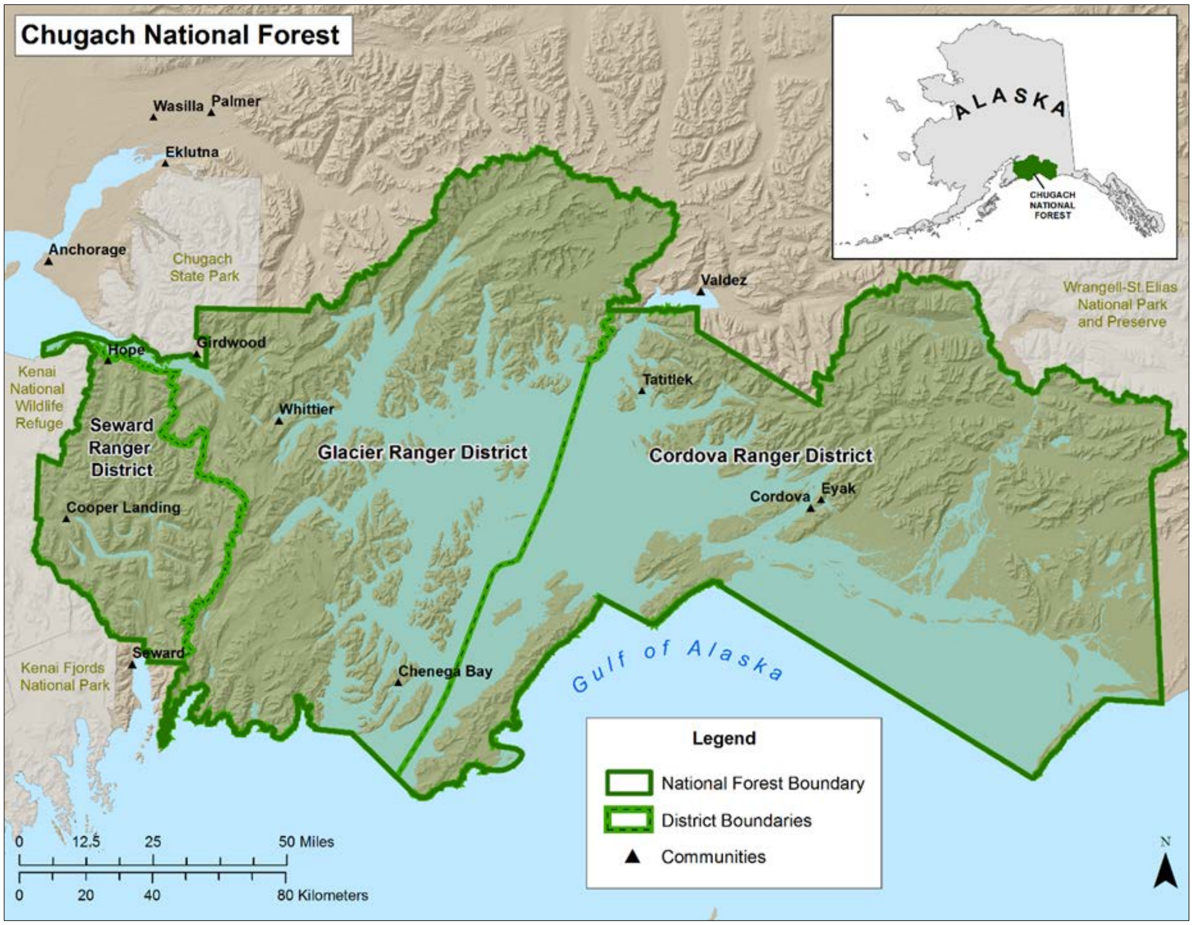
The Chugach National Forest, located in southcentral Alaska, is the farthest north and west of all national forests in the NFS and, by declaration, is the second largest at approximately 5.4 million acres. The Chugach National Forest is composed of large, functional, intact ecosystems spread across coastal and inland landscapes and is located close to half the population of Alaska. Nearly 99 percent of the national forest is managed to allow natural ecological processes to occur with limited human influence. The remainder of the national forest is in the front country management area, most of which is on the Kenai Peninsula, and includes areas of active management and the largest focused amount of human uses.

The national forest is divided into three administrative units, the Glacier, Seward, and Cordova Ranger Districts (map 1). The Chugach National Forest is bordered by the Wrangell-Saint Elias National Park and Preserve to the northeast of the Copper River Delta and by public lands managed by the Bureau of Land Management to the east. On the Kenai Peninsula and to the west, the national forest is bordered by the Kenai National Wildlife Refuge and the Kenai Fjords National Park. To the north and near Girdwood, the national forest is bordered by the Chugach State Park.

Communities within the plan area include Whittier, Hope, Cooper Landing, Moose Pass, Tatitlek, Chenega Bay, Eyak, and Cordova. Adjacent to the plan area are the communities of Anchorage, Seward, Girdwood, Valdez, Sterling, Kenai, and Soldotna.

Regulatory Direction

In 1976, the National Forest Management Act directed the Forest Service to develop land and resource management plans (hereafter referred to as forest plans) and use the direction in them to manage the natural resources and human uses of each national forest. The National Forest Management Act and its implementing regulations (36 CFR 219) require every national forest to revise its land management plan every 15 years. The responsible official also has the discretion to determine at any time that conditions on a plan area have changed significantly such that a plan must be revised.



Map 1. Vicinity map of the Chugach National Forest

This forest plan revision follows two previous forest planning efforts culminating in a forest plan in 1984 and a revised forest plan in 2002. The 2002 forest plan provided updated management direction based on new laws and policies, resource supply potentials and projections of demand, the results of monitoring and evaluation, and the identification of public issues and management concerns. The 2002 forest plan was amended five times. While much of the amended 2002 forest plan remains relevant, public comments and updated information from the assessment phase of this forest plan revision revealed areas where the forest plan needs to change to better manage and protect the resources in anticipation of a changing climate while keeping up with changes in forest use.

In addition to the National Forest Management Act, there are many other laws and regulations that apply to the management of national forests, including, but not limited to, the Clean Air Act, Clean Water Act, Endangered Species Act (ESA), and National Historic Preservation Act (NHPA). Additional direction and policy for management of national forests are provided in executive orders, the Code of Federal Regulations, and the Forest Service directives system, the latter of which consists of Forest Service manuals and Forest Service handbooks. Such direction is generally not repeated in a forest plan.

Plan Revision under the 2012 Planning Rule

A new NFS Planning Rule was published to the Federal Register in 2012, with final directives for agency implementation released January 30, 2015. The 2012 Planning Rule is the most significant update of Forest Service planning regulations in 30 years.

The 2012 Planning Rule emphasizes that forest plans are to guide management of the national forests so they are ecologically sustainable and contribute to social and economic sustainability. The national forests are managed to provide ecosystems and watersheds with ecological integrity and diverse plant and animal communities. In addition, they are managed to have the capacity to provide people and communities with ecosystem services and multiple uses that provide a range of social, economic, and ecological benefits for the present and into the future.

The 2012 Planning Rule describes three phases of the planning process:

- Assessment
- Development, amendment, or revision of forest plans
- Monitoring

The Forest Service initiated the process of revising the 2002 forest plan in 2012. After an extensive period of public outreach, the Chugach National Forest Assessment of Ecological and Socio-Economic Conditions and Trends (forest plan assessment) was published in 2014, describing the current state of the national forest. Supporting documentation published online included the Wilderness Area Inventory and Evaluation, Wild and Scenic River Evaluation, Evaluation of Timber Suitability, and Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula. The climate change assessment has since been published as a general technical report by the USDA Forest Service Pacific Northwest Research Station (PNW-GTR-950). Two letters designating species of conservation concern were also posted with these supporting documents. The forest plan assessment includes an evaluation of relevant information, including existing ecological, economic, and social conditions and trends across the broader landscape, to help inform the need to change the 2002 forest plan.

A Preliminary Need to Change the Forest Plan was developed from the findings in the forest plan assessment. This document summarizes topics or focus areas that need to change or be addressed in the plan revision. These topics form the scope of the proposed action.

A Proposed Revised Land Management Plan was published in December 2015. Concurrent with publication of this document, a notice of intent to prepare an environmental impact statement was published in the Federal Register and initiated a scoping period, during which the public was invited to comment on the proposed revised forest plan. A scoping report summarized the public comments received during this scoping period and identified issues, or points of disagreement, related to the proposed plan.

Forest Plan Content

Forest plans provide a framework for integrated resource management and for guiding project and activity decisionmaking. Plans themselves do not compel any action, authorize projects or activities, or guarantee specific results. Instead, they provide the vision and strategic direction needed to move the national forest toward ecological, social, and economic sustainability.

The draft forest plan includes plan components and other content. Once approved, most additions, modifications, or removal of plan components will require a plan amendment. A change to other content may be made using an administrative change process, whereby nonsubstantive errors, such as misspellings or typographical mistakes, are corrected or information (such as data and maps) is updated. Administrative changes only apply to plan components when change is necessary to conform the forest plan to new law or regulation, and there is no discretion (FSH 1909.12 Ch. 21.5). The public will be notified of all plan amendments and administrative changes before they become effective.

Plan Components

A forest plan is a general framework to guide Forest Service staff when they propose, analyze, and decide on projects and activities. The five required components of a forest plan are desired conditions, objectives, standards, guidelines, and suitability of lands. A plan may also include goals as an optional plan component.

- A desired condition is a description of specific social, economic, or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. This description is specific enough to allow progress toward achievement to be determined but does not include a completion date.
- An objective is a concise, measurable, and time-specific statement of a desired rate of progress toward one or more desired conditions. Objectives are based on reasonable foreseeable budgets.
- A standard is a mandatory constraint on project and activity decisionmaking established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- A guideline is a constraint on project and activity decisionmaking that allows for departure from its terms, so long as the purpose of the guideline is met. Guidelines are established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.
- Suitability of lands is determined for specific lands within the plan area. The lands are identified as generally suitable or not suitable for various uses or activities based on desired conditions applicable to those lands. The suitability of lands is not identified for every use or activity. A forest plan's identification of certain lands as suitable for a use is not a commitment to allow such use but only an indication that the use might be appropriate. If a plan identifies certain lands as not suitable for a use, then that use or activity may not be authorized unless a change in the forest plan is made.
- A goal is a broad statement of intent that describes an outcome that is not at the sole control of a national forest, such as the result of a partnership.

Other Plan Content

Other content in the forest plan consists of background information, general descriptions of areas to provide context to plan components, identification of watersheds that are a priority for maintenance and restoration, proposed and possible actions, and potential management approaches. Management approaches describe the principal strategies and program priorities the responsible official intends to employ to carry out projects and activities under the forest plan. Management approaches may discuss potential processes, such as analysis, assessment, inventory, project planning, or project monitoring.

The draft forest plan monitoring program is based in the practice of adaptive management. The adaptive management cycle includes: identifying the desired conditions (forest plan); activities to help get there (project-level implementation); monitoring whether or not the intended results are being achieved (monitoring program), and using those evaluations to improve implementation activities or to amend the forest plan.

Public Participation

The Forest Service began to engage the public about the forest plan revision process in March 2012. The public and stakeholders were informed through press releases, letters, web-based information, and 10 community workshops led by the Forest Service and the University of Alaska Anchorage in spring 2012. Additionally, an online participatory mapping interface (Talking Points) was available for the public to use from April to November 2012.

On January 31, 2013, the Forest Service issued a news release announcing the beginning of the first phase of the planning process. On February 7, 2013, a legal notice was published in the Anchorage Daily News announcing the beginning of the assessment phase of the forest plan revision and upcoming opportunities for public engagement. Eighteen additional public meetings and workshops were held in local communities in 2013. In addition to these efforts, the Forest Service also conducted a series of targeted outreach efforts to federally recognized Alaska Native Tribes and Corporations, youth, new audiences, permittees, and neighboring landowners, including the State of Alaska, to capture stakeholder input for the assessment.

Integrated public, stakeholder, and Forest Service employee input was collected and synthesized with the best available information about current national forest conditions, emerging trends, and issues, resulting in the publication of the Assessment of Ecological and Socio-Economic Conditions and Trends in November 2014. The public was notified of the completion of the forest plan assessment on the Chugach National Forest website, using the plan revision mailing list, and in a news release. Few public comments were received.

Simultaneously in 2014, Forest Service specialists began several concurrent tasks required under the national framework as part of the revision phase. These included reviews of 2002 forest plan content to identify preliminary need to change themes, changed conditions of eligible wild and scenic rivers, and inventory and evaluation of potential wilderness areas.

A 60-day public comment period with nine accompanying open house meetings were held in spring 2015 following publication of the following documents: Assessment of Ecological and Socio-Economic Conditions and Trends; Preliminary Need to Change Report; Draft Wilderness Inventory and Evaluation Report; Wild, Scenic ,and Recreational Rivers Evaluation Report; and a spring 2015 Plan Revision Newsletter. Many public comments were received and were considered in the development of the proposed action.

The notice of intent to prepare an environmental impact statement was published in the Federal Register on December 18, 2015. The notice of intent initiated a scoping period during which public comment on the proposed action (proposed revised forest plan) was received from December 18, 2015 to February 19, 2016. The public was informed of the notice of intent, proposed action, and comment period through the Chugach National Forest website, mailing lists to stakeholders and interested members of the public, and a press release.

Based on comments from Forest Service personnel, public, other agencies, and non-governmental organizations, the planning interdisciplinary team identified the significant issues and needs for change that form the basis of the alternatives analyzed in this draft environmental impact statement.

Purpose of and Need for Revising the Forest Plan

This action is being undertaken to meet the legal requirements of the National Forest Management Act and the provisions of the 2012 Planning Rule. There is a need to provide management direction that addresses changing social and environmental conditions. There is a need to consider new information from monitoring and scientific research and public involvement. The revised forest plan will guide management activities for the Chugach National Forest for the next 10 to 15 years.

The need for plan revision is directly related to six overarching needs for change identified in the assessment and through public involvement. Although much of the existing management direction contained in the 2002 forest plan is adequate to provide sustainable, integrated resource management, several emphasis areas potentially needing change were identified:

- There is a need to integrate the interests of Alaska Native Tribes and Corporations and the State of Alaska with the forest plan and promote collaborative relationships.
- There is a need to provide diverse recreation opportunities in cooperation with partners, while protecting the natural, cultural, and scenic environment for present and future generations.
- There is a need to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System and determine whether to recommend any such lands for wilderness area designation. There is a need to review special designations on the forest, and determine what plan components are needed for existing special designations and whether any additional special designations should be recommended for designation.
- There is a need to provide management direction to support terrestrial and aquatic ecosystem functions across the landscape and promote ecosystem resilience to encourage the persistence of native plant and animal species in a changing climate.
- There is a need to remove site-specific travel management direction from the plan, consistent with agency policy.
- There is a need to revise plan components consistent with the 2012 Planning Rule, including management areas and monitoring questions and associated indicators that address the eight categories identified in § 219.12(5).

Issues

Public involvement generated issues to be considered by the forest plan revision team. The team separated the issues into two groups: non-significant and significant. Significant issues are those used to develop alternatives and modify the proposed action. Nonsignificant issues are identified as those: (1) outside the scope of the proposed action; (2) already addressed by law, regulation, the proposed revised plan, or other higher level decision; (3) irrelevant to the decision to be made; or (4) conjectural and not supported by scientific or factual evidence.

A list of non-significant issues and reasons regarding their categorization as non-significant is available in the planning record. Additional information is available on the Chugach National Forest public website.

Issues That Served as the Basis for Alternative Development

The Forest Service identified two significant issues during scoping related to (1) the amount of land to be recommended for wilderness area designation and (2) the distribution of recreation opportunity spectrum classes across the national forest.

Wilderness Area Recommendation

With each revision of a land management plan, the Forest Service identifies and evaluates lands that may be suitable for inclusion the National Wilderness Preservation System and determines whether or not to recommend any such lands for wilderness designation. The Forest Service made wilderness area recommendations for the Chugach National Forest in 1984 and 2002. There is concern about how much area should be recommended for wilderness area designation.

The Nellie Juan-College Fiord Wilderness Study Area was established in 1980 through passage of ANILCA and is managed to preserve the area's character and potential for inclusion in the National Wilderness Preservation System. Most people who commented would like to see more of the area within the wilderness study area recommended for wilderness area designation than the 2002 proposal of 1.4 million acres. Considering recent land conveyances, approximately 1.9 million acres of NFS lands are currently within the wilderness study area and available for recommendation.

In areas outside the wilderness study area, some people want to increase opportunities for solitude and remote recreation experiences by increasing the amount of recommended wilderness area. Others are concerned that any increase in recommended wilderness area could affect the amount of area available for non-wilderness uses.

Recreation Opportunity Spectrum

Since the early 1980s, recreation opportunity spectrum has been used as a framework for identifying, classifying, planning, and managing a range of recreation classes. Recreation opportunity spectrum can be used as a zoning tool to establish programmatic direction for recreation management. Recreation opportunity spectrum is an important tool for defining desired conditions and for integrating recreation with other resource values to achieve multiple social and natural resource objectives. Recreation opportunity spectrum describes the suitability of areas for various motor vehicle and non-motor vehicle uses, but specific areas and routes open to motor vehicle use are determined through separate, project-specific travel management decisions. Recreation opportunity spectrum maps will assist the public in understanding the type of classes (landscapes) provided, the types of transportation that is suitable in an area, the social setting to expect, and the level of management and infrastructure.

There is concern about where various recreation opportunities and classes should occur and to what condition they should be managed. Some people would like the recreation opportunity spectrum map to reflect the desired conditions and classes that are to be managed for, while others would like the map to reflect current conditions and existing decisions.

Some people want to maximize protections of the existing wilderness character within the Nellie Juan-College Fiord Wilderness Study Area by increasing the amount of the primitive recreation class assigned to the wilderness study area, while others are concerned that such an increase could limit opportunities for outfitters and guides and other permitted uses (such as commercial fishing, nature filming, and recreation events).

From Needs for Change and Issues to Revision Topics

Revision topics are used in the environmental impact statement to organize the alternatives and to compare and contrast the differences between alternatives. Revision topics integrate the needs for change with the issues, providing four themes to be addressed in revising the forest plan for the Chugach National Forest.

Revision Topics

Revision topics 1 and 2 respond to the significant issues, and revision topics 3 and 4 respond to other need for change elements and to public comments that were not identified as significant issues.

Revision Topic 1 Land Allocations

There is a need to identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System and to determine whether or not to recommend any such lands for wilderness area designation. There is a need to identify and provide management direction for rivers eligible and suitable for inclusion in the National Wild and Scenic Rivers System, IRAs, and national scenic and national historic trails, and to revise management areas consistent with the 2012 Planning Rule.

Revision Topic 2 Recreation Opportunities

There is a need to provide diverse recreation opportunities in cooperation with partners, while protecting the natural, cultural, and scenic environment for present and future generations. Integrated plan components are also needed to address the uncertainties associated with a changing climate, as they relate to the timing and location of recreation opportunities and associated infrastructure.

Revision Topic 3 Ecological Sustainability

Plan components are needed to guide management of key ecosystem elements, such as, air, soil, water, and vegetation to maintain terrestrial and aquatic ecosystem functions across the landscape. There is a need to provide management direction that promotes ecosystem resilience in a changing climate, and maintain habitats consistent with natural ecosystem processes at a landscape scale that will provide for the persistence of a diversity of native plant and animal species.

Revision Topic 4 Social, Economic, and Cultural Sustainability

There is a need to acknowledge the values and interests in the Chugach National Forest held by Alaska Native Tribes and Corporations and better integrate traditional and cultural properties in the plan. There is a need to describe the importance of the land and features of the Chugach National Forest to first nations (e.g., the Chugach, Eyak, Ahtna, and Dena'ina).

There is a need to provide plan components that will guide the contribution to social, economic, and cultural sustainability of communities of the plan area.

There is a need to remove site-specific travel management direction from the forest plan to be consistent with the directives associated with the 2005 Travel Management Rule (36 CFR Part 212). Forest plans are strategic in nature, and by design they do not authorize site-specific activities or uses. The 2002 forest plan currently includes site-specific management direction for summer and winter motor vehicle access including an Access Management Plan in appendix B that was developed prior to promulgation of the 2005 Travel Management Rule.

Decision Framework

The responsible official for this proposed action is the forest supervisor of the Chugach National Forest. After reviewing the analysis in the final environmental impact statement, the responsible official will issue a record of decision in accordance with agency decisionmaking procedures which will:

- Disclose the decision (identify the selected alternative) and reasons for the decision.
- Discuss how public comments and issues were considered in the decision.
- Discuss how all alternatives were considered in reaching the decision, specifying which one is the environmentally preferable alternative.

Approval of the revised forest plan will identify management areas and will include recommendations for areas that can only be designated by statute, such as wilderness areas.

Transition to the Revised Plan

The final record of decision will describe how the transition from the current to the revised plan will occur, including which projects would continue to be implemented under the 2002 forest plan and which projects would be implemented under the revised plan.

Chapter 2. Alternatives

Introduction

This chapter describes and compares the alternatives considered by the responsible official for the draft forest plan. Alternatives are defined by the different ways they address the significant issues and the revision topics, providing a framework for analyzing the different ways of accomplishing the needed changes to the forest plan and addressing the issues described in chapter 1. Maps showing the spatial differences among the alternatives are displayed at the end of this DEIS.

The alternatives describe a range of options for guiding management activities on the Chugach National Forest, as required by National Environmental Policy Act regulations. Four alternatives are described in detail. Alternative A is the no-action alternative, which reflects the 2002 forest plan. Alternative B was released for public review and comment as the proposed action in 2015. Alternative C represents our proposal for revising the forest plan. Development of alternatives C and D was driven by issues identified during scoping. At this time, the agency has not identified a preferred alternative.

This chapter presents the alternatives in comparative form, so differences among alternatives can be readily discerned. This section describes how each of the alternatives responds to the four revision topics identified in chapter 1. Tables are provided that compare potential future activities by alternative and summarize the environmental consequences associated with each alternative.

The Alternatives Considered in Detail section describes how the alternatives address Revision Topic 1 Land Allocations and Revision Topic 2 Recreation Opportunities. These topics respond to the significant issues raised in scoping as well as the need for change topics. The Elements Common to Alternatives B, C, and D section describes how the alternatives address revision topics 3 and 4. These topics respond to additional needs for change and to public comments that were not significant issues and are very similar in all the action alternatives.

Alternative Development Process

Alternative B, the proposed revised plan published in 2015, was developed to address the needs for change identified in the forest plan assessment and the pre-assessment public involvement process. Comments provided by the public, Alaska Native Tribes and Corporations, and partner agencies during scoping and consultation were used to identify the significant issues identified in chapter 1 and to develop alternatives C and D.

Elements Common to All Alternatives

Forest plans provide a framework to guide project selection, project design, and project implementation, to move towards or maintain desired conditions. They do not create, authorize, or execute any site-specific ground-disturbing activities. While the alternatives differ in how they address issues and revision topics in a broad sense, management of specific resources and programs would not vary by alternative in several important respects.

All alternatives are based on the concepts of multiple-use and ecosystem management, are designed to protect national forest resources, and comply with applicable laws, regulation, and policy. In addition, the following elements are common to all alternatives:

- All NFS lands within the Nellie Juan-College Fiord Wilderness Study Area would continue to be managed to preserve their character and potential for future designation into the National Wilderness Preservation System, subject to the provisions of ANILCA and other applicable regulations and policy, regardless of whether they are recommended for designation or not. The wilderness study area would not be affected until Congress acts to designate wilderness area(s) and/or terminates the wilderness study area designation. Designated lands would be managed according to the provisions identified by Congress, and the wilderness study area would no longer exist. NFS lands within the wilderness study area that were not designated as wilderness area(s) would be assigned to another management area through a forest plan amendment.
- No lands outside the wilderness study area are recommended for wilderness area designation in any of the alternatives.
- All currently designated areas, such as research natural areas and IRAs, would remain in place.
- Existing recommendations for additions to the National Wild and Scenic River System are carried forward in all alternatives. No new recommendations are included in any alternative. All recommended rivers and segments of rivers would be managed to maintain or enhance their free-flowing status and outstandingly remarkable values.
- Existing recreation special use permits would remain in effect. Renewal would be governed by law and policy. Project implementation that is connected to authorized permits would be required to be consistent with either the 2002 forest plan or the revised forest plan, as specified in the transition language in the Record of Decision.
- Existing special use permits for communication sites, utility corridors, transportation corridors, and other special uses would remain in effect. Renewal would be governed by law and policy.
- A leasing availability analysis for oil and gas was completed as part of the 2002 plan revision which assigned NFS lands within the Chugach National Forest to one of four geographic zones. At this time none of the four geographic zones are available for oil and gas leasing. Zones 3 and 4 had low or no oil and gas production potential. In Zone 1, the 1982 CNI Settlement Agreement gave the Chugach Alaska Corporation (CAC) rights to drill from a private portion of the mineral estate beneath the Chugach National Forest with the rights to be extinguished if a producing well was not established by December 31, 2004. A producing well was not established and the rights have expired. In Zone 2, the 1982 CNI Settlement Agreement gave CAC first opportunity to acquire, through exchange, the rights to explore, develop and produce oil and gas in the area in the event that the Secretary of Agriculture elected to make all or any part of the area available for oil and gas leasing. The exchange rights terminated on January 2, 2008.
- Current forest orders and regional orders would remain in effect.
- Current designations of national scenic, historic, and recreational trails, and national scenic byways would not be changed.
- Memoranda of understanding and memoranda of agreement would remain in place (see appendix B).

Elements Common to Alternatives B, C, and D

Revision Topic 3 Ecological Sustainability

Species of Conservation Concern

The National Forest Management Act of 1976 requires the Forest Service to “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area in order to meet overall multiple-use objectives.” As such, the 2012 Planning Rule requires the Forest Service to maintain or restore ecological sustainability, integrity, and diversity. The 2012 Planning Rule requires a combination of ecosystem focused and species focused plan components to “contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern within the plan area.” (36 CFR 219.9(b)(1)). Species of conservation concern are species identified by the regional forester that are known to occur in the plan area and for which there is substantial concern about the species’ capability to persist over the long term in the plan area. Species of conservation concern do not include federally listed threatened, endangered, or candidate species. The regional forester identified a list of species of conservation concern for the Chugach National Forest. This list does not vary by alternative.

Two species, Aleutian cress (*Aphragmus eschscholtzianus*) and dusky Canada goose (*Branta canadensis occidentalis*) were identified as species of conservation concern by the regional forester during this plan revision. Alternatives B, C, and D include ecosystem-focused and species-specific plan components designed to provide ecological conditions to maintain a viable population of each species of conservation concern in the plan area, to the extent that is within Forest Service authority, the inherent capability of the plan area, and the fiscal capability of the unit.

Identifying species of conservation concern usually occurs during the planning phase, but may occur at any time (FSH 1909.12 Ch. 21.22a). Following the current plan revision, new scientific information may indicate some species should be added or removed from the list prompting a review and evaluation. A determination by the regional forester that the species of conservation concern list should be changed would result in examination of the forest plan and an amendment, if appropriate (FSH 1909.12 Ch. 21.22b).

Species of conservation concern will assume the conservation planning role formerly held by Regional Forester’s Sensitive Species. Because the formal transition from the sensitive species list to the species of conservation concern approach would occur only when the record of decision is signed, the draft environmental impact statement evaluates and discloses outcomes for Chugach National Forest sensitive species based on the current list from 2009, but plan components have not been developed for any sensitive species.

Effects to plants and animals on the Regional Forester’s Sensitive Species List that could result from adoption of one of the action alternatives are discussed in this draft environmental impact statement. Similarly, management indicator species (MIS) are not included in the draft forest plan because they are not a part of the 2012 Planning Rule.

Revision Topic 4 Social, Economic, and Cultural Sustainability

Travel Management

Management direction for the use of many different means of transportation is an integral part of the 2002 forest plan (alternative A). Travel management decisions in the 2002 forest plan included:

- Roads, trails, and areas open and closed to motor vehicle use during summer and winter
- Areas suitable for airboats operating outside of established water bodies or flowing channels
- Areas suitable for landing helicopters in summer and winter

Subsequent changes in national regulation and policy have necessitated changing how decisions about those means of transportation are made and how the information related to those decisions is stored. The 2005 Travel Management Rule (36 CFR parts 212, 251, 261, and 256) defines travel management more narrowly, and does not include the use of boats or aircraft. Alternatives B, C, and D include plan components related to authorized and administrative uses of boats and aircraft; use of boats and aircraft by the general public for recreational or other purposes would be governed by forest orders.

The 2005 Travel Management Rule and the 2012 Planning Rule have separated travel management planning from land management planning. Specific decisions on routes and areas open and closed to motor vehicle use are generally no longer made in forest plans, but are instead made on a project-by-project basis, as needed.

This does not mean that the decisions on motor vehicle use in the 2002 forest plan would be nullified by a new forest plan decision; those decisions, including the 2007 Kenai Winter Access Project decision, would remain in place and would be carried forward in the decision for this plan revision under alternatives B, C, and D.

The revised plan would not include the list of routes in appendix B of the 2002 forest plan; this information is now stored in the Forest Service INFRA database. The authorized routes open and closed to summer motor vehicle use are displayed on the Chugach National Forest’s Motor Vehicle Use Map (MVUM), which is updated periodically as new travel management decisions are made. Similarly, routes and areas closed to winter motorized use are displayed on maps associated with Forest Orders and in the future would be displayed on an Over Snow Vehicle Use Map. Maps displaying routes and areas open and closed to winter and summer motor vehicle use are available to the public on the Chugach National Forest website.

Allocations for Recreation Use

Allocation of commercial and noncommercial recreation use is not addressed at the forest plan level for alternatives B, C, and D. Commercial and noncommercial recreation use allocations, where determined necessary, would be determined on a project level basis. The landscape level allocations for commercial and noncommercial recreation use in the 2002 forest plan (alternative A) proved to be of limited use because of the wide variety of recreation uses in any given management area, the variety of limiting factors that constrain different types of recreation use in any one area, and the variety of ecosystems (coastal forest to alpine tundra) within a given management area.

Alternatives Considered in Detail

Four alternatives are considered in detail. Alternative A is the no-action alternative, and is the current Chugach National Forest Land and Resource Management Plan (2002 forest plan). Alternative B is the 2015 draft forest plan released for public scoping. Alternatives C and D respond to the significant issues identified during scoping. Alternatives C and D use the same draft forest plan but respond differently to the significant issues, and as a result, have different management area and ROS maps.

How Revision Topics Relate to Alternatives

This section describes how the alternatives differ in response to the significant issues and related revision topics identified in chapter 1. Revision topics 1 and 2 respond to the significant issues and are addressed in this section.

Differences in the alternatives related to the amount of NFS lands recommended for designation as wilderness area(s) and the amount of these lands in the various management areas are described under revision topic 1. This topic addresses issue 1.

Differences in the alternatives related to recreation opportunity spectrum classes are described under revision topic 2. Recreation classes are a tool used to plan how the desired range of recreation opportunities are arranged on the landscape and describe the appropriate kinds of recreation infrastructure for each class. A description of recreation opportunity spectrum classes is in chapter 3 in the Affected Environment and Environmental Consequences for Recreation.

Recreation opportunity spectrum classes describe suitability and management intent, but are not used to regulate public activities and uses. When a recreation class is changed from one that allows motorized use to a class that does not allow motorized use, that decision must be followed by a site-specific travel management decision (e.g., the Kenai Winter Access Project decision). Similarly, recreation classes do not regulate administrative use, nor do they affect any valid existing rights. This topic addresses issue 2.

Revision Topic 3 Ecological Sustainability and Revision Topic 4 Social, Economic, and Cultural Sustainability are not discussed in this section but are discussed in the Comparison of Alternatives section. The differences among the alternatives for these topics are primarily related to the way they are addressed through the plan components.

Alternative A No Action

Under alternative A, the existing plan, as amended, would continue to guide management of the Chugach National Forest. Electronic copies of this plan are available on the Chugach National Forest website.

Revision Topic 1 Land Allocations

Wilderness Area Recommendation

Alternative A recommends 1,387,510 acres (72 percent) of NFS lands in the Nellie Juan-College Fiord Wilderness Study Area for wilderness area designation.

Management Areas

The 2002 forest plan includes 21 management areas with management area prescriptions that include desired conditions, suitability determinations, and standards and guidelines.

Revision Topic 2 Recreation Opportunities

Alternative A reflects the 2002 forest plan recreation opportunity spectrum map (see alternative A recreation opportunity spectrum map in the map package). The 2002 forest plan uses several different subclasses and seasonal variations in addition to the primary recreation classes of primitive, semi-primitive non-motorized, semi-primitive motorized, roaded natural, and rural. The urban class is not used on the Chugach National Forest. The current recreation classes used on the Chugach National Forest are described in detail in the forestwide standards and guidelines section of the 2002 forest plan (USDA 2002).

Alternative A is the only alternative that includes subclasses for the primitive, roaded modified, and semi-primitive recreation classes. For mapping purposes and comparisons of acreages among alternatives, the two primitive classes have been combined, the roaded modified class has been combined with roaded natural, and the semi-primitive classes have been combined with the semi-primitive non-motorized class for alternative A. The seasonal variation of semi-primitive non-motorized (winter motorized allowed) is used in all alternatives.

The recreation classes are described for each of the three geographic areas: Kenai Peninsula, Prince William Sound, and Copper River Delta.

Kenai Peninsula Geographic Area

The dominant recreation class for the Kenai Peninsula Geographic Area is semi-primitive non-motorized with winter motorized allowed. This recreation class provides opportunities for non-motorized recreation in the summer months and winter motorized recreation when snow conditions allow. Of the three geographic areas, the Kenai Peninsula receives the most motorized use due to the access from the highway system, proximity to more than 60 percent of the population of Alaska, and the ability of snowmachines to traverse snow-covered landscapes that are mostly inaccessible during the summer. The semi-primitive motorized class covers approximately 32 percent of the remaining area and provides an opportunity for motorized access year round, more recreation development, and larger group sizes. The primitive class is only applied on the Black Mountain Research Natural Area (less than 1 percent of the area). The roaded natural class is applied to the highway corridors (6 percent of the area), and the rural class was only applied to federal mining claims (less than 1 percent of the area).

Prince William Sound Geographic Area

This geographic area is divided into two distinct parts for the discussion of recreation opportunity spectrum: the Nellie Juan-College Fiord Wilderness Study Area and the remaining part of the Prince William Sound Geographic Area.

Nellie Juan-College Fiord Wilderness Study Area: Located on the west side of Prince William Sound, the wilderness study area is managed to maintain the area’s character and potential for future wilderness designation and therefore has recreation classes of primitive and semi-primitive non-motorized, with two small areas of semi-primitive non-motorized (winter motorized allowed) to provide snow machine access during winter months (per ANILCA Section 1110(a)).

Remaining part of Prince William Sound: This consists of a small area around Whittier west of the wilderness study area boundary and all of the area east of the wilderness study area. These areas primarily have semi-primitive non-motorized and primitive classes with a small amount of semi-primitive motorized and roaded natural classes.

Copper River Delta Geographic Area

The primitive recreation class has been applied to large expanses of remote and inaccessible terrain east of the Copper River and north of Sheridan and Scott glaciers (80 percent of the area). The area around Sheridan and Scott glaciers has more accessible routes with adjacency to the Copper River Highway and has been managed semi-primitive motorized (12 percent of the area). The recreation class south of the Copper River Highway is semi-primitive non-motorized (winter motorized allowed) to provide winter motor vehicle recreation opportunities (6 percent of the area). The Copper River Highway is roaded natural (1 percent of the area).

Alternative B

This alternative is the proposed revised plan released for public scoping in 2015.

Revision Topic 1 Land Allocations

Wilderness Area Recommendation

The wilderness area recommendation would be the same as in alternative A. This alternative would recommend 1,387,510 acres (72 percent) of the NFS lands in the Nellie Juan-College Fiord Wilderness Study Area for wilderness area designation. No lands outside of the wilderness study area would be recommended for wilderness area designation.

Management Areas

Some of the 21 management areas in the 2002 forest plan were consolidated, and similar management areas were combined to provide a simpler and more streamlined approach. The proposed forest plans in alternatives B, C, and D have eight management areas, each with associated plan components and other plan content. Suitable activities and uses for each management area are identified. Management areas in the action alternatives (B, C, and D) are:

- Management Area 1 Wilderness Study Area
- Management Area 2 Wild, Scenic, and Recreational Rivers
- Management Area 3 Research Natural Areas
- Management Area 4 Backcountry Areas
- Management Area 5 ANILCA 501(b) Areas
- Management Area 6 *Exxon Valdez* Oil Spill (EVOS) Acquired Lands
- Management Area 7 Municipal Watershed
- Management Area 8 Front Country

Revision Topic 2 Recreation Opportunities

The recreation opportunity spectrum classes in alternative B for the Prince William Sound and Copper River Delta geographic areas are the same as the classes in alternative A. In the Kenai Peninsula Geographic Area, this alternative would incorporate changes to recreation classes necessary to be consistent with the Kenai Winter Access Project Record of Decision (2007). This was a travel management decision that did not include a forest plan amendment to modify recreation classes to align with the decision. The Kenai Winter Access Project only affected the Seward Ranger District within the Kenai Peninsula Geographic Area.

Recreation class changes related to the Kenai Winter Access Project that would be incorporated in alternative B follow:

- The class for the west side of Seward Highway near Summit Lake would change from semi-primitive motorized to semi-primitive non-motorized.
- The class for the east side of the Seward Highway from Hope Highway intersection to and including Mills Creek would change from semi-primitive non-motorized (winter motorized allowed) to semi-primitive non-motorized.
- The class for Center Creek east of Johnson Pass Trail would change from semi-primitive non-motorized to semi-primitive non-motorized (winter motorized allowed) to allow permitting of helicopter skiing.
- The class for the Carter Crescent drainage would change from semi-primitive non-motorized to semi-primitive non-motorized (winter motorized allowed).
- A larger area of Snow River drainage would change from semi-primitive non-motorized (winter motorized allowed) to semi-primitive non-motorized.

The class for the upper section of Russian Lakes Trail (between Aspen Flats Cabin and Upper Russian Lake) would change from semi-primitive non-motorized (winter motorized allowed) to semi-primitive non-motorized.

Alternative C

This alternative is the modified proposed action, and represents our proposal for revising the forest plan.

Revision Topic 1 Land Allocations

Wilderness Area Recommendation

Most of the wilderness study area would be recommended for wilderness area designation (1,819,700 acres, 94 percent). The following areas would be excluded from the wilderness area recommendation in this alternative:

- Blackstone Bay
- Area west of and adjacent to CAC lands around Nellie Juan Lake and Nellie Juan River
- Glacier Island (south of Columbia Bay)
- Erlington Island (south end of wilderness study area)
- All *EVOS* acquired lands within the wilderness study area boundary (three separate parcels)
- Split estate parcel west of CAC land on Knight Island
- Small parcel east of and surrounded by CAC lands on Knight Island

No lands outside of the wilderness study area would be recommended for wilderness area designation.

Management Areas

In the Kenai Peninsula Geographic Area, land allocation changes would be made in the Palmer Creek drainage and areas around Grant Lake/Ptarmigan Lake and west of the Hope Highway corridor.

Compared to alternative B, approximately 67,464 acres would change from management area 8 front country to management area 4 backcountry. This change responds to public comments that management area 8 front country boundaries were too broad. Most of the area that would be changed from management area 8 front country to management area 4 backcountry is relatively remote and current management reflects the management intent for backcountry more than for front country. In this alternative, the area adjacent to the Palmer Creek Road that is in the roaded natural recreation class is retained as management area 8 front country, and plan components were added to retain the current level of development along Palmer Creek Road. No other management area changes are proposed.

Revision Topic 2 Recreation Opportunities

Kenai Peninsula Geographic Area

Recreation opportunity spectrum settings in the Kenai Peninsula Geographic Area would be consistent with the Kenai Winter Access Project Record of Decision for winter motorized recreation access as described in alternative B, and would also include the changes described below.

Alternative C would change much of the semi-primitive motorized to semi-primitive non-motorized (winter motorized allowed) on the Kenai Peninsula. This change would more accurately reflect the types of recreation use allowed by current travel management decisions and the change to a non-motorized setting for summer months. This change responds to public comments and is more consistent with the desired conditions for the Kenai Peninsula Geographic Area. While current travel management decisions allow off-highway vehicle use on designated routes, there are no designated routes in these areas. Implementation of this alternative would change the recreation class, but a forest order would be needed to prohibit summer helicopter use by the public.

The change would apply to these specific areas (see alternative C recreation opportunity spectrum map in the map package):

1. Between the Hope Highway and Palmer Creek Road near the town of Sunrise
2. West of Palmer Creek Road and on either of side of Resurrection Creek south to Wolf Creek
3. The entire area east of Hope Highway and west of Turnagain Pass
4. The area around Summit Lake and the Quartz Creek drainage east of the Seward Highway
5. The area west of Snug Harbor road to and including Stetson Creek and Cooper Creek drainage
6. The Grant Lake drainage and the eastern portion of the Falls Creek drainage
7. The south fork of Snow River and the Godwin Glacier area

Alternative C would increase the primitive recreation class by 78,966 acres (see alternative C recreation opportunity spectrum map in the map package) in Snow River (currently a mix of semi-primitive motorized, semi-primitive non-motorized, and semi-primitive non-motorized (winter motorized allowed) and Upper Mills Creek (currently semi-primitive non-motorized (winter motorized allowed). This would change the recreation class, but a separate travel management decision would be needed to change any allowed motor vehicle use. This change would create two additional primitive recreation class areas accessible from the highway system on the Kenai Peninsula Geographic Area in response to public comments.

Adjacent to Crow Creek Road, the recreation class would change from semi-primitive non-motorized to semi-primitive non-motorized (winter motorized allowed). This change would make the recreation class consistent with current travel management decisions (closed to summer motor vehicle use but open to winter motor vehicle use).

In the Upper Winner Creek drainage, the recreation class would change from semi-primitive non-motorized to semi-primitive non-motorized (winter motorized allowed). This change would make the recreation class consistent with current travel management decisions (closed to summer motor vehicle use and open to helicopter use in the winter months).

In the Twentymile tributary immediately east of the Upper Winner Creek drainage, the recreation class would change from semi-primitive non-motorized (winter motorized allowed) to semi-primitive motorized. This change would make the recreation class consistent with current travel management decisions (open to summer helicopter use and open to all winter motor vehicle use).

The recreation class in the Spencer Whistlestop area would change from semi-primitive motorized to roaded natural. The Spencer Whistlestop area has a higher level of recreation development, larger number of parties encountered per day, and a more roaded environment than is appropriate for a semi-primitive motorized class.

The recreation class in the southern portion of Whittier Glacier (south of Whittier and just west of the wilderness study area boundary) would change from semi-primitive motorized to semi-primitive non-motorized (winter motorized allowed). This change would require a separate travel management decision to open the area to winter motorized use. This change would accommodate winter snowmachine use from Whittier that is already occurring nearby and provide an expanded area to use snowmachines that is outside the wilderness study area boundary.

Prince William Sound Geographic Area

In alternative C, nearly all of the wilderness study area would have a primitive recreation class, with the exception of narrow fringes along Blackstone Bay, Pigot Bay, Harriman Fiord, Cochrane Bay, Culross Passages, and Coghill Lake. This change would align with current user experience and levels of desired recreation development and level of encounters and would result in approximately 741,765 acres more of the primitive recreation class than alternatives A and B. This change also more closely aligns with the management objective of retaining the wilderness study area’s existing character and potential for inclusion in the National Wilderness Preservation System. While the desired recreation setting would change, areas and routes open to motor vehicle use would not change. Motor vehicle use would still be consistent with the new recreation settings in the area immediately south of Whittier and around Blackstone Bay, as shown in alternative B and as provided for by ANILCA Section 1110(a).

In the eastern part of the Prince William Sound Geographic Area, the recreation class on Hinchinbrook Island would change from primitive to semi-primitive non-motorized. Having a semi-primitive motorized class directly adjacent to a primitive class is typically not appropriate because motorized use impairs the solitude and remoteness that are characteristic of a primitive class. The two tips of this island remain in the semi-primitive motorized setting because they currently experience summer motorized use. Similar management for recreation settings on the three big islands (Montague, Hinchinbrook, and Hawkins) in eastern Prince William Sound was desired by the Forest Service.

The research natural area north of Olsen Bay in eastern Prince William Sound would change from semi-primitive non-motorized to the primitive recreation class.

Copper River Delta Geographic Area

The recreation class south of the Copper River Highway would change from semi-primitive non-motorized (winter motorized allowed) to semi-primitive motorized. This class would accommodate the current amount of summer use of airboats in small waterways throughout the delta area. Land-based motorized uses in the summer are not allowed currently. Any future changes to land-based summer motorized use would require a separate travel management decision. This change would make the recreation class for summer months more consistent with what the visitor may experience in this area (the sounds and sights of motorized jet and airboats navigating small waterways and sloughs throughout this entire area of the delta) and desired recreation opportunities.

North of Scott and Sheridan glaciers, the recreation class would change from primitive to semi-primitive non-motorized (winter motorized allowed). This change would be consistent with current travel management rules and permitted heli-skiing use in the winter months and would be consistent with the desired winter motor vehicle recreation use in the area along the Tasnuna River from Thompson Pass north of Valdez.

Rural recreation classes (located in areas with mining claims in the 2002 forest plan) would change to the surrounding class in this alternative. Mining claim ownership and claim boundaries change frequently, so individual recreation classes are not appropriate for these areas. The only exception is the area directly south of Hope on the Kenai Peninsula where historic and modern placer operations have modified the natural environment in many places and where long term mining operations are planned.

Alternative D

This alternative would increase the amount of recommended wilderness area compared to what is proposed for alternative C and would include additional changes to recreation classes.

Revision Topic 1 Land Allocations

Wilderness Area Recommendation

Almost the entire wilderness study area would be recommended for wilderness area designation (1,884,200 acres or 97 percent) with the following exclusions:

- Area west of and adjacent to CAC lands around Nellie Juan Lake and River
- All EVOS acquired lands within wilderness study area boundary (three separate parcels)
- Split estate parcel west of CAC land on Knight Island
- Small parcel east of and surrounded by CAC lands on Knight Island

No lands outside of the wilderness study area would be recommended for wilderness area designation.

Management Areas

In the Kenai Peninsula Geographic Area, land allocation changes would be made in areas around Grant Lake/Ptarmigan Lake and west of the Hope Highway corridor and in the Palmer Creek drainage. Approximately 3,896 more acres would change from management area 8 front country to management area 4 backcountry, compared to alternative C, and 71,360 more acres would change compared to alternative B. In this alternative, a larger portion of the Palmer Creek drainage would change from management area 8 front country to management area 4 backcountry, including the area adjacent to Palmer Creek Road that was excluded in alternative C.

Revision Topic 2 Recreation Opportunities

Recreation opportunity spectrum classes for this alternative would be the same as alternative C except that all NFS lands within the wilderness study area would be in the primitive recreation class, an increase of approximately 43,295 acres. This change would address public comments that indicated a desire to see the entire wilderness study area managed in a primitive recreation class. While winter snow machine use would still be allowed within the wilderness study area as provided for by ANILCA Section 1110(a), a subsequent travel management decision would be needed to implement an authorized motor vehicle use closure around Whitter and Blackstone Bay to prohibit snow machine use not allowed by ANILCA.

Alternatives Considered but Eliminated from Detailed Study

Implement a Commercial Timber Harvest Program

Feasibility is limited by the small potentially suitable timber base (6,060 acres), immature spruce stands due to spruce beetle mortality in the 1990s, lack of roads and mills, and largely inaccessible terrain. In addition, the primary interest of local communities is provision of fuelwood.

Approximately 70 percent of the standing timber volume on the Kenai Peninsula was killed by spruce bark beetles in the 1990s. About 80 to 100 years growth are needed to replace a mature forest.

In 2016, there were only three active saw mills within a 100 mile drive of the national forest. Only one of these mills operates continually throughout the year.

Approximately 99 percent of the Chugach National Forest lies within IRAs governed by the Roadless Area Conservation Rule (36 CFR 219 Subpart D). The intent of this rule is to protect the social and ecological characteristics of these areas from road construction and reconstruction and most timber harvesting activities. Many miles of road in IRAs would be needed to access additional timber volume, which is now mostly hemlock and not a commercial species.

Given the general prohibition on road building and timber harvest over such a vast extent of the national forest, a commercial timber harvest program would be extremely difficult to implement.

Do Not Recommend Any Areas for Wilderness Area Designation

There is strong public support for recommending most or all of the wilderness study area for wilderness area designation. Beginning in 1973, there was recognition of the unique wilderness qualities in the wilderness study area with the first Roadless Area Review and Evaluation. In 1974, the Chugach National Forest multiple use plan recognized the outstanding scenic qualities of the Harriman Fiord area and the Columbia Glacier area, and during deliberation on HR 39 (which eventually was passed into law as ANILCA), the administration favored wilderness area designation for 696,000 acres in the Nellie Juan area and 847,000 acres in the College Fiord area.

Consider the Following Areas for Wilderness Area Designation

Gulch Creek and Alpenglow Complex

This area currently supports a heli-skiing permit and multiple small active mining operations in the lower Gulch Creek area. A wilderness area recommendation in this area would necessitate elimination of this area from the heli-skiing permit.

Snow River and Greater Paradise Lakes Valley

This area was considered and eliminated because it currently has a winter motor vehicle corridor that is used to access the south fork of Snow River and the Godwin Glacier area. This route is very popular with snow machine enthusiasts. A wilderness area recommendation in these areas would necessitate different plan components to protect wilderness character and would prohibit winter motor vehicle users from accessing these areas. In addition, the land development potential for CAC for their private parcels in the Nellie Juan Lake and River area was considered.

Green, Montague, Evans, Hawkins, and Hinchinbrook Islands

These lands are outside the wilderness study area. There was strong cohesive public opinion regarding recommending wilderness area designation for areas within the wilderness study area but only a few comments indicated support for areas outside the wilderness study area. With the breadth of the wilderness study area and the amount of roadless areas outside the wilderness study area, interest in wilderness area recommendations outside the wilderness study area was lacking.

Green Island is a designated research natural area. Approximately half of Evans Island is privately owned, and recommending wilderness area designation on the half that is NFS lands would not be consistent with the values, uses, and subsistence uses of the Chenega Corporation.

Recommend the Entire Wilderness Study Area for Wilderness Area Designation

This alternative was considered but eliminated. Three EVOS acquired parcels were excluded from wilderness area recommendations in all of the alternatives because the subsurface estates are owned by CAC, which has expressed interest in developing the subsurface estate. Such development would not be compatible with wilderness area designation. The surface is managed as directed in the purchase agreement and restrictive covenants.

A small parcel of land on Knight Island was not recommended in any of the alternatives because it is completely surrounded by CAC lands and would be administratively difficult to manage as a designated wilderness area.

Comparison of Alternatives

This section compares how the four alternatives respond to the four revision topics. The revision topics incorporate the significant issues identified in scoping and the needs for change identified in the assessment. An overall summary of the alternatives related to the significant issues is presented in table 1.

Table 1. Comparison of alternatives by significant issues and management areas

Plan Attribute	Alternative A No Action	Alternative B	Alternative C	Alternative D
Wilderness area recommendation [significant issue 1]	1,387,510 acres	1,387,510 acres	1,819,700 acres	1,884,200 acres
Wilderness study area recommended for wilderness area designation [significant issue 1]	72 percent	72 percent	94 percent	97 percent
Recreation opportunity spectrum [significant issue 2]	2002 recreation opportunity spectrum map	2002 recreation opportunity spectrum map with Kenai Winter Access Project changes	2016 recreation opportunity spectrum changes across all geographic areas; fringe of semi-primitive non-motorized class in wilderness study area in higher recreation use areas	2016 recreation opportunity spectrum changes; entire wilderness study area is in primitive class
Management areas	21 management areas	8 management areas	8 management areas; slight increase in backcountry and decrease in front country from alternative B	8 management areas; slight increase in backcountry and decrease in front country from alternative C

Revision Topic 1 Land Allocations

Wilderness Recommendation

Lands recommended for wilderness area designation vary by alternative (table 1) but are all within the wilderness study area. Alternatives A and B would recommend the same amount of NFS lands for wilderness area designation, while alternative C would increase the recommended lands by 432,190 acres. Alternative D would recommend 64,500 acres more than alternative C and would recommend approximately 496,690 more acres than alternatives A and B.

Management Areas

Management areas were reduced for the action alternatives, and similar land allocations were combined. These changes were made to simplify the management area scheme and does not significantly change the management intent. The same number of acres would be allocated to each management area in the action alternatives except for the backcountry and front country management areas (table 2). In the Kenai Peninsula Geographic Area, areas in the Palmer Creek drainage and areas around Grant Lake/Ptarmigan Lake and west of the Hope Highway corridor would change from front country to backcountry. This change was proposed in response to scoping comments and would result in greater consistency between current management and the intent for these management areas as expressed in the revised forest plan. Management area 4 backcountry would increase by approximately 67,464 acres between alternatives B and C, and 3,896 acres between alternatives C and D, for a total increase of approximately 71,360 acres between alternatives B and D.

Table 2. Management area allocations for action alternatives

Management Area	Alternative B Acres (percent)	Alternative C Acres (percent)	Alternative D Acres (percent)
Management Area 1 Wilderness Study Area	1,908,881 (35)	1,908,881 (35)	1,908,881 (35)
Management Area 2 Wild, Scenic, and Recreational Rivers	31,663 (<1)	31,663 (<1)	31,663 (<1)
Management Area 3 Research Natural Areas	29,843 (<1)	29,843 (<1)	29,843 (<1)
Management Area 4 Backcountry	1,627,951 (31)	1,695,415 (31)	1,699,311 (31)
Management Area 5 ANILCA 501(b) Areas	1,538,664 (28)	1,538,664 (28)	1,538,664 (28)
Management Area 6 EVOS Acquired Lands	100,378 (2)	100,378 (2)	100,378 (2)
Management Area 7 Municipal Watershed	439 (<1)	439 (<1)	439 (<1)
Management Area 8 Front Country	177,329 (3)	109,865 (2)	105,969 (2)

Other Land Allocations

The Nellie Juan-College Fiord Wilderness Study Area boundary and the IRA boundaries would remain the same in all alternatives. The wilderness study area boundary was designated by Congress and cannot be changed by the Forest Service. The IRA boundaries were defined through the Roadless Area Conservation Rule, and cannot be modified by plan revision.

Research natural areas, national scenic, national recreation, and national historic trails also remain the same in all alternatives.

No additional rivers were found eligible for inclusion into the National Wild and Scenic River System (Land Management Plan appendix E) during the assessment phase, so these would be unchanged from the 2002 forest plan and do not vary by alternative.

Revision Topic 2 Recreation Opportunities

Recreation opportunity spectrum classes vary by alternative (table 3). Forestwide, the area in the primitive class would be similar between alternatives A and B and between alternatives C and D, but C and D would increase by about 7 to 8 percent over A and B. The area in the semi-primitive non-motorized class would be similar between alternatives A and B and also between alternatives C and D, but would decrease by about 15 percent between these two. NFS lands in the Non-motorized classes would decrease by 5 to 6 percent for alternatives C and D.

The area in the semi-primitive non-motorized (winter motorized allowed) class would increase by about 7 percent for alternatives C and D, while other motor vehicle classes would either remain the same or decrease slightly across the action alternatives.

Table 3. Forestwide recreation opportunity spectrum classes, by alternative

Recreation Opportunity Spectrum Class	Alternative A Acres (percent)	Alternative B Acres (percent)	Alternative C Acres (percent)	Alternative D Acres (percent)
Primitive	2,498,666 (46)	2,498,665 (46)	2,899,932 (54)	2,943,228 (54)
Semi-primitive non-motorized	1,535,709 (28)	1,557,772 (29)	840,944 (16)	797,819 (15)
Semi-primitive non-motorized (winter motorized allowed)	704,998 (13)	692,316 (13)	1,134,683 (21)	1,134,550 (21)
Semi-primitive motorized	583,284 (11)	574,556 (11)	449,129 (8)	449,151 (8)
Roaded natural	85,810 (2)	85,730 (2)	89,992 (2)	89,931 (2)
Roaded	6,681 (<1)	6,110 (<1)	469 (<1)	470 (<1)

Recreation classes vary by alternative across the three geographic areas (table 4). For the Kenai Peninsula Geographic Area, alternative B is similar to current recreation classes, while alternatives C and D add a moderate amount of the primitive class and change a larger area of semi-primitive motorized to semi-primitive non-motorized (winter motorized allowed). Of the three geographic areas, the Kenai Peninsula has the greatest area of motorized classes, largely due to the presence of the road system there.

Table 4. Comparison of recreation opportunity spectrum classes for the three geographic areas of the Chugach National Forest, by alternative

Recreation Opportunity Spectrum Class	Alternative A Percent	Alternative B Percent	Alternative C Percent	Alternative D Percent
Kenai Peninsula				
Primitive	<1	<1	7	7
Semi-primitive non-motorized	17	19	14	14
Semi-primitive non-motorized (winter motorized allowed)	45	44	60	60
Semi-primitive motorized	32	31	13	13
Roaded natural	6	6	6	6
Rural	<1	<1	<1	<1
Total	100	100	100	100

Recreation Opportunity Spectrum Class	Alternative A Percent	Alternative B Percent	Alternative C Percent	Alternative D Percent
Prince William Sound				
Primitive	45	45	73	75
Semi-primitive non-motorized	51	51	26	24
Semi-primitive non-motorized (winter motorized allowed)	3	3	<1	0
Semi-primitive motorized	1	1	1	1
Roaded natural	<1	<1	<1	<1
Rural	0	0	0	0
Total	100	100	100	100
Copper River Delta				
Primitive	80	80	55	55
Semi-primitive non-motorized	1	1	1	1
Semi-primitive non-motorized (winter motorized allowed)	6	6	26	26
Semi-primitive motorized	12	12	17	17
Roaded natural	1	1	1	1
Rural	0	0	0	0
Total	100	100	100	100

Table 5. Comparison of summer and winter motorized and non-motorized recreation opportunity spectrum class settings for geographic areas and forestwide, by alternative

Recreation Opportunity Spectrum Class	Alternative A Percent	Alternative B Percent	Alternative C Percent	Alternative D Percent
Kenai Peninsula				
Summer motorized	38	37	20	20
Summer non-motorized	17	19	21	21
Winter motorized	83	81	79	79
Winter non-motorized	17	19	21	21
Prince William Sound				
Summer motorized	1	1	1	1
Summer non-motorized	96	96	99	99
Winter motorized	4	4	1	1
Winter non-motorized	96	96	99	99
Copper River Delta				
Summer motorized	12	12	18	18
Summer non-motorized	81	81	56	56
Winter motorized	19	19	44	44
Winter non-motorized	81	81	56	56
Total National Forest				
Summer motorized	13	12	10	10
Summer non-motorized	87	88	90	90
Winter motorized	26	25	31	31
Winter non-motorized	74	75	69	69

The Prince William Sound Geographic Area has the largest area of the primitive classes, largely due to the presence of the wilderness study area. Primitive classes would increase substantially in alternatives C and D. Within the wilderness study area, alternative C includes a fringe of semi-primitive non-motorized class on the coastline within the popular bays closest to Whittier to allow for additional recreation use and some minimal recreation infrastructure, while in alternative D all lands within the wilderness study area are in the primitive class. However, the distribution of motorized and non-motorized classes varies little by alternative in this geographic area (table 5).

In the Copper River Delta Geographic Area, primitive recreation classes would decrease in alternatives C and D, while semi-primitive non-motorized (winter motorized allowed) and semi-primitive motorized classes would increase, allowing for motor vehicle activities, such as airboats and snowmachines. Overall, motorized classes would increase in this geographic area, while non-motorized classes would decrease. Most of the recreation class changes in this geographic area would increase consistency between the classes and current travel management rules and permitted uses, such as heli-skiing.

Summary of Recreation Opportunity Spectrum Changes and Alignment with Travel Management

The following tables display recreation opportunity spectrum class changes for the action alternatives. Changes to travel management decisions, the type of management decision required, and pertinent comments are also displayed. Travel management decisions would be made separately from the forest plan decision, as described earlier in this chapter. Management direction needed for administrative and authorized uses would be included in the plan components in the revised forest plan, and forest orders would be needed for public recreational or other uses.

Table 6. Recreation opportunity spectrum changes proposed in alternative B

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
West side of Seward Highway near Summit Lake	Semi-primitive motorized	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
East side of Seward Highway from Hope Hwy intersection to and including Mills Creek	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
South side of Center Creek drainage east of Johnson Pass Trail	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	Change aligns with Kenai Winter Access Project decision
Carter Lake and Crescent Lake drainages	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	Change aligns with Kenai Winter Access Project decision
Eastern portion of North Fork of Snow River drainage	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
The upper section of Russian Lakes Trail (between Aspen Flats Cabin and Upper Russian Lake) and western side of Cooper Lake	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision

Table 7. Recreation opportunity spectrum changes proposed in alternative C

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
2002 mapped mining claims across the Kenai Peninsula Geographic Area	Rural	Recreation class of the surrounding area	No	Not applicable	Eliminating rural setting from all mining claims mapped in 2002 will align with current travel management for those areas closed to the public for motorized travel
West side of Seward Highway near Summit Lake	Semi-primitive motorized	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
East side of Seward Highway from Hope Highway intersection to and including Mills Creek	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
South side of Center Creek drainage east of Johnson Pass Trail	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	Change aligns with Kenai Winter Access Project decision
Area east and south of Summit Lake	Semi-primitive motorized	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
The Quartz Creek drainage east of the Seward Highway	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	Change aligns with current summer travel management of closed to motorized uses except subsistence
Carter Lake and Crescent Lake drainages	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	Change aligns with Kenai Winter Access Project decision

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
The entire North Fork of Snow River drainage except the very southern side of the drainage	Semi-primitive motorized and Semi-primitive non-motorized (winter motorized allowed)	Primitive	No	Not applicable	Change aligns with Kenai Winter Access Project decision for non-motorized uses
The upper section of Russian Lakes Trail (between Aspen Flats Cabin and Upper Russian Lake) and western side of Cooper Lake	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive non-motorized	No	Not applicable	Change aligns with Kenai Winter Access Project decision
West side of Cooper Creek and Stetson Creek	Semi-primitive motorized	Semi-primitive non-motorized	No	Eliminate summer helicopter access through forest order	The current travel management category also specifies that off-highway vehicles are allowed on designated routes. There are no designated routes in this area therefore there is no change in allowed off-highway vehicle use.
Between the Hope Highway and Palmer Creek Road near the town of Sunrise	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate summer helicopter access through forest order	
West of Palmer Creek Road and on either of side of Resurrection Creek south to Wolf Creek	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate summer helicopter access through forest order	
The entire area east of Hope Highway and west of Turnagain Pass	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate summer helicopter access through forest order	

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
The area west of Snug Harbor Road to and including the east side of Cooper Creek drainage	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate summer helicopter access through forest order	The current travel management category also specifies that off-highway vehicles are allowed on designated routes. There are no designated routes in this area therefore there is no change in allowed off-highway vehicle use.
The Grant Lake drainage and the eastern portion of the Falls Creek drainage	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate summer helicopter access through forest order	The current travel management category also specifies that off-highway vehicles are allowed on designated routes. There are no designated routes in this area beyond what is allowed on Crown Point Mining Road and Falls Creek Mining Road in the area west of this area.
The south fork of Snow River and the Godwin Glacier area	Semi-primitive non-motorized and Semi-primitive motorized	Primitive	No	Eliminate summer helicopter access in the southern side of north fork of Snow River drainage, south fork of Snow River drainage, and the Godwin Glacier area through forest order	Change aligns with Kenai Winter Access Decision. Winter motorized corridor along South Fork of Snow River is maintained in this alternative.
Area adjacent to either side of Crow Creek Road	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	This change would make the recreation setting consistent with the current travel management (closed to summer motorized use but open to helicopter use in the winter months).

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
Upper Winner Creek drainage	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Not applicable	This change would make the recreation setting consistent with current travel management (closed to summer motorized use but open to helicopter use in the winter months)
Twentymile tributary immediately east of the Upper Winner Creek drainage	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive motorized	No	Not applicable	This change would make the recreation setting consistent with current travel management (open to summer helicopter use and open to all winter motorized use
Spencer Whistle Stop area	Semi-primitive motorized	Roaded natural	No	Not applicable	No changes to types of motorized uses allowed.
Area south of Whittier and west of Blackstone Bay	Semi-primitive motorized	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate summer helicopter use through forest order	
Southern portion of Whittier Glacier located south of Whittier and west of Blackstone Bay	Semi-primitive non-motorized	Semi-primitive non-motorized (winter motorized allowed)	Yes	Allow winter motorized use	Winter motorized use would be allowed through a separate travel management decision.
Wilderness Study Area	Semi-primitive non-motorized	Primitive	No	Not applicable	Nearly all of the Wilderness Study Area would have a primitive recreation setting with the exception of narrow fringes of semi-primitive non-motorized along Blackstone Bay, Pigot Bay, Harriman Fiord, Cochrane Bay, Culross Passages and Coghill Lake. This change stays in alignment with current travel management.
Hinchenbrook Island	Primitive	Semi-primitive non-motorized	No	Not applicable	This change stays in alignment with current travel management.
Olsen Bay Research Natural Area	Semi-primitive non-motorized	Primitive	No	Not applicable	This change stays in alignment with current travel management.

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
South of Copper River Highway (from Eyak River to Copper River)	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive motorized	No	Not applicable	This area is closed to motorized use, except for subsistence, in the summer months. This change would align with current summer use of airboats in small waterways throughout the delta area. Use of watercraft is exempted from 36 CFR 212.51 travel management regulations so this change is still consistent with current travel management.
North of Scott and Sheridan Glaciers	Primitive	Semi-primitive non-motorized (winter motorized allowed)	No	Eliminate helicopter use in summer months through forest order	This change would be consistent with the current winter travel management but would require a forest order decision to prohibit summer helicopter use.
Lands south of Copper River Highway and north of Long Island	Semi-primitive non-motorized (winter motorized allowed)	Semi-primitive motorized	Yes	Open area for motorized uses in summer months	This area is currently closed to motorized uses in the summer months. Allowing off-highway vehicle use of the area would require a separate travel management decision.

All changes in recreation classes listed above for alternative C would apply to alternative D except that all NFS lands within the wilderness study area would be in the primitive recreation class (table 8).

Table 8. Recreation opportunity spectrum changes proposed in alternative D

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Management Decision Needed	Comments
Wilderness Study Area	Semi-primitive non-motorized	Primitive	No	Not applicable	Entire wilderness study area would be in the primitive recreation class, which is consistent with current travel management.

For all alternatives, there are four areas where the recreation is not changing but current travel management decisions are inconsistent with the class. Table 9 displays these areas and the changes to travel management decisions that would be required. Travel management decisions would be made separately from the forest plan decision, as described earlier in this chapter. Management direction needed for administrative and authorized uses would be included in the plan components in the revised forest plan, and forest orders would be needed for public recreational or other uses.

Table 9. Recreation opportunity spectrum and travel management inconsistencies for all alternatives where no recreation opportunity spectrum changes are proposed

Location	Current Recreation Class	New Recreation Class	Need Separate Travel Management Decision?	Type of Travel Management Decision Needed	Comments
Montague Island	Semi-primitive non-motorized	No change	Yes	Prohibit winter recreation motorized use	A separate travel management decision would be required to prohibit winter recreation motorized access. Motorized access for subsistence purposes would still be allowed.
North side of Green Island	Semi-primitive non-motorized	No change	Yes	Prohibit winter recreation motorized use	A separate travel management decision would be required to prohibit winter recreation motorized access. Motorized access for subsistence purposes would still be allowed.
All lands east of Copper River except barrier islands	Primitive	No change	Yes	Prohibit winter recreation motorized use	A separate travel management decision would be required to prohibit winter recreation motorized access. Motorized access for subsistence purposes would still be allowed.
Kayak Island	Primitive	No change	Yes	Prohibit winter recreation motorized use	A separate travel management decision would be required to prohibit winter recreation motorized access. Motorized access for subsistence purposes would still be allowed.

Revision Topic 3 Ecological Sustainability

The findings in the forest plan assessment suggest that the 2002 forest plan has provided well for ecological sustainability. While some of the plan components that provide for ecological sustainability in the 2002 forest plan (alternative A) have been carried forward into the action alternatives (alternatives B, C, and D), others have been modified, and new components have been added to meet the requirements of the 2012 Planning Rule.

Plan components in the action alternatives reflect a shift in emphasis towards providing resilience, which is the ability of ecosystems to absorb or recover from the effects of disturbances. These plan components were developed with the recognition that natural disturbance processes (e.g., insects and diseases) and a changing climate will likely result in changing landscape conditions throughout the plan period, and management must be able to adapt to these changing conditions.

Alternatives B, C, and D include plan components to provide ecological conditions to maintain a viable population of each species of conservation concern. While effects to plants and animals on the Regional Forester’s Sensitive Species List that could result from adoption of one of the action alternatives are discussed in the draft environmental impact statement, species-specific plan components are not included for these species. Similarly, management indicator species (MIS) are not included in the revised forest plan because they are not a part of the 2012 Planning Rule.

Revision Topic 4 Social, Economic, and Cultural Sustainability

The 2002 forest plan has also been effective in guiding the contribution to the social, economic, and cultural sustainability of communities within the plan area. Some plan components have been carried forward into the action alternatives. In order to meet the requirements of the 2012 Planning Rule, some plan components have been modified and new components have been added.

In particular, the plan components in the action alternatives, especially alternatives C and D, place a greater emphasis on partnerships and collaborative relationships and a greater emphasis on acknowledging the values and interests in the Chugach National Forest held by Alaska Native Tribes and Corporations and the State of Alaska.

Summary of Environmental Consequences by Alternative

The kinds of environmental consequences considered in this programmatic draft environmental impact statement and the assumptions used in the analysis are described in the opening sections of chapter 3. Those sections may be referenced to answer questions that may arise about the summaries provided here.

None of the actions proposed in any of the alternatives would significantly change management of the Chugach National Forest. The management intent of the 2002 forest plan (alternative A) would change very little under the action alternatives (alternatives B, C, and D). While the draft forest plan is organized differently from the current one, and many changes in plan components have been proposed to conform with the 2012 planning rule, changes to future management activities and resulting consequences to natural resources and social and cultural resources would be minor in most cases.

The recommended wilderness area would continue to be managed the same as the wilderness study area. If all or part of the recommended wilderness area is designated by Congress, management of the selected area would change to conform to the terms of the designation.

While changes to recreation classes alter management intent, these changes in and of themselves do not change what is allowed to happen on the ground. Two of the proposed changes would require travel management decisions to be consistent with the change in recreation classes, but changes to the classes would not in themselves prohibit or allow motorized use. The designation of roads, trails, and areas available for motorized use would remain the same in all alternatives.

The following sections of chapter 3 are included in this draft environmental impact statement solely to provide context and information about current conditions and, in some case, trends. While this information is relevant to the environmental consequences of other resource areas, the alternatives create no environmental consequences associated with these topics:

- Forest Insects and Diseases
- Current and Potential Future Climate
- Land Status and Ownership
- Tribal Relations
- Geology
- Special Uses (non-recreation)

A brief summary of environmental consequences for the remaining resource sections discussed in chapter 3 follows.

Social and Economic Contributions

None of the action alternatives are expected to result in a quantifiable economic impact when compared with management under the 2002 forest plan. The recreation classes vary somewhat by alternative. In the future, travel management decisions based on recreation class changes made in this plan could result in changes to the size and location of areas available for motorized use. While this could affect the type of recreational user visits and spending, the economic consequences of these potential changes would be minor and are not quantifiable at this time.

Past, present, and reasonably foreseeable activities in the project area include the revisions of management plans for adjacent State lands and national parks, construction of a proposed hydro-electric power project, potential development of private mineral estates and timber extraction, and highway rehabilitation projects. Many of these actions have the potential to make economic contributions, in the form of jobs and labor income, to the local economy. However, none of the actions are expected to measurably affect annual recreation use, visitor spending, and associated employment, income, and tax revenue stemming from the Chugach National Forest. Therefore, no cumulative effects are anticipated related to economic activity from the national forest.

Cultural Resources

The amount and degree of potential adverse impacts would not vary by alternative because management of cultural resources is almost exclusively dictated by law, regulation, and policy and all alternatives include plan components to protect cultural resources. Indirect effects to cultural resources have the potential to occur as unintended consequences of management actions and authorized uses. Indirect effects to cultural resources may result from increased public access and use of an area and other designated special uses. Increasing human interactions in these areas increases the potential for site disturbance and destruction. Unknown sites may be discovered during project activities, resulting in unplanned and inadvertent adverse impacts to such sites. None of these potential impacts vary by alternative.

Subsistence Resources

The alternatives analyzed would result in little change to the abundance and distribution of resources important to subsistence. Because little habitat manipulation is proposed in any of the alternatives, moose and caribou populations in Game Management Unit 7 of the Kenai Peninsula will continue to decline or exist at low population levels unless natural disturbances alter the vegetation.

None of the alternatives limit access to public lands for the purposes of subsistence gathering activities. No new road construction is proposed in this forest plan or in any of the alternatives. Motorized access for subsistence activities by rural residents of Alaska would not change under the alternatives.

There is potential for projects to occur on Chugach Alaska Corporation (CAC) lands that could affect subsistence resources; however, projects on CAC lands typically include mitigation measures that would reduce impacts to subsistence resources. Cumulatively, there is the potential for minor localized impacts to subsistence resources; however, these impacts do not vary in any measurable way by alternative.

Forest Products

Commercial timber production is the purposeful management and sale of sawtimber on a commercial scale that provides sufficient volume on a continuing basis to support a milling industry. Commercial timber production is not compatible with the 2002 forest plan or any of the proposed alternatives for the following reasons: 1) the acreage available for timber production is limited, 2) there is a high level of demand for personal and Alaska free use fuelwood and sawtimber, and 3) the standing volume of sawtimber is low within the area available for timber management (less than 1.25 mbf per acre estimated).

All of the proposed alternatives prioritize supplying wood products for Alaska free use and personal needs through vegetation management treatments for other purposes (e.g., wildlife habitat enhancement and hazardous fuels reductions). The number of acres accessible for special forest product harvests and wood products management from NFS lands does not vary by alternative.

Access to Alaska free use timber and fuelwood is available in the front country, backcountry, and ANILCA 501(b) management areas and is conditionally available in other management areas. Of the one million acres of forested land, approximately 11,170 acres are available for harvest of fuelwood.

While the estimated growing potential for this 11,170 acres is 2,180 cords per year, due to the current age distribution of the forest, a realistic removal of fuelwood would be 1,000 cords annually. The later part of the plan period would yield more volume as trees reach the size suitable for fuelwood harvest. Fuelwood removed under Alaska free use (36 CFR 223.10) may also contribute to the volume removed.

Harvest of small quantities of sawtimber would meet the current requests for Alaska free use sawtimber through the provisions of CFR 223.10 based on current requests fulfilled.

Census data indicate that there are 2,900 households within and immediately adjacent to the national forest boundary with 639 households using wood as a primary source of heat. Actual need as estimated by volume of fuelwood removed from public log decks, past fuelwood sales, areas where free use harvest is available, and fuelwood disposals from land conversions is estimated at 2,000 to 2,500 cords. The volume of wood available as well as the price of home heating oil affects demand and need.

Of this need, approximately half is typically removed from NFS lands by private individuals or commercial enterprises. The remainder is likely provided from non-NFS lands.

Harvest of fuelwood and personal free use harvest of sawtimber would be sustainable at current levels throughout the plan period. These conclusions are consistent with the sustained yield calculations in appendix B of the draft land management plan.

Recreation

The alternatives analyzed include some variation in recreation classes, although those variations are relatively minor. Future travel management decisions needed to address recreation class changes made in this forest plan revision could result in changes to the size and location of areas available for motorized use. The effects of alternative B on recreation opportunities are very similar to alternative A, except where changes in recreation classes were made to address the 2007 Kenai Winter Access Project decision that changed access for winter motorized recreation (table 6). There would be no effects to recreation visitors as the changes in recreation opportunity spectrum would match current travel management decisions. Alternatives C and D have more acres in the primitive class and less in the semi-primitive non-motorized, semi-primitive non-motorized (winter motorized allowed) and semi-primitive motorized classes. The amount of roaded natural and rural classes changed very minimally across the alternatives. Alternatives C and D are generally more consistent with current recreation uses and current travel management decisions, and would not change current visitor experiences. Several changes in classes may require further project level travel management analysis and decisions to change motorized use designations, which may change visitor experiences.

Wilderness

Current management direction for the wilderness study area includes maintaining existing character and potential for inclusion in the National Wilderness Preservation System. This direction is not affected by the plan revision process and would remain in place for all wilderness study area lands in Management Area 1 until Congress acts on the wilderness area recommendation or terminates the wilderness study area designation. If designation occurs, the wilderness study area designation would presumably be eliminated.

Alternatives A and B have the least area recommended for wilderness area designation (72 percent). These areas are located farther from the port towns of Whittier and Valdez and encompass some of the most remote areas within the Chugach National Forest. About 63 percent of the area recommended for wilderness area designation would be managed under a primitive recreation class with most of these areas located farther away from Whittier and Valdez.

Alternative C recommends 94 percent of the wilderness study area for wilderness area designation. This would include some of the popular recreation areas, such as bays along Port Wells, Esther Island, and Cochrane Bay and Culross Passage. The remaining areas not recommended would include Blackstone Bay, EVOS acquired lands, areas near private lands in the Nellie Juan Lake area, and two islands (Glacier Island and Erlington Island) near the Native villages of Tatitlek and Chenega Bay. About 98 percent of the area recommended for wilderness designation would be managed under a primitive recreation class. The popular areas for recreation use closest to Whittier would have a semi-primitive non-motorized recreation class along the shoreline and a primitive recreation class farther from shore to reflect and accommodate current use patterns. This alternative would best align with direction to preserve wilderness character (should Congress designate the area as wilderness) with consideration of current and future recreation use of shoreline areas.

Alternative D recommends 97 percent of the wilderness study area for wilderness area designation. The only lands not included are EVOS acquired lands and the land around Nellie Juan Lake. The entire area recommended for wilderness designation would be managed in the primitive recreation class. This alternative aligns most closely with management direction to preserve wilderness character (should Congress designate the area as wilderness), but could require additional monitoring in more popular recreation use areas to assess wilderness character attributes and verify that recreation development and use is in alignment with the primitive recreation class.

Minerals

The only consequences to mineral resources would result from designation of recommended wilderness areas. Currently all NFS lands within the wilderness study area are open to mineral entry. If the recommended wilderness area is designated by Congress, the lands designated would be withdrawn from mineral entry, subject to valid existing rights. The greatest amount of land would be withdrawn under alternative D, and the least amount would be withdrawn under alternative A. This pattern would be the same for areas of high mineral potential.

Discovery and development of locatable minerals would be adversely affected by mineral withdrawals resulting from wilderness area designation, but withdrawals would be subject to valid existing rights.

Infrastructure

Overall, management of the national forest road system would not differ significantly by alternative. The most substantial difference among alternatives is that alternatives B and D would allow a higher level of recreation infrastructure development along road systems in the Palmer Creek drainage, which includes Palmer Creek Road and Coeur d' Alene Campground. Alternative C would maintain infrastructure at the current level.

Forest plan direction now covered by the travel management rule would be removed from the forest plan in alternatives B, C, and D, but this change would not affect management of the road system. The designation of roads, trails, and areas available for motorized use would remain the same in all alternatives.

Air Quality and Carbon

Implementation of any of the alternatives considered in detail would not substantially change the existing air quality of the national forest. In all alternatives, anthropogenic emissions from Forest Service administrative functions, recreation, transportation (including cruise ships), special uses, mining, and vegetation management would vary little and there would be no significant differences between the alternatives. Management of the Chugach National Forest would continue to result in continued carbon sequestration unless there is an increase in large-scale disturbance. Anthropogenic greenhouse gas (GHG) emissions from forest administrative functions, recreation, transportation (including cruise ships), special uses, mining, oil and gas, and vegetation management are expected to vary little among alternatives and there would be no significant differences between the alternatives. All areas within the national forest are currently in compliance with National Ambient Air Quality Standards. Any cumulative effect most likely would be temporary and would not be expected to substantially degrade long term air quality within the national forest. Air quality could be affected in the event of future mineral exploration and development and increases in cruise ship emissions.

Soils

Recreation use and mining operations are the two main activities that affect soil productivity and soil stability within the Chugach National Forest. Recreation and mining activities generally convert productive sites and soils to an essentially non-productive site for a period of more than 50 years. Under all the alternatives, soil productivity and soil stability are expected to be maintained across the national forest overall in the long term, and the effects of the implementation of any of the alternatives are expected to be minimal to the soil resource except on a very site specific basis, but implementation of best management practices (BMPs) would ensure reduced impacts.

Watersheds and Water Resources

All of the alternatives would continue management direction providing for ecological sustainability. All alternatives would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Overall, all of the alternatives would result in minimal environmental consequences to watersheds and water resources. Minor, short term cumulative effects may result under all alternatives. Ninety-nine percent of the Chugach National Forest watersheds are in Class 1 (good, functioning properly condition) and are considered to have good integrity. Watersheds with good integrity are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities.

Riparian and Wetland Resources

All alternatives would continue management direction providing for ecological stability. All alternatives would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions, such as riparian and wetland restoration, would continue as resources are available. Overall, all of the alternatives have minimal environmental consequences to riparian and wetland resources. Ninety-two percent of the Chugach National Forest riparian and wetland areas are in Class 1 condition (good, functioning properly condition). Healthy, properly functioning riparian and wetland areas generally exhibit strong integrity, are more resilient to stressors, have a greater capacity to adapt, and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities. Cumulative effects across the plan area are not expected to vary by alternative.

Aquatic Ecosystems and Habitats

Chugach National Forest fish resources, water resources and watersheds will continue to contribute to the sustainability of diverse aquatic habitats and the social, economic, and cultural integrity of communities in the plan area under all of the alternatives. The likely increase in future water use, both consumptive and non-consumptive, and impacts from climate change on those uses will also remain the same under all alternatives.

For all alternatives, cumulative effects to the aquatic habitats, species, and activities affecting salmon and the aquatic species associated with them will be minimal and without significant changes to the natural distributions and functions in nearly all streams and lakes on the national forest. In addition, there are very few human impacts on NFS lands affecting the presence of aquatic life and fish resources.

Terrestrial Ecosystems

Changes resulting from ongoing directional climate change (glacial recession and upward migration of treeline and shrubline) and successional changes on uplifted lands in the Copper River Delta would have a greater effect on terrestrial ecosystems than implementation of any of the proposed alternatives. Increasing human uses, especially recreation, will continue to facilitate the transport and establishment of invasive species. This trend would be offset slightly by implementation of alternatives C and D, which propose reduction in the area of year-round motorized recreation settings and an increase in area in primitive recreation classes. If wilderness is designated, lands would be withdrawn from mineral entry, which would reduce the potential for disturbance that could result in habitat loss and establishment of invasive species on those lands.

Terrestrial Wildlife and Habitats

For most wildlife species, the effects of resource management vary little among the four alternatives. The large, intact landscapes of the Chugach National Forest continue to support diverse highly functional ecological communities which in turn provide abundant and well distributed habitats for nearly all native wildlife species. The small and concentrated footprint of ground and vegetation disturbing management activities helps to minimize the effects of disturbance and habitat fragmentation.

The effects of motorized access on wildlife include both the disturbance effects of the vehicle and the disturbance effects of other human activities facilitated by vehicle access. Winter snowmachine use is the most common and widespread motorized use within the Chugach National Forest and may have the greatest effects on sensitive species due to habitat limitations, restricted mobility, and the vulnerability of animals in poor physical condition.

Since information necessary to determine the intensity, patterns, and trends of motorized use are currently unavailable, analyses were limited to acres of land open or potentially open to motorized access as a surrogate to the area of habitat at risk from increased human disturbance. Under alternatives A and B, more area is open or would potentially be opened to motorized access and could lead to greater negative effects on sensitive wildlife species than under alternatives C and D.

For nine of the wildlife species and groups considered in detail, the potential effects of the alternatives on the availability of suitable habitat and the abundance, distribution, and persistence of the species or group are not measurable. In several cases, notably the Cook Inlet beluga whale, Kittlitz’s murrelet and the Aleutian tern, the populations may be seriously affected by problems, such as changing ocean conditions, but these factors are outside the ability of the Forest Service to influence. Management actions under the alternatives are expected to provide minor to moderate benefits for five of the species considered in detail.

Eight of the terrestrial wildlife species or groups reviewed in detail are not expected to be measurably affected by any of the alternatives, and Forest Service management activities are unlikely to affect the availability or suitability of their habitat on NFS lands. Since there are no direct or indirect effects to these eight species or groups there can be no cumulative effects for them either. For the remaining five species reviewed for which indirect effects were identified, cumulative effects are discussed in detail at the end of each section.

Wildfire and Fuels

The effects of use of fire, both planned and unplanned, is the same under all alternatives. Wildfire would continue to be managed as it currently is and fuels treatment objectives, including acres of hazardous fuels treated annually, are the same under all alternatives. Areas not treated (with fire, mechanical, chemical, or combinations of treatments) will continue to advance toward climax successional stages, and understory seral species (shrubs and herbs) may decline or become more decadent. Coarse and fine-scale landscape patterns will become more homogenous as succession advances.

Current weather trends, longer growing seasons, and fire suppression efforts are affecting mosaic fire effect patterns involving fuel profiles. This will continue to reduce resilience against insects and disease and ultimately add to undesired hazardous fuel loadings, greatly influencing fire intensities and behavior, and contributing to undesired fire effects. Wildlands resilience to uncharacteristic and undesired wildfire because of a high variable in weather trends could change fire regimes. Return intervals, which currently span long lengths of time (up to 600 years), could become more frequent.

Under all alternatives, the Forest Service would continue to collaborate with adjoining communities on community wildfire protection plans, emphasizing cross boundary projects that include a multitude of partners and land jurisdictions. If the scope and scale of these projects increases, the cumulative effect would be one that assists in achieving protection objectives where human values intermix with ecological processes. With a greater number of people living and recreating in these wildland urban interface areas, there is a greater probability of more human caused wildfire ignitions that could affect national forest vegetation, in spite of fire prevention efforts.

Chapter 3. Affected Environment and Environmental Consequences

This chapter describes current physical, biological, and social and economic conditions and trends in the plan area and analyzes the environmental consequences (effects) expected to result from adopting a land management plan (forest plan or plan) based on one of the action alternatives (alternative B, C, or D), or from taking no action (choosing alternative A). It also presents the scientific and analytical basis for the comparison of alternatives presented in chapter 2. In some cases, more detailed information is available in resource specialist reports, which are available in the planning record in the supervisor's office of the Chugach National Forest in Anchorage, Alaska. The environmental analyses focus on the needs for changing the existing forest plan and the issues identified through the scoping process; they also examine potential effects to programs and resources of the Chugach National Forest.

Organization of this Chapter

The introductory sections in this chapter describe the nature of the programmatic analysis used in this draft environmental impact statement (DEIS), the science and assumptions used in the analysis, and the projects and plans considered in the analysis of cumulative effects.

The main body of this chapter is divided into three main sections. The Agents of Change section describes the current condition and expected trends for forest insects and diseases and changing climate conditions within the Chugach National Forest. This is followed by the affected environment and environmental consequences analyses for resources primarily related to the social and economic sustainability of the plan area. The third main section presents the analysis of affected environment and environmental consequences for resources primarily related to the ecological sustainability of the plan area.

Each of the individual resource analyses includes:

- Introductory information
- Methodology section describing the spatial and temporal scales of the analysis and assumptions and methodology specific to that analysis
- Description of the affected environment and trends related to or affecting the resource
- Environmental consequences, including indirect and cumulative effects

The Relationship between Forest Plans and Site Specific Activities

This analysis examines the implications or longer term environmental consequences of managing the national forest under the programmatic framework provided by the draft revised forest plan and its alternatives. Because a forest plan does not authorize or mandate any site specific projects or activities (including ground disturbing activities), there can be no direct effects; the analyses presented in this chapter discuss the potential for indirect and cumulative effects to result from application of the alternatives.

Forest plans do not authorize, fund, or carry out any project or activity described in the effects analyses. Instead, they provide a programmatic framework that guides site specific activities that may be carried out in the future. Implementation of site specific projects must be preceded by project level planning, environmental analysis, and a decision by the appropriate Forest Service official. The analyses presented in this chapter describe the potential for the environmental consequences to occur, and in many cases are only estimates. The effects analyses are useful for comparing alternatives on a forestwide basis but are not intended to be applied to specific locations within the national forest.

The forest plan sets the stage for future management actions needed to achieve desired outcomes (desired conditions and objectives), and provides the sideboards (such as suitability determinations and standards and guidelines) designed to manage risks to ecological, social, and economic environments during implementation of future activities and uses. The forest plan also identifies potential management approaches that may be used to help achieve desired conditions.

Science and Assumptions Used in the Environmental Analyses

In developing the environmental analyses that follow, the planning team used the best available scientific information, which is documented in the planning record.

Assumptions made in the analyses of alternatives include:

- Planning and implementation of site specific projects and activities would be consistent with applicable law, regulation, and policy.
- Applicable BMPs would be applied during project and activity implementation and would be effective.
- Planning and implementation of site specific projects and activities would be consistent with plan components, such as desired conditions, objectives, standards and guidelines, management areas, and suitability determinations.
- Goals and potential management approaches would influence collaborative efforts and be considered in developing programs of work.
- While estimates are made for the purpose of analysis, the actual level of accomplishment of plan objectives would depend on environmental conditions, budgets, and staffing.
- Implementation of the forest plan would facilitate progress toward the attainment of desired conditions for each resource.
- The planning period is 10 to 15 years; other timeframes may be used to compare expected future trends. Plans are expected to be revised at least every 15 years.
- Plan monitoring would occur and the forest plan would be amended as needed.
- Wilderness assumptions for analysis purposes only include:
    - ♦ Congressional designation would occur where areas are recommended for wilderness designation.
    - ♦ If wilderness area designation occurs, Congress would also eliminate the wilderness study area designation.
    - ♦ Designated wilderness areas would be managed consistent with the provisions of ANILCA.
    - ♦ Designation would include provisions to allow continued monitoring and restoration/remediation actions within the designated *Exxon Valdez* oil spill zone.

The discussions in this chapter describe the potential for consequences to occur, and, in many cases, they are only estimates. To estimate the consequences of alternatives at the programmatic plan level, the ongoing activities and uses have been estimated (see table 10). Most of the numbers in this table are an average of activity and use data for the past five years. It is assumed that these accomplishments would continue to occur at similar levels throughout the plan period (15 years) and would be similar for all alternatives.

Cumulative Effects

The Council on Environmental Quality (CEQ) regulations for implementing the procedural provisions of NEPA defines a cumulative impact as “the impact on the environment which results from the incremental impact of the action when added to the past, present, and reasonably foreseeable future actions regardless of what Agency (Federal or non-federal) or person undertakes such other actions” (40CFR S 1508.7). As noted by CEQ’s guidance memorandum of June 24, 2005 and consistent with Forest Service NEPA Regulations (36 CFR 220.4(f)) (July 24, 2008), the effects of past actions can generally be captured by a description of the affected environment (Connaughton 2005), which is detailed in each individual resource section of this chapter.

CEQ guidance on programmatic NEPA characterizes the kinds of impacts to be considered in a programmatic analysis such as this one: “Because impacts in a programmatic NEPA review typically concern environmental effects over a large geographic and/or time horizon, the depth and detail in programmatic analyses will reflect the major broad and general impacts that might result from making broad programmatic decisions. Programmatic NEPA reviews address the broad environmental consequences relevant at the programmatic level” (CEQ 2014).

Based on this guidance, the cumulative effects analysis for the Chugach National Forest land management plan revision considers the broad, programmatic effects of the proposed plan and alternatives added to the broad, programmatic effects of the plans of adjacent land ownerships. Cumulative effects are assumed to vary depending on whether the management direction and intent of plans of adjacent ownerships is similar to or different from that of the Chugach National Forest. Also considered are a few major projects with the potential for broad effects on the Chugach National Forest. The plans and projects considered in this analysis are:

- Copper River Basin Area Plan, State of Alaska, Department of Natural Resources
- Prince William Sound Area Plan, State of Alaska, Department of Natural Resources
- Kenai Area Plan, State of Alaska, Department of Natural Resources
- Kenai National Wildlife Refuge
- Wrangell and St. Elias National Park
- Kenai Fiords National Park
- CAC, potential development of access routes, mineral extraction, and timber harvest
- CAC Mineral Estate Development in Port Gravina
- Grant Lake Hydroelectric Project, Kenai Hydro LLC/Homer Electric Association, Inc.
- Sterling Highway Milepost 45 to 60 Project
- Seward Highway Milepost 75 to 90 Road and Bridge Rehabilitation Project

Spatial and temporal boundaries for cumulative effects are defined in the Methodology sections of the individual resource analyses.

Table 10. Ongoing activities and uses

Activity or Use	Description	Average output per year
Acres forest vegetation established	Includes: direct seeding (both full or fill-in) both with and without concurrent site preparation or site preparation post treatment done mechanically/manually or by burning; tree planting or fill in tree planting with or without concurrent site preparation seeding or certification of natural regeneration. Natural regeneration established: with no site preparation, mechanical and manual site preparation, chemical or other means to alter the seed bed establishing forest vegetation.	62
Acres forest vegetation improved	Acres receiving timber stand improvements. Individual tree release and weeding, area release and weeding. Pre-commercial thinning of individual trees or in strips, pruning, fertilizing individual trees or areas.	117
Acres forest treated using timber sales, contracts, and agreements	Acres treated using regeneration and intermediate harvest methods to provide for wood products and to improve and enhance ecosystem health and resiliency to wildfire and insect or disease epidemics.	37
Timber products provided to the public in cords (sale and permitted free use/subsistence)	Volume of trees provided to the public for use as fuelwood, cordwood, and sawtimber	615
Timber free use permits issued	Permits issued to the public as (free use) cordwood, fuelwood, poles, posts and sawtimber (no-fee permitted cordwood decks and standing sawtimber) (AK free use sawtimber).	226
Non-timber special forest products permits issued	Permits issued for commercial use and harvest of non-timber special forest products, such as holiday boughs, medicinal plants, educational plant specimens, and willow cuttings for soil stabilization.	6
Acres fuels treated in the wildland urban interface (WUI)	Acres treated to reduce or maintain fuels conditions in the wildland-urban interface, consistent with Community Wildfire Protection Plan objectives.	844
Acres treated to reduce risk of catastrophic wildfire	Acres treated to reduce risk of catastrophic wildfire. Acres outside of a community wildfire protection plan.	272
Acres lake habitat restored/enhanced	Surface acres of lakes, ponds or reservoirs enhanced or restored, including structural and non-structural improvements and treatment of non-native aquatic invasive species such as *Elodea* spp.	142
Acres terrestrial habitat restored/enhanced	Total acres restored or enhanced to achieve desired terrestrial habitat conditions. Includes invasive species treatments, moose habitat improvement projects.	8,037
Acres soil/water resources protected/maintained/improved	Total acres of treatment for the purpose of protecting, maintaining, improving or restoring water or soil resources including land treatments, structures, and other non-structural measures.	1,103
Acres treated for noxious weeds/invasive plants	Acres treated to control or eliminate invasive plant infestations.	94
Miles stream habitat restored/enhanced	Miles treated using structural or non-structural methods to provide biological benefits to stream habitat.	33
Percent of watersheds in Class 1 condition	Class 1 watersheds exhibit high geomorphic, hydrologic, and biotic integrity relative to their natural potential condition.	99

Activity or Use	Description	Average output per year
Harvest of key subsistence species (number of animals or fish):		
Unit 6 Deer	Estimated deer harvest within Unit 6.	1,423
Unit 7 Caribou	Reported caribou harvest within Unit 7.	22
Moose (Units 6 and 7)	Reported moose harvest within Units 6 and 7.	101
Mountain Goat (Units 6 and 7)	Reported mountain goat harvest within Unit 6.	97
Black Bear (Units 6 and 7)	Reported black bear harvest within Units 6 and 7.	730
Salmon harvest from subsistence Russian River dipnet fishery	Reported number of salmon harvested from the subsistence dipnet fishery on the Russian River.	1,307
Salmon harvest from subsistence Copper River Delta fishery	Reported number of salmon harvested from the subsistence fishery within fresh waters of the Copper River Delta, excluding the Copper River and its tributaries.	658
Locatable minerals plans of operations administered	Locatable minerals plans of operations administered.	52
Number of mineral material (salable) contracts/ permits	Number of mineral material (salable) contracts/ permits.	94
Tons of mineral materials disposed	Tons of mineral materials (i.e., sand and gravel, shot rock, etc.) sold, used for administrative purposes or provided for free use.	116,182
Miles of NFS Roads maintained open	Total miles of NFS Roads maintained for public use.	82
Miles of NFS Roads closed	Total miles of NFS Roads not maintained for public use.	12
Miles trails maintained open	Total miles of system trails on NFS lands maintained for public use (mileage includes summer trails and winter trails that are not on same alignment as summer trails).	433
Number recreation sites	Includes trailheads, visitor centers, cabins, campgrounds, and other sites available for recreational purposes.	107
Number recreation special use authorizations administered	Total number of recreation special use authorizations administered (primarily outfitter/guides, recreation events, and isolated cabins).	176
Number lands special use authorizations administered	Total number of lands special use authorizations administered (includes communications sites, temporary fish camps, roads, powerlines, telephone lines, and other lands authorizations).	134

Agents of Change

This section describes current conditions and likely trends for climate and for forest insects and diseases. These descriptions provide part of the baseline for environmental analysis, as the potential changes described in this section may alter some of the resources analyzed in this chapter.

Forest Insects and Diseases

Introduction

The composition of forest insects and diseases in and around the Chugach National Forest varies from year to year. This is especially true of forests in northern locations where changing long term climatic trends can have big influences on the interactions of forest insects and pathogen populations and their host tree species making these interactions difficult to predict. Based on past forest health observations, which of these disturbance agents might have visible and notable impacts over the plan period can be predicted. Table 11 displays the various insects and diseases that will probably dominate at one time or another during this period. These were selected based on past severity, host range, geographic location, and ability to erupt into epidemics.

Table 11. Pathogens and insects that attack trees or shrubs within the Chugach National Forest and are most likely to influence vegetation composition, structure, and function over broad spatial areas for extended periods (a decade or longer)

Insect or Disease	Tree or Shrub Species Impacted	Geographic Area Affected	Notes
Spruce bark beetle (*Dendroctonus rufipennis*)	Lutz, white, and Sitka spruce	All areas	Increasing activity in 2016, particularly north of the plan area New infestations on the western edge of Chugach National Forest (boundary with Kenai National Wildlife Refuge) May result in renewed spruce mortality across large portions of Chugach National Forest on Kenai Peninsula during the next 20 years
Spruce aphid (*Elatobium abietinum*)	Sitka spruce	Coastal areas	Coastal spruce forests within the Pacific northwest maritime region Invasive species from Europe but known from British Columbia since 1915 Attacks mature needles, not new growth Doesn't usually kill the tree, but may result in 15 to 20 percent mortality May influence view-scape across broad areas, including multiple watersheds over extended periods
Spruce bud blight (*Gemmamyces piceae*)	All spruce species	All areas	Known from Europe, attacks all spruce species, biotic non-native invasive species First observation in North America was in 2013 in Homer, Alaska May lead to mortality after multiple years of attack Appears to attack a high proportion of spruce in a stand
Alder canker (several species of fungus)	Thinleaf alder, Sitka alder, and Siberian alder	All areas	Large patches along floodplains—mostly thinleaf alder Leads to mortality of alder, frequently in large patches of thinleaf alder within 500 meters of streams Small patches above treeline, mostly Sitka alder Nutrient impacts to watershed Insect defoliation can reduce tree vigor, which can increase susceptibility to canker diseases

Spruce Bark Beetle (*Dendroctonus rufipennis*)

Mortality caused by spruce bark beetles occurred on nearly 200,000 acres in 2016. This is a fivefold increase from 2015, and is the largest level of infestation since 1999. Most activity occurred outside of the analysis area in river valleys of the Susitna, Theodore, and Beluga; the north Aleutian Range; and southeast Alaska. What happens within the analysis area during the next decade depends on the following:

1) *The presence and size of an existing endemic beetle population*

Under endemic conditions, spruce beetles are widespread, generally occupying stressed or recently killed or uprooted trees. The size of the beetle populations are correlated with the abundance of windfall, logging debris, stressed living trees, and other similar breeding host materials. Suitable host material is common but not always abundant. Normal loadings of breeding material help sustain insect populations during non-outbreak periods. Historically, various types of small scale disturbances (fires, wind events, wet snow fall, etc.) served to generate a continual source of breeding material for endemic beetle populations. In addition, warm winter temperatures can allow increasing populations.

A monitoring network composed of traps baited with various attractants distributed from Seward to Moose Pass to Cooper Landing, an area within the Chugach National Forest that has been designated as the Forest Health Treatment Area, indicated a sparse beetle population during 2016.

2) The size and density of host trees in a vulnerable state

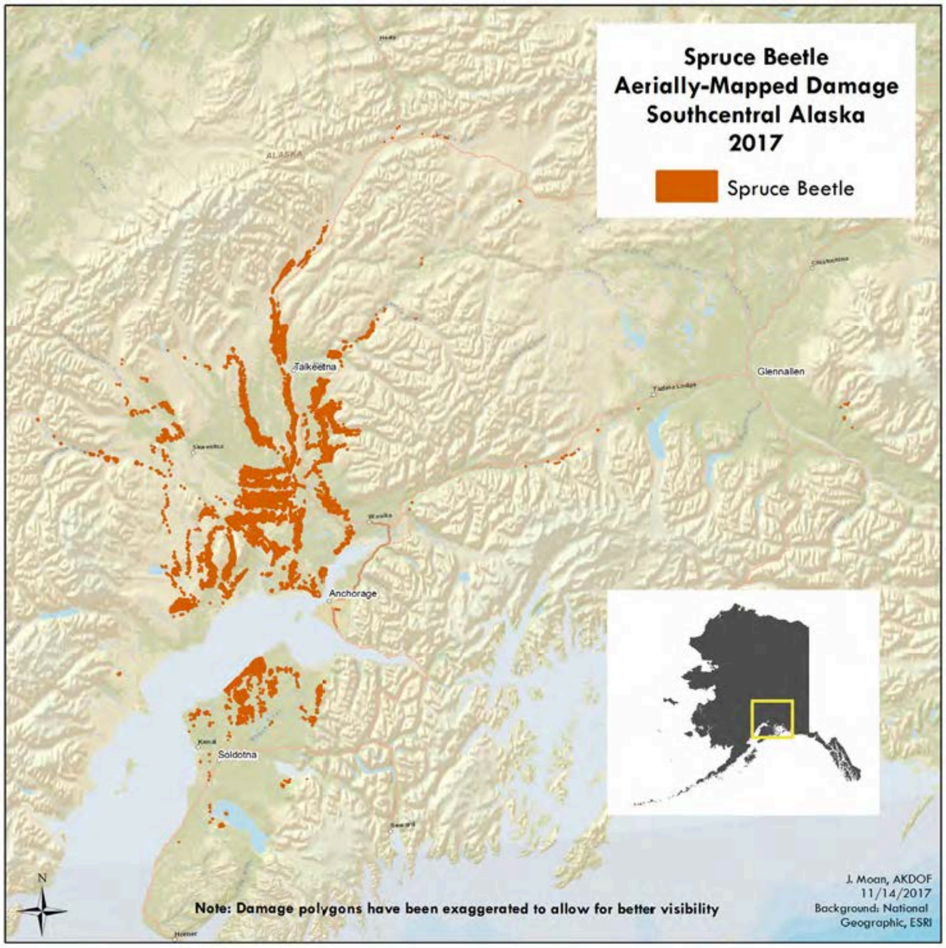
Mature trees under stress are especially susceptible to attack at early stages of an outbreak if beetle populations are high. Mature slow growing trees with large diameters are commonly individually attacked during non-outbreak periods and serve to sustain breeding populations of spruce beetles. Slow growth is probably related to low oleoresin pressure and, thus, less capability to pitch out invading insects. Slow growing trees are attacked first as beetle populations increase. The greater the density of these trees, the greater the probability that a stand will be attacked (Reynolds and Holsten 1996).

Newly infested areas on the Kenai Peninsula are probably those that were missed by the previous 1990s infestation (see map 2). Berg (2016), however, speculated that small trees avoided by the beetle during that infestation had now grown big enough to become vulnerable and that these would serve as the host population for a renewed outbreak. Furthermore, the beetle probably spread to remaining areas where trees have attained a vulnerable condition, in other words, large diameter trees (greater than 12 inches) in dense stands with a large component of spruce (greater than 70 percent). If environmental conditions persist, it will be either or both of these host populations that could be impacted.

3) A conducive environment

Long-term trends in temperature and precipitation influence insect and host populations in ways that can incite spruce beetle outbreaks. When these trends invigorate insect populations while stressing host populations, insect outbreaks can occur. In this regard, the summers of 2015 and 2016 in Seward had average monthly May to August temperatures of 12.8° C (55° F) and 12.9° C (55.2° F). Berg et al. (2006) explained, "… a run of two or more warm summers (exceeding 51° F) would generate a detectable level of spruce beetle activity.…"Although the summer average temperatures have been above this trigger level, beetle populations have not increased in monitored locations within and near the Chugach National Forest.

In this regard, outbreaks are rare and difficult, often impossible, to predict. Several conditions need to coincide. In previous spruce beetle outbreaks on the Kenai Peninsula, for instance, a shift in average summer temperature was accompanied by increasing temperatures in spring, winter, an earlier spring warm up, and an extended summer growth period. The increasing summer temperatures were accompanied by drought, which reduced the growth rate of trees. These environmental conditions imposed on large contiguous groups of mature vulnerable trees, which were already stressed by intraspecific competition, served as major inciting factors to the 1990s infestation. Additionally, increases in temperature can alter beetle development rates, causing beetles to shift from a multivoltine life cycle (one generation every two years) to a univoltine life cycle (one generation per year), increasing the number of beetles per year across the landscape (Hansen et al. 2001).

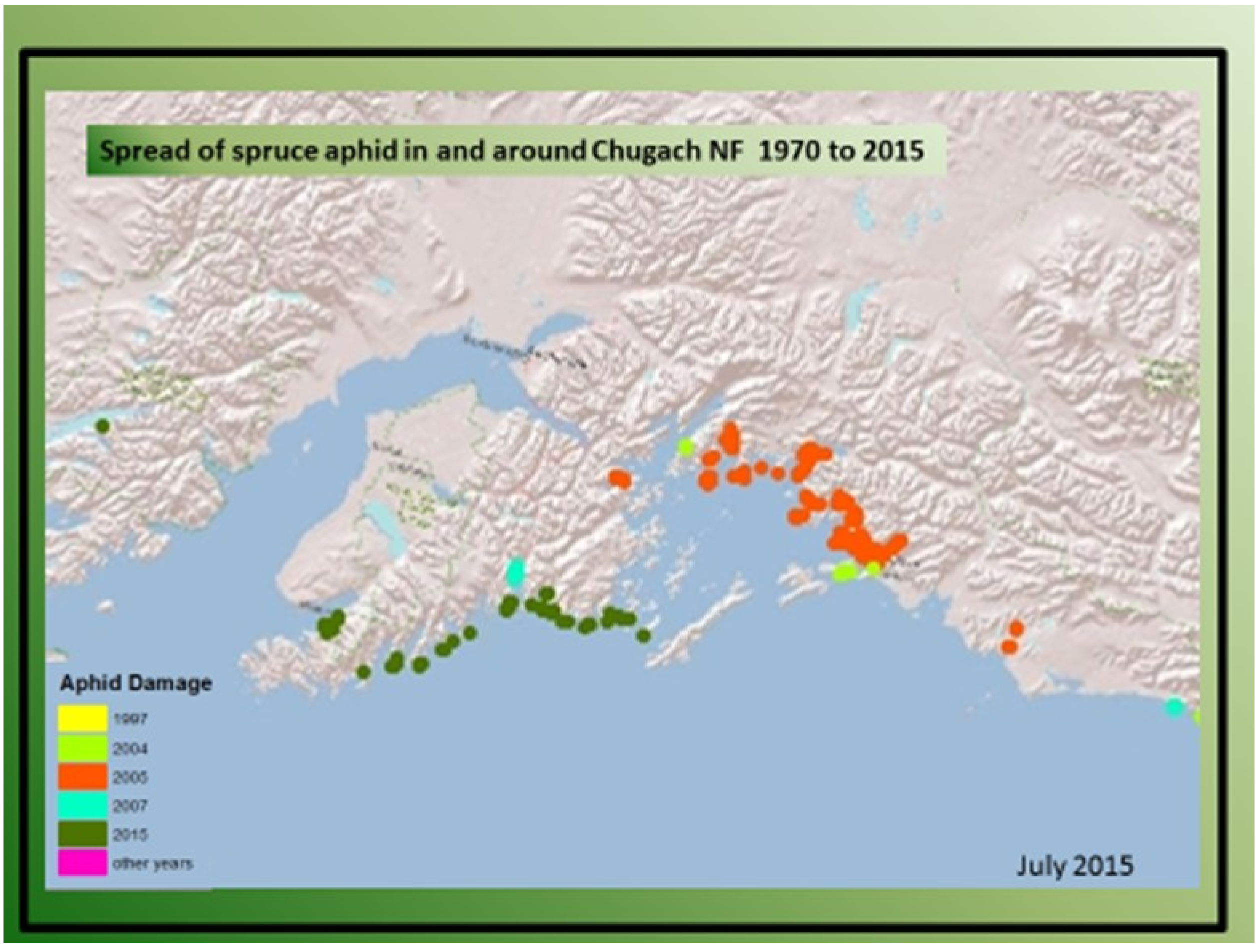


Map 2. Mapped pattern of spruce bark beetle affected stands in 2017. On the Kenai Peninsula, trees missed by the beetle during the 1990s infestation were attacked. North of the Kenai Peninsula, trees were infested where outbreaks have been mostly absent.

During the next decade or two within the analysis area, where endemic populations are already high, the incidence of spruce beetle infestations is expected to intensify in stands missed by the 1990s outbreak. This would include areas east of Nikiski, west of the Moose and Chickaloon rivers, north of Sterling, and the western edge of Chugach Mountains from Skilak Lake to Chickaloon Bay.

Spruce Aphid (*Elatobium abietinum*)

The recent mild winters of 2014-15 and 2015-16 triggered increased spruce aphid activity on the Kenai Peninsula. In 2015, spruce aphid was reported and positively confirmed for the first time on the western Kenai Peninsula. Concerned citizens from Halibut Cove on the south side of Kachemak Bay and in Homer contacted multiple agencies about the alarming damage associated with these aphids. An aerial pest survey of coastal areas neighboring Halibut Cove, the Kenai Peninsula, and Prince William Sound found occasional groups of symptomatic trees, but not as severe. Areas with groups of trees showing similar symptoms include the Kenai Fjords National Park and east at Johnstone Bay, Auke Bay, Bainbridge Island, and Latouche Island in Prince William Sound.



Map 3. Spruce aphid distribution along coastal areas of southcentral Alaska as observed during aerial pest surveys beginning in 1997

During 2016, spruce aphid was mapped on more than 34,000 acres during the aerial detection surveys, more than half of which was on the Kenai Peninsula (18,000 acres). Late winter and early spring ground surveys found infested trees throughout Homer. These surveys also found infestations on the western coast of Resurrection Bay near Seward, although the damage was less severe than that found in and around Homer. Aerial surveys conducted in July documented aphid damage essentially ringing the coastal forest areas of Kachemak Bay from the Homer area to Seldovia Point, and smaller, less severe, pockets of symptomatic trees scattered along the southeastern coast of the peninsula between Nuka Passage and Port Bainbridge. Aphid activity was also observed on several islands in

Prince William Sound: Bainbridge, Latouche, Montague, Hinchinbrook, and Hawkins as well as islands within the Kodiak Archipelago (191 acres), specifically on Raspberry and Afognak Islands. By October, field inspections of the western Kenai Peninsula found abundant aphid populations along the coast 45 miles north of Homer, nearly to Ninilchik and in Homer as far inland as Ohlson Mountain.

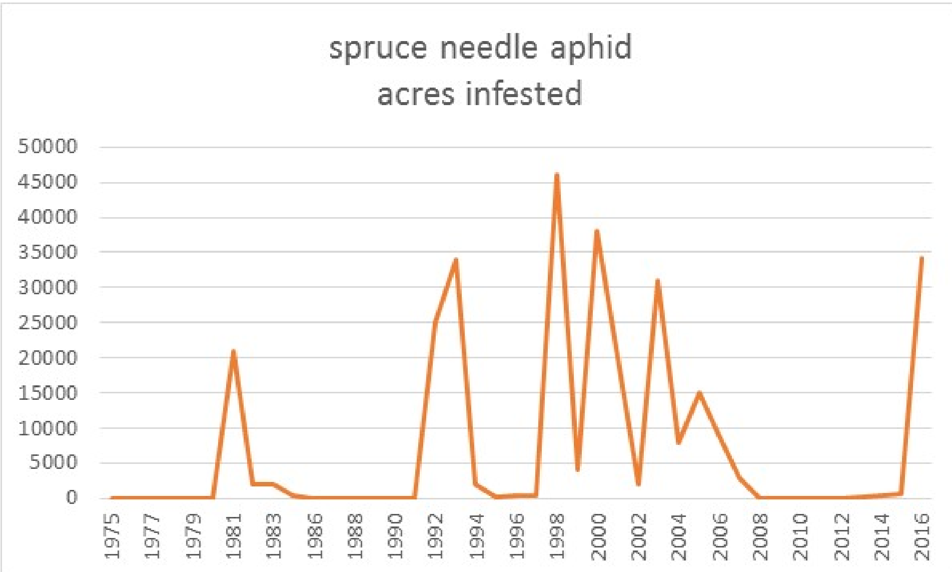


Figure 1. Area (acres) infested by spruce aphid statewide from 1975 to 2016

During the next decade or two, spruce aphid populations are expected to track with or coincide with above average ambient freezing and winter temperatures. They will probably show patterns similar to its infestation history in southeast Alaska where infestations have occurred irregularly: in 1981, 1993, 1998, 2000, 2003, and 2005 (see figure 1). Infestations will probably occur in late winter and spring should winter temperatures remain above freezing and minimum ambient temperatures are above -14° C (6.8° F) to -7° C (19.4° F). In 2016, temperatures across the Kenai Peninsula were considerably lower than in 2014-15 and 2015-16. As a consequence, aphid quantities are expected to be much lower and their spread into new locations would be restricted during 2017. Nonetheless, the aphid has established a widespread presence in coastal areas of the Chugach National Forest, allowing populations of this pest to increase when winter conditions are mild. Furthermore, trees stressed by spruce aphids may become more vulnerable to spruce beetle attack. Beyond 2017, outbreak years are nearly certain, but predictions are difficult.

Gemmamyces Bud Blight (*Gemmamyces piceae*)

Forest Health Protection (FHP) conclusively identified the fungal pathogen *Gemmamyces piceae* in Alaska in 2016 (see figure 2). *G. piceae* has not previously been reported in North America and is unlikely to be native. This pathogen has caused a massive outbreak of spruce bud blight disease in Central Europe. Since the Czech Republic outbreak began in 2009, frequent and rapid tree mortality has resulted from 70 to 80 percent bud loss. In Alaska it was first detected in 2013, although it was likely present for some years. As of 2016, the pathogen has been documented at several locations near Anchorage (Far North Bicentennial Park, Little Campbell Lake, and Kincaid Park), seven locations on the northern and western Kenai Peninsula (near Hope, Kenai, Clam Gulch, Ninilchik, Anchor Point, Homer, and Kachemak City), and one location in Fairbanks west of the university (see map 4).

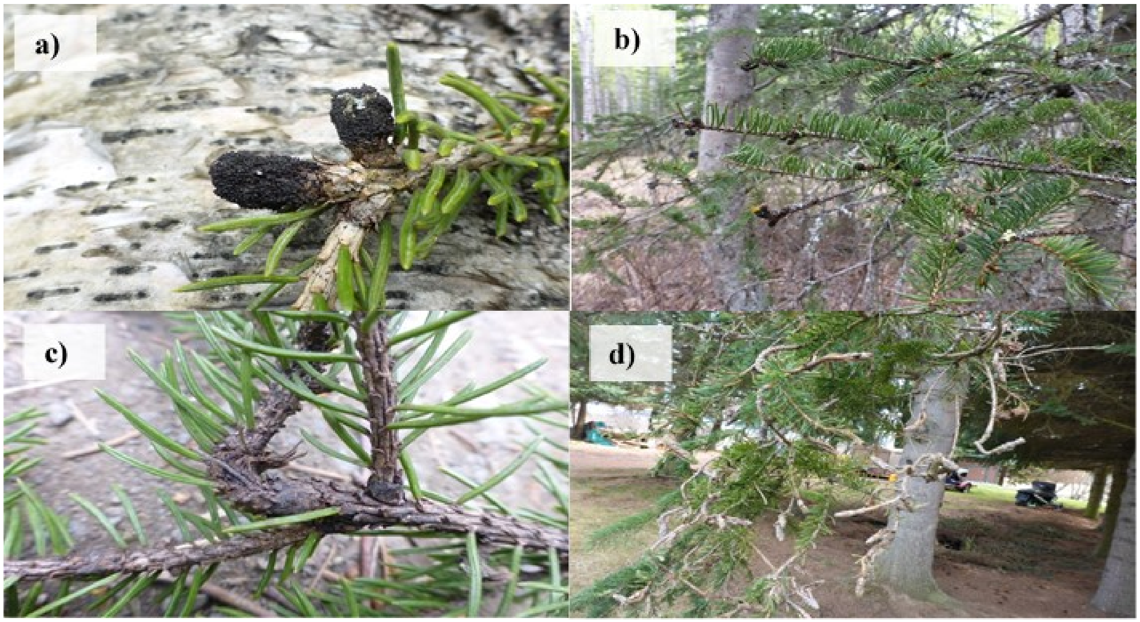
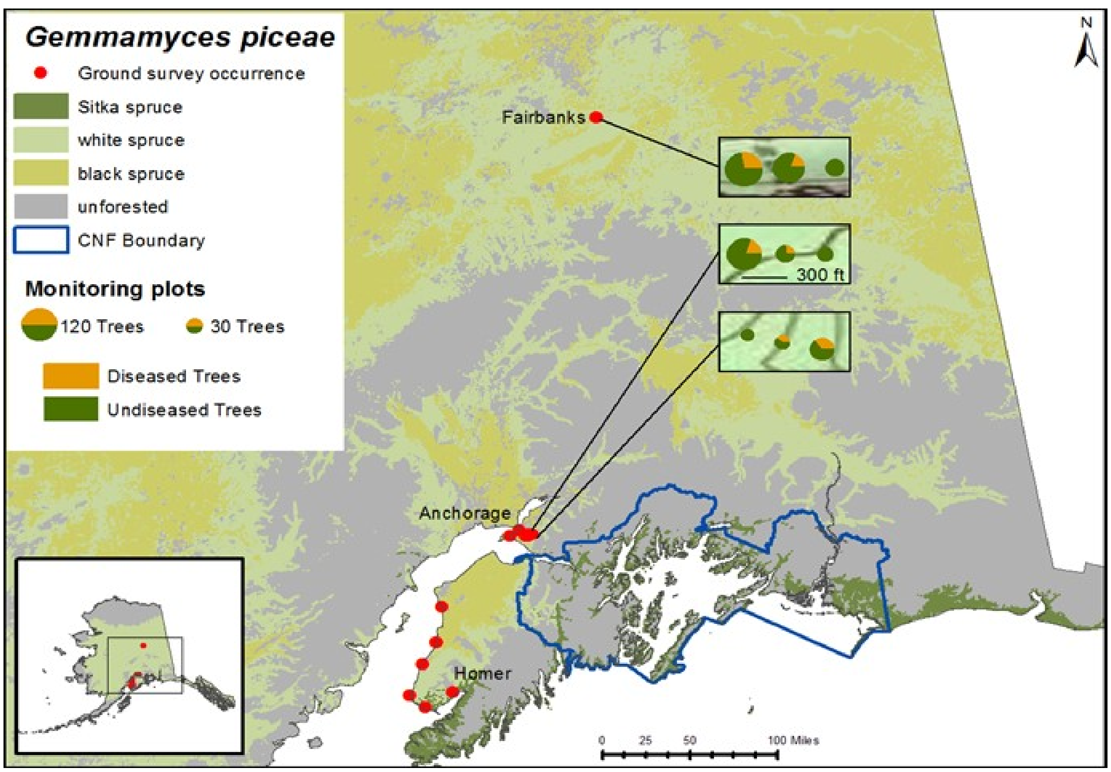


Figure 2. Gemmamyces bud blight of spruce in Alaska: a) fruiting bodies of the causal fungus Gemmamyces piceae, b) black, swollen, misshapen spruce buds with fruiting bodies, c) deranged growth on white spruce in the forest near Anchorage, and d) deranged growth on ornamental Colorado blue spruce near Homer.



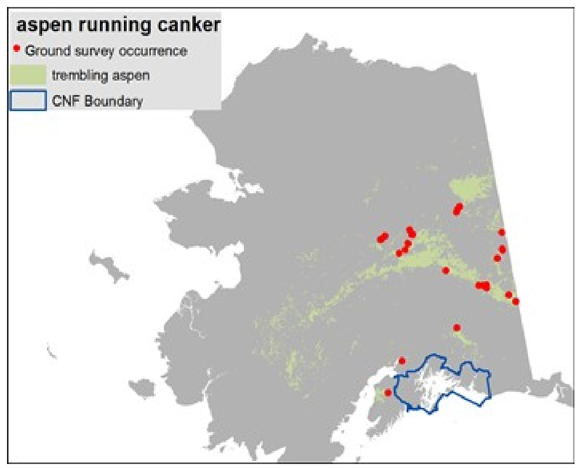
Map 4. Gemmamyces bud blight monitoring survey in 2016. The three inset boxes show the enlarged locations of three fixed radius monitoring plots. Pie chart size is relative to the number of spruce trees within a plot and colors represent the proportion healthy and diseased trees in a plot.

Within the national forest, white, Sitka, and black spruce have been affected, and Colorado blue spruce in ornamental settings. Forest Health Protection began installing monitoring plots at these known locations in 2016. Preliminary analysis found that damaged buds affected up to 40 percent of the trees within plots. Most diseased trees had very few damaged buds (less than five percent), but highly infected trees can have up to 100 percent of the buds dead or damaged. Mortality in Alaska has not yet been attributed to this disease; however, close monitoring is critical. An intensive plot based detection survey along the major road systems of southcentral and interior Alaska will commence in 2017.

Although the fungus has not been found within the Chugach National Forest, it seems very likely it is present, because it is either a cryptic native or has been introduced via live Colorado blue spruce ornamental trees and subsequently spread into native spruce species. Due to environmental similarities with the Czech Republic, Cerny et al. (2016) posited that the introduction of *G. piceae* to the native range of Colorado blue spruce in North America could cause extreme losses. However, a recent paper (Jaklitsch and Voglmayr 2017) made an apparently unsupported claim that it is widespread in North America. Given that this pathogen is capable of growth and reproduction in cold temperatures, it is expected to continue its spread into native forests during the next decade or two.

Aspen Running Canker (unknown fungus)

Figure 3. Trembling aspen along the Taylor Highway killed by a running canker disease that runs the length of tree boles.



Map 5. Locations where running aspen canker has been found in ground surveys (2014-2016)

The most damaging aspen disease in Alaska is an aggressive running canker (localized dead and dying cambium) of undetermined etiology. Since 2014 more than 30 locations throughout southcentral and interior Alaska have been mapped (see map 5). Vertically elongated cankers run along the bole and can girdle and kill trees within a single season (see figure 3). Although sometimes colorfully orange (a common aspen stress response), the cankers are usually subtle in appearance and may be slightly sunken. Large numbers of dead aspen can often be seen from the road system of interior Alaska.

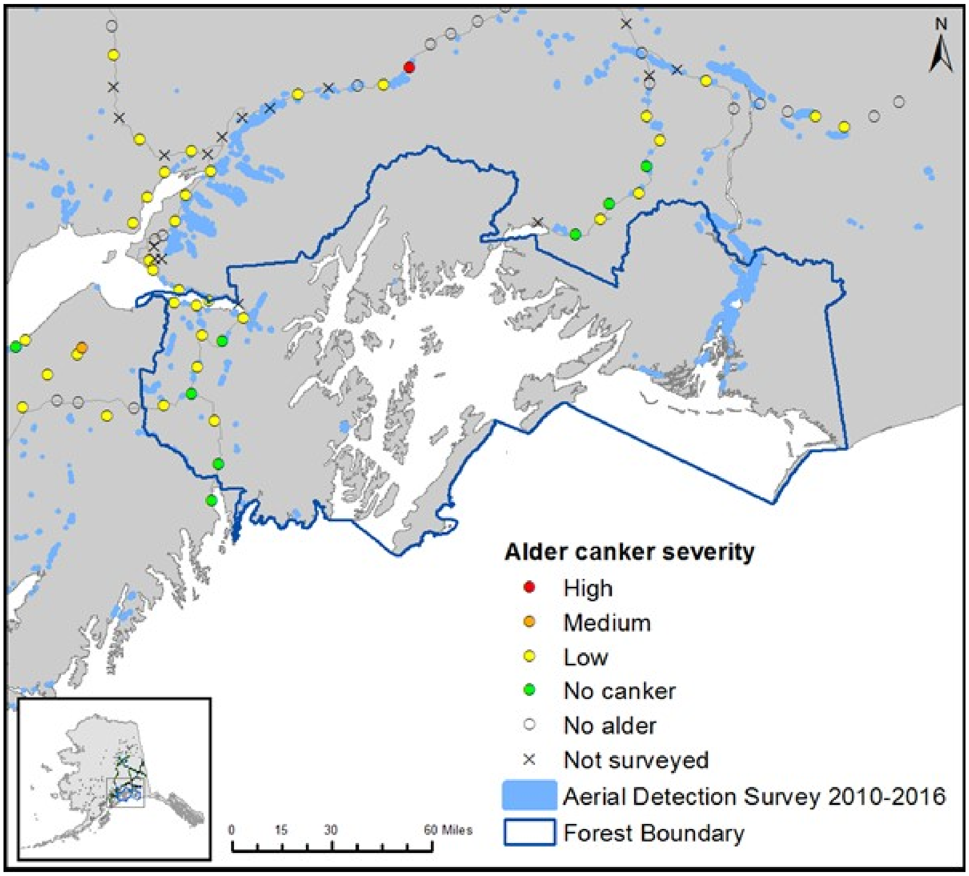
The Bonanza Creek Long Term Ecological Research Regional Site Network (BNZ LTER) in interior Alaska inventoried all permanently tagged aspen trees within intermediate-aged stands (40 to 60 years old) in 2015 and 2016. Across stands, up to 65 percent of aspen trees had canker, and most of those trees were dead. The percent incidence in live trees is suspected to be conservative given the difficulty in detecting canker within the upper canopy and the extended latent phase of most diseases. More mesic (wet) stands tended to have higher incidence of canker than those on drier soils. All of the sites containing aspen had canker on smaller diameter trees. However, larger diameter trees were cankered primarily at sites with greater disease incidence. Up to 50 percent of the aspen biomass within these stands is infected with canker.

Whether this large amount of aspen mortality is a sudden phenomenon, has been slowly increasing, or remains in a static state is unknown. The BNZ LTER is well positioned for studying these dynamics during the next several decades. Although this canker disease has only been found at one location within the Chugach National Forest, it may well be present in nearly all aspen stands. In collaboration with the University of Alaska Fairbanks, FHP is inventorying aspen stands across the road-accessible southcentral and interior Alaska, including within the national forest. During the next couple of decades, it is anticipated that loss of aspen canopy in intermediate-aged stands in the interior will release white and black spruce growing in the understory. Most of these stands are mixed conifer/hardwood, and spruce is currently limited by shade and snowshoe hare browsing. Release of spruce will ultimately reshape stand structure and ecosystem function. Without canker, aspen abundance on the landscape has been expected to increase with a shift in the fire regime towards larger, more severe fires that burn through organic layers and expose mineral soil. This would create a more favorable substrate for hardwood seedling establishment. However, if the current canker outbreak persists, the successional dynamics of these post fire stands is uncertain, particularly on drier slopes where aspen dominates (rather than birch, which dominates in wetter soils).

Alder Canker (*Valsa melanodiscus Otth. Valsalnicola* spp.) and Other Fungi

Alaska's aerial detection survey has mapped alder branch dieback and whole stem mortality on more than 44,590 cumulative acres within the Chugach National Forest since 2010 (see map 6). Most of the affected acreage has been mapped on thinleaf alder (*A. incana* subsp. *tenuifolia*) near river floodplains. However, many acres of dieback have been found on Sitka (*Alnus viridis* subsp. *sinuata*) and Siberian (*A. viridis* subsp. *fruticosa*) alder species up to two miles from riparian areas and 1,500 feet elevation. The incidence of dieback on Sitka alder on the Kenai Peninsula has increased in the past four years.

Severe dieback was first noticed in 2003, and in 2006, a statewide plot-based survey was implemented on the road system. In 2016, FHP resurveyed those plots using the same methodologies, with minor modifications (see figure 4). Eleven of the 192 plots were measured within the Chugach National Forest and the results largely agreed with the statewide survey. Considering the Chugach National Forest only sites, canker was found in 73 percent of plots with alder in 2016, compared to 43 percent in 2006. Due to difficulty distinguishing Sitka alder (*Alnus viridis* subsp. *sinuata*) from Siberian alder (*A. viridis* subsp. *fruticosa*), these two subspecies were combined for data analysis. Canker incidence on *A. viridis* increased nearly threefold; only about 27 percent of the plots with this host are now canker-free compared to 71 percent in 2006 (see map 6). Only two plots harbored thinleaf alder (*A. incana* subsp. *tenuifolia*) in 2016; one of them was canker-free while the other had a low level of canker.



Map 6. Alder canker on alder species mapped by aerial and ground surveys. The aerial detection survey measured approximately 44,590 acres of alder canker between the years 2010 and 2016. Ground plots were measured in 2016 every 10 miles on over 3,000 miles of major roads of southcentral and Interior Alaska. Eleven plots were measured on the Chugach National Forest.

Figure 4. Number of plots on the Chugach National Forest with cankered stems of *Alnus incana* subsp. *tenuifolia* (thinleaf alder) and the *A. viridis* subspecies *sinuata* (Sitka alder) and *fruticosa* (Siberian alder) found in road surveys conducted in 2006 and 2016. High=61-100 percent infected stems, Medium= 31-60 percent, Low=1-30 percent.

Dieback is usually due to girdling cankers (localized dead and dying areas) caused by the fungus *Valsa (Cytospora) melanodiscus*, although several other fungi cause very similar cankers. Initially caused by airborne spores, cankers can grow rapidly. As the pathogen kills the phloem, cambium, and outer xylem it partially or completely girdles branches and/or main stems. Sprouting is common below dead tissue. The fungi that cause alder canker are presumably native and usually relatively benign fungi for which conditions have changed to their advantage.

Dieback symptoms on thinleaf alder have been reported since the late 1980s in northeastern Oregon and the southern Rocky Mountains (Worrall 2009). Evidence suggests that water stress due to climate warming is linked to increased alder canker incidence and severity (Worrall et al. 2010; Ruess et al. 2009; Rohrs-Richey et al. 2011). This may explain why these presumably native pathogens have caused unprecedented damage in the past decade. In addition, canker mortality is greater on thinleaf alder stressed by defoliation from the invasive insect, green alder sawfly (*Monsoma pulveratum*), first found in Alaska in 2004. During the next decade or two the expected increasing temperature trends are conducive to making an already severe epidemic even more damaging. Continued alder mortality poses a considerable threat to areas that are dependent on alder for its nitrogen-fixing contribution to soil nutrition. In early successional floodplains that are densely populated by thin-leaf alder, high disease severity will quickly reduce total ecosystem nitrogen inputs. Changes in successional processes and ecosystem function are expected over the long term (Nossov et al. 2011). Permanent removal or reduction of thinleaf alder from riparian ecosystems on a landscape scale would profoundly affect long term nutrient cycling and forest productivity, aesthetic value, and allochthonous inputs to rivers and streams.

Conclusion

Based on current models, the climate in Alaska is predicted to change, and with this change the long term patterns of both temperature and precipitation are impacted. Climatic patterns of temperature and precipitation influence the distribution and abundance of both insect and pathogen populations, and their hosts. The Chugach National Forest has diverse and abundant insect and pathogen communities that directly or indirectly affect forests through herbivory, pathogenesis, decomposition, defoliation, deformation, and sometimes mortality. These agents will be impacted by future changing climatic conditions, but in what ways and by how much is difficult to predict, although incidence, severity, and distribution of some insects and pathogens may increase under a climate warming scenario, this is not true for all. However, these parameters for insects, pathogens, and their hosts will change over space and time, and the interactions amongst each other will be altered. Rapidly expanding literature on insect and pathogen climate interactions worldwide clearly demonstrates the challenges and uncertainty in predicting future trends for any particular species. The insects and pathogens now resident within the Chugach National Forest are no exception.

Current and Potential Future Climate

The Chugach National Forest occurs within two climate regions: the Cook Inlet and the Southcentral regions (Shulski and Wendler 2007). The Cook Inlet climatic region, which occurs on the leeward side of the Chugach Mountains and across much of the Kenai Peninsula, represents a subarctic area of transition between maritime and continental climate. Temperatures are moderate compared to regions to the interior north, precipitation is substantially less than in maritime regions, and the growing season is longer than 100 days at lower elevations. The Southcentral climatic region, which includes most of the Chugach National Forest, is under a strong maritime influence with high annual precipitation, very frequent cloud cover, and moderate temperatures (Shulski and Wendler 2007). Both regions experience highly variable weather among years, particularly with respect to the timing and amount of precipitation and the depth of snowpack at low elevations. This variability is a consequence of variation in broad scale ocean circulation patterns and the proximity of the Chugach National Forest to the Gulf of Alaska. Both the Pacific Decadal Oscillation (PDO) and El Niño-Southern Oscillation (ENSO) influence year-to-year variation in weather for this portion of Alaska more than in northern and interior regions. Consequently, the climate of the plan area is highly variable from year to year and decade to decade.

In general, the Chugach National Forest experiences short, cool summers and long winters. Cloud cover is frequent through the summer, particularly after mid-June, and temperatures rarely exceed 26.7° C (80° F). Winter snowpack, even near sea level, can extend from October through May. Winters have periods of deep cold but also periods with temperatures well above freezing. Extensive coastline, in combination with complex topography resulting from mountain ranges extending north-south and east-west, results in extremely complex weather patterns and a mixture of continental and maritime influences. Precipitation, snowpack, and temperature maps in Blanchet (1983), along with climate descriptions in Davidson (1996) and DeVelice et al. (1999), and climate statistics in Shulski and Wendler (2007) provide detail regarding differences in climate among portions of the Chugach National Forest.

In the Kenai Mountains, the climate is transitional between maritime and continental, with mean annual temperatures of 3.9° C (39° F) at low elevations and -6.7° C (20° F) at upper elevations. The annual precipitation ranges from 50 to 200 centimeters (20 to 80 inches) with a mean maximum snow pack of 50 to 300 centimeters (20 to 120 inches), depending on elevation and location. Climate data at the Cooper Lake Hydroelectric Project weather station on the Kenai Peninsula shows a decline in monthly precipitation from January through June followed by an abrupt increase in precipitation from July through September. There is a brief period of relative drought in June. This dry period reduces fuel moisture and increases fire frequency in the Kenai Mountains.

Storm tracks tend to move in a counterclockwise pattern from the Gulf of Alaska into Prince William Sound, resulting in abundant precipitation and cool, but not cold, temperatures throughout Prince William Sound. The lands around Prince William Sound feature mean annual temperatures ranging from 4.4° C (40° F) at shoreline to zero degrees C (32° F) at upper elevations. Mean annual precipitation ranges from 200 centimeters (80 inches) at sea level to over 760 centimeters (300 inches) at some upper elevations. The mean maximum snow pack ranges from 150 to 400 centimeters (60 to 160 inches) depending on location and elevation. Precipitation at the Main Bay weather station exceeds 200 millimeters (8 inches) for each month.

In the Copper River Delta area, mean annual temperature varies from 1.1° C (34° F) to 5.6° C (42° F). Average precipitation ranges from 200 centimeters (80 inches) at the seashore to 500 centimeters (200 inches) further inland. The mean maximum snowpack ranges from 25 to 200 centimeters (10 to 80 inches) with depth increasing with distance from the seashore. Strong continental winds, which drain the Alaska interior in the winter, flow out of the Copper River Canyon, cooling this area. Climate at the Cordova Federal Aviation Administration weather station is similar in overall pattern to Main Bay in western Prince William Sound. However, monthly precipitation at the Cordova Federal Aviation Administration weather station ranges between 125 to 450 centimeters while it is between 250 and 650 centimeters at Main Bay, demonstrating increased precipitation further in Prince William Sound.

The northern portion of the national forest represented by the high Chugach and Saint Elias mountains, features cold, wet summers and winters. Annual precipitation occurs mainly as snow at elevations above 2,500 meters (8,000 feet). Snow accumulations range up to 800 centimeters (320 inches) annually.

The southern and eastern coasts of the Kenai Peninsula have a maritime climate characterized by heavy precipitation falling as snow in the higher altitudes (up to 10 meters on the ice fields). The

Kenai Mountains create a partial rain shadow for the eastern, particularly northeastern Kenai Peninsula (Ager 2001).

Long Term Trends

The current physical and ecological characteristics of the Chugach National Forest reflect incredible geological and physical disturbance that results, in part, from directional climate change over thousands of years. The transition of the region from almost complete ice cover to the current interglacial condition resulted in the steady colonization of exposed land by plants and animals and the migration of biota through the region; these processes still occur today (Ager 2001; Ager et al. 2010). A brief overview of the change experienced in the region over the past 10 or more millennia provides important context from which to consider climate change in the next half century.

At the last glacial maximum, approximately 20,000 years ago, the vast majority of the Chugach National Forest was under a vast ice sheet. Hence, the current topography and vegetation represents the outcome of climate warming and resulting glacial retreat followed by species recolonization. During the last 14,000 years, directional change of receding glaciers and vegetation establishment dominated the region and continues today. These directional processes began earlier on the western Kenai Peninsula than around Prince William Sound. Deglaciation progressed in Prince William Sound sufficiently enough to expose low-lying areas by 9,000 years before present, resulting in colonization by tundra (Heusser 1983). Conifers first become apparent about 2,700 years before present throughout Prince William Sound. By 2,000 years before present, coastal rainforest species (e.g., western hemlock and Sitka spruce) developed into forest communities (Heusser 1983).

The transition from Pleistocene ice-cover to contemporary conditions was not completely unidirectional. Periods of glacial advance occurred 3,200 and 2,500 years before present and again quite recently with the little ice age, resulting in glacial advances and subsequent retreat (Jones et al. 2009). While not as obvious in the glacial record, significant warm periods occurred. Patterns of high temperatures during the Medieval Warm Period (about 950 to 1100 a.d.) appear similar to that of the late twentieth century (1961 to 1990) and the rate of temperature increase was comparable to that of the past couple decades (Mann et al. 2008).

Long-term warming associated with the global interglacial over several thousand years in this region has been complemented by further climatic forcing associated with human activity (Shulski and Wendler 2007; Wendler and Shulski 2009; IPCC 2014; Bieniek et al. 2014). In general, during the past century, polar regions have warmed more substantially than the rest of the earth, in part due to reduction in snow and ice cover in the arctic (Shulski and Wendler 2007). During the twentieth century, much of Alaska warmed twice as rapidly as the global average (Chapin et al. 2014; Stewart et al. 2013; Wendler and Shulski 2009). The pattern of warming is far more pronounced in winter and spring than in autumn. Examining the Cook Inlet climate region (one of the climate regions intersecting the Chugach National Forest) during the past century, average annual temperature was 1.3° F (0.7° C) higher (Shulski and Wendler 2007). Average temperature in January and February during this period was 3.1° F higher than a century earlier (NOAA 2017). Warming during the past century was accompanied by an array of associated changes, such as extension of the growing season, fewer extremely low temperatures in the winter, and more extreme high temperatures in the summer. The pattern of warming is complicated, however, by short and intermediate-term variation in sea surface temperatures that influence climate for much of the North Pacific leading to year-to-year and decade-to-decade variation in weather. The Pacific Decadal Oscillation (PDO) and El Niño-Southern Oscillation (ENSO) are two recognized patterns contributing to the variation (Hartmann and Wendler 2005).

Potential Future Climate

Predicting future climate conditions is difficult and results in uncertainty. Employing multiple scenarios or descriptions of potential futures based on differing assumptions is a common approach to provide insights to future climate (Knapp and Trainor 2013; Peterson et al. 2003; Rickards et al. 2014). Scenarios Network for Alaska and Arctic Planning produced a set of downscaled climate projections based on a subset of global circulation models from the Intergovernmental Panel on Climate Change (IPCC) that have been shown to model climate in Alaska most effectively. Scenarios Network for Alaska and Arctic Planning used mean (composite) outputs from five global circulation models and examined outputs based on midrange (A1B) and more pessimistic (A2) predictions of GHG emissions. Based on the downscaled modeling specific to the Chugach National Forest, Scenarios Network for Alaska and Arctic Planning summarized results to describe two scenarios. Summaries of these analyses follow, concentrating on the results from A1B when making reference to an individual scenario. More detail can be found in Fresco and Floyd (2017).

Most climate models predict that high latitudes will experience a much larger rise in temperature than the rest of the globe over the coming century; however, the coastal location of the Chugach National Forest in a region with complex weather patterns and tortured topography results in patterns of change dissimilar to arctic Alaska (SNAP 2015). While characteristics of future climate will be presented as average conditions, the expectation for high variability remains.

Temperature

Temperature profiles are expected to warm by about 3° C (5° F) in the next 50 years. Areas with July temperatures below freezing are unlikely to undergo significant glacial melting, although it should be noted that daily highs will exceed mean values, and that direct solar radiation can drive effective temperatures above recorded air temperature.

Winter temperature change is expected to be more extreme. Average temperatures in the coldest month of the year are predicted to rise from only slightly above freezing in the warmest coastal areas to well above freezing, or approximately 4.5° C (40° F). Moreover, these warm temperatures will spread inland toward Cordova, Valdez, Seward, and to some areas as much as 20 miles inland, with above-freezing Januaries dominating across all coastal regions of the Chugach National Forest. Portions of many river basins will shift from a below-freezing to above freezing temperature regime. Across the region, winter warming is expected to be approximately 3° to 3.5° C (4.5° to 6° F). While the greatest impact of summer warming may be in the coldest regions of the national forest, where snow and glaciers will be most influenced, the greatest winter impacts may be in the warmest coastal and near-coastal regions, where a shift is underway between winters with seasonal mean temperatures below freezing to winters with the mean temperature across December, January, and February above freezing. Although this shift does not preclude significant frost and snowfall, it does imply a change in the duration and prevalence of snowpack and ice.

Areas with mean January temperatures above freezing may still experience days or even weeks of freezing temperatures, and daily lows are likely to be significantly cooler than mean values. However, it is unlikely that significant ice formation would occur in such areas, particularly given the fact that sea water freezes at approximately -2° C (28° F) rather than at zero degrees C (32° F). For brackish water, intermediate freezing temperatures are the norm.

Precipitation

The projected decadal trend is toward greater precipitation in both January and July. However, model predictions for precipitation are less robust than those for temperature, in part because precipitation is intrinsically more geographically and temporally variable. In addition, while precipitation is predicted to increase, inferring the hydrologic status of soils, rivers, or wetlands based on this greater influx of water is problematic. Increases in temperature (and associated changes in both snowpack and evapotranspiration) may more than offset increases in precipitation, yielding a drying effect. Changes in seasonality and water storage capacity can also affect hydrologic balance. Furthermore, a shift in the percentage of precipitation falling as snow can drastically alter the annual hydrologic profile. While current models do not examine storm frequency, the literature suggests increases in the frequency and severity of storms in the Gulf of Alaska and Bering Sea (Graham and Diaz 2001; Terenzi et al. 2014).

Season Length and Freeze / Thaw Events

Across the national forest, date of thaw in the spring is expected to come earlier. Large areas of coastal and near-coastal land are projected to shift from early spring thaw to the rarely freezes category. This is likely to correspond with a lack of winter snowpack and an altered hydrologic cycle. Primarily frozen areas are expected to become far less extensive at sea level. Further from the coast and at higher elevations, changes are projected to occur as a shift of three to 10 days, on average. For example, the A2 scenario (greater GHG emissions) shows spring thaw occurring in Soldotna and Kenai around April 4 in the current decade, but in late March by the 2060s.

Autumnal changes are, overall, projected to be slightly greater than those in the spring, with the date the running mean temperature crosses the freezing point shifting noticeably later in just a single decade. Major changes in warm season length include incursion of the rarely freezes zone as far as 20 miles inland; an increase from about 200 days to about 230 days for Palmer, Anchorage, Wasilla, and Kenai; and an even more substantial increase for Seward, Valdez, and Cordova.

Snow and Glacier Conditions

The following summarizes scenarios describing the status of snow and characteristics of glaciers, as examined in Littell et al. (2017).

Temperature and precipitation are key determinants of snowpack. Therefore climate change will affect the role of snow and ice in the landscapes and hydrology of the Chugach National Forest region. Modeling snow depth from downscaled climate models is extremely difficult. Therefore, snow-day fraction (the proportion of days when it precipitates where snow is expected to fall) and snow water equivalent (the water yield from existing snowpack) are useful approaches to develop scenarios to understand snowpack.

Snow-day fraction and snow water equivalent are projected to decline most in late autumn (October to November) and at lower elevations. Snow-day fraction is projected to decrease 23 percent from October to March (the winter period), between sea level and 500 meters elevation. From sea level to 1,000 meters, the snow-day fraction is projected to decrease by 17 percent between October and March. Averaged across the cool season, snow water equivalent is expected to decrease at elevations below 1,000 meters due to increased temperature, but increase at higher elevations due to increased precipitation. Compared to 1971 to 2000, the percentage of the landscape that will be snow dominant in 2030 to 2059 is projected to decrease and the percentage where rain and snow are codominant (transient hydrology) is projected to increase from 27 to 37 percent. Most of this change will be at lower elevations.

Glaciers in the region have been losing mass during the past century; however, the dynamics of glaciers, particularly whether they advance or retreat at a particular time, is extremely complex (Littell et al. 2017). Glaciers in the region are currently losing about six cubic kilometers of ice per year, and half of this loss comes from Columbia Glacier (Berthier et al. 2010). During the past decade, almost all glaciers surveyed within the Chugach National Forest are losing mass (with one exception), including glaciers that have advancing termini (Larsen et al. 2015). In the future, glaciers not calving into the ocean will retreat and shrink at rates equivalent or higher than the current rates of three meters per year at their termini (Larsen et al. 2015). As an example of the potential rate of glacier retreat, Columbia Glacier will likely retreat another 15 kilometers and break into multiple tributaries during the next 20 years before stabilizing. Other tidewater glaciers have uncertain futures, but will likely not advance significantly in the coming decades.

Land Status and Ownership

This analysis focuses on land status and ownership within the Chugach National Forest boundary. In 1892, President Benjamin Harrison designated the first Federal forest reserve in Alaska, the Afognak Forest and Fish Culture Reserve. A 1907 presidential proclamation created the Chugach National Forest and a 1908 executive order combined the Chugach National Forest with the Afognak Reserve.

Significant changes in ownership patterns followed enactment of the Alaska Statehood Act in 1958 and the Alaska Native Claims Settlement Act (ANCSA) in 1971. These acts provided land selection rights to the state and to ANCSA Corporations, and many lands within the national forest were selected for conveyance. In 1980, the Alaska National Interest Lands Conservation Act (ANILCA) changed the boundary of the Chugach National Forest and added lands on the Copper River Delta.

After the 1989 *Exxon Valdez* oil spill in Prince William Sound, the Forest Service acquired the surface estate of many large private parcels within the spill area, as well as thousands of acres of conservation easements, to provide for the recovery of natural resources affected by the oil spill.

Definitions Specific to this Analysis

Conveyance: A transfer of legal title to land. This is more accurately described in table 12.

Partial interest: Ownership of some portion of the ownership rights to real estate, such as rights of way, mineral rights, and conservation easements.

Alaska Native selections: The ANCSA established a system for settling Alaska Native land claims through transfer of public lands. Pursuant to the ANCSA, Alaska Native Corporations (ANCs) can select lands from within the Chugach National Forest boundary.

Dual selected lands: Lands where more than one Alaska Native Corporation and/or the State of Alaska have selected the same lands.

Overselected lands: Alaska Native Corporations have been allowed to select up to 25 percent more lands then their entitlements in order to ensure they receive their full entitlement after all selections have been adjudicated.

State selections: Pursuant to the Alaska Statehood Act of July 7, 1958, the State of Alaska is entitled to select lands from within the Chugach National Forest boundary.

Outstanding and reserved mineral rights: Outstanding mineral rights are those rights owned by a party other than the surface owner at the time the surface was conveyed to the United States. There is usually no contractual or other legal relationship between the United States and the owner of outstanding mineral rights. Reserved mineral rights are those rights held by the surface owner at the time the surface was conveyed to the United States. The deed typically details the rules and regulations required for the holder to exercise the reserved mineral rights.

Conservation easement: A legally binding restriction placed on a parcel of land to protect its associated resources. Conservation easements protect land for future generations while allowing owners to retain many private property rights and to continue to use the land under the terms of the conservation easement.

Methodology

Spatial Scale

All land within the Chugach National Forest.

Temporal Scale

The 15-year plan period.

Affected Environment

In addition to guidance contained in planning documents, the management of public lands within the plan area is determined by documents associated with the establishment or designation of those lands for a particular purpose (proclamations, legislation, or executive orders), or by documents associated with the acquisition of those lands or interests from a private landowner (e.g., a patent or deed). In general, land status of both public and private lands within the plan area is largely informed by the terms of the land conveyance document. For example, the approximately 101,662 acres purchased by the Forest Service after the *Exxon Valdez* oil spill are managed, pursuant to the deeds, for purposes associated with restoration and certain restrictions apply to their use. The conveyance documents for certain lands and interests in lands that were once part of the NFS (NFS) but have since been transferred to state or private ownership similarly contain special terms that affect land status (e.g., public access easement reservations).

Ownership

Within the boundary of the Chugach National Forest, approximately 5,415,148 acres are NFS lands (national forest, national forest with outstanding and reserved mineral rights, and any lands currently under selection but not yet conveyed) and approximately 840,504 acres are owned by other individuals or entities. Other major landowners include the State of Alaska, ANCSA regional and village corporations, the Alaska Railroad, municipalities, cities, towns, and private individuals. The land status map in the map package displays the land status and ownership within the boundary. Table 12 displays the acreage, status, and ownership of lands within the national forest.

Statehood and Alaska Native Claims Settlement Act (ANCSA) Conveyances

Some NFS lands within the Chugach National Forest have been selected by tribal entities or the State of Alaska and are being transferred to State or private ownership as a result of the Alaska Statehood Act and the ANCSA. The national forest experienced a net decrease between 2002 and 2016 of nearly

18,512 acres of NFS lands due, in part, to conveyances authorized by the Alaska Statehood Act and the ANCSA. Special land status is accorded to NFS lands selected by the State or Alaska Native regional or village corporations under these acts during the interim period between selection and conveyance. For example, the State's concurrence is required before the Forest Service may authorize certain activities on NFS lands selected by the state.

Ownership of the surface and subsurface estate is split for certain lands within the plan area as a result of the transfer of ANCSA selections and other conveyances and acquisitions that affect only the surface or subsurface estate. In some cases, the subsurface estate is owned by another party while the surface is part of the NFS and is administered by the Forest Service. As of February 2017, the subsurface estate of approximately 116,876 acres of NFS lands within the plan area was owned by other entities.

Table 12. Acreage by land status and ownership within the Chugach National Forest boundary

Ownership	Acres
Federal/Forest Service administered[1]	5,415,148
State conveyed	407,359
Native Corporations conveyed[2]	421,796
Municipality, city, town, or private	11,349

Source: Chugach National Forest GIS database

NOTE: Differences between these numbers and those in the 2002 Forest Plan FEIS are due to refinement of GIS mapping, land conveyances, and ownership adjustments. Acreages will continue to change due to continuous adjustments and updates.

1 - Includes lakes surrounded by forest lands without a navigability determination, surface estate on lands with split estate or reserved minerals rights, and shoreline areas that are in deferred ownership agreement with the State of Alaska.

2 - Native Corporations include Chugach Alaska Corporation (CAC), Cook Inlet Region, Inc. (CIRI), Chenega Corporation (Chenega), The Eyak Corporation (Eyak) and Tatitlek Corporation (Tatitlek)

Partial Interests

Various owners hold partial land interests within the plan area, such as mineral rights or conservation easements. Since the *Exxon Valdez* oil spill in 1989, the Forest Service has acquired conservation easements and timber conservation easements affecting thousands of acres of land from Native village corporations for the purpose of restoring resources injured by the spill. On lands affected by the timber conservation easements, the landowner generally retains all rights of surface ownership, except for the right to harvest timber. On lands affected by the conservation easements, uses of the property that will materially impair or interfere with its conservation values are prohibited.

Rights-of-way and easements affect both private and public lands throughout the plan area. The Forest Service has reserved or acquired rights-of-way needed for public access and has granted private or other public entities rights-of-way for access across NFS lands.

Condition and Trends in Land Status and Ownership

Ongoing implementation of the Alaska Statehood Act and the ANCSA continues to change land status and ownership patterns within the plan area. While the Forest Service seeks to consolidate NFS lands where possible, to reserve or acquire public access easements where needed, and to include terms and conditions associated with the conservation of ecological resources where appropriate, opportunities for consolidation of NFS lands are limited by a lack of willing sellers and ongoing conveyances.

Environmental Consequences

No indirect or cumulative environmental consequences to land status are anticipated to result from any of the alternatives. Land conveyances will continue to change the land status and ownership within the Chugach National Forest boundary; however, these landownership adjustments will not be affected by any of the alternatives.

Social and Economic Contributions

Introduction

The Chugach National Forest plays an integral role in the social and economic fabric of southcentral Alaska. This section provides an overview of socioeconomic measures, such as population change, income, employment, and demographics. The economic contribution of the Chugach National Forest to the surrounding region is also presented. This section provides social and economic analysis, including past and current conditions and the environmental consequences of the four alternatives on the social and economic environment.

A significant focus of this section on social and economic contributions are the seven key ecosystems services: 1) water quantity and quality, 2) animals and plants as food and resources, 3) wood as a renewable energy and fuel source, 4) carbon sequestration and impacts of climate change, 5) recreation experiences, 6) education and research, and 7) sustaining biodiversity, and intact ecosystems and connectivity for global ecological processes. The discussion of these key ecosystem services helps guide the discussion and establish the connection between the national forest and human benefits.

Social, economic, and cultural sustainability was identified as one of the emphasis areas of management direction potentially needing change and is described under revision topic four in the purpose and need of the forest plan revision. Social, economic, and cultural sustainability of the Chugach National Forest is a stated goal of the proposed land management plan. The discussion of sustainability is woven throughout the discussion of each element, including the ecosystem services.

Methodology

Spatial Scale

The spatial scale for this analysis is consistent with the study area identified in the Chugach National Forest land management plan assessment (USDA 2014a). The spatial scale for the social, economic, and environmental justice analysis is southcentral Alaska and consists of (1) the Municipality of Anchorage, which includes Girdwood; (2) the Kenai Peninsula Borough; and (3) the Valdez-Cordova census area. These areas include the communities of Anchorage; Chenega Bay; Cooper Landing; Cordova, which includes Eyak; Hope, which includes Sunrise; Kenai; Moose Pass; Seward; Soldotna; Sterling; Tatitlek; Valdez; and Whittier.

The social and economic influence of the Chugach National Forest extends beyond the national forest boundary. Resource conditions and management decisions in each of the geographic areas may have a direct or indirect effect on social and economic conditions in different parts of the study area, as well as outside the study area. Communities within these geographic areas were recognized as having the strongest social and economic ties to the Chugach National Forest. While Chugach National Forest visitors travel from far and wide, residents of these three areas were identified as having stronger ties and are most likely to be affected by changes in national forest management because of their reliance on its resources to sustain the social, cultural, and economic well-being of their communities.

Temporal Scale

The temporal boundaries for the socioeconomic analysis extend 15 years, which is the proposed plan period. The measurable social and economic consequences of the action alternatives are expected to occur during this period.

Measurement Indicators

Table 13 lists resource indicators and measures for assessing effects.

Table 13. Resource indicators and measures

Resource Element	Resource Indicator	Measure	Addresses: Purpose and Need or Key Issue?	Source
Economic Contribution	Employment and income	Employment and income	No	IMPLAN 2009
Ecosystem services	Water quantity and quality	Human uses (qualitative evaluation)	Yes	USDA 2014a Water specialist report
Ecosystem services	Animals and plants as food and resources	Use and availability; qualitative evaluation	Yes	Forestry and Subsistence specialists reports
Ecosystem services	Wood as a renewable energy and fuel source	Use and availability; qualitative evaluation	Yes	Census 2016 Forestry specialist report
Ecosystem services	Carbon sequestration and impacts of climate change	Qualitative evaluation of social cost of carbon	Yes	Air quality specialist report
Ecosystem services	Recreation experiences	Recreation opportunity spectrum classifications; visitor use	Yes	Economic and Social Assessments (USDA 2014a) USDA 2016 Recreation specialist report
Ecosystem services	Education and research	Qualitative evaluation	Yes	Economic and Social Assessments (USDA 2014a) USDA 2016
Ecosystem services	Sustaining biodiversity, intact ecosystems and connectivity for global ecological processes	Qualitative evaluation	Yes	Economic and Social Assessments (USDA 2014a)

Analysis Methods and Assumptions

Economic contribution analysis is used to estimate how the Chugach National Forest contributes to regional employment and labor income. Economic contribution analysis evaluates direct, indirect, and induced effects using region-specific multipliers derived from input-output models. Input-output analysis is a means of examining the production and consumption relationships between different industries, services, businesses, government sectors, and consumers (e.g., households) within an economy. Economic contribution analysis allows one to examine the effect of a change in one or several economic activities on the economy for a region, all else being held constant.

The IMPLAN modeling system (IMPLAN 2009) was used to estimate the economic contributions of the Chugach National Forest in the forest plan assessment (USDA 2014a). These results are summarized in this section. IMPLAN multipliers are derived from cross-sectional data regarding employment, output, and expenditures from a single point in time that should be consistent with the period of time for activity data (e.g., IMPLAN multipliers should be based on 2008 data if recreational visit numbers are from 2008 surveys). Data used by IMPLAN to create economic impact models specific for the impact area surrounding the Chugach National Forest are compliant with the Data Quality Act (Section 515 of Public Law 106-554). The impact area is assumed to consist of the Municipality of Anchorage, the Kenai Peninsula Borough, and the Valdez-Cordova census area, consistent with the boundaries of the analysis area defined for assessing social, cultural, and economic conditions.

Affected Environment

The following sections describe the current conditions and trends related to the social and economic environment of the study area, including population and demographic changes, employment and income conditions, potential environmental justice populations, and non-market benefits and values. Ecosystem services are also evaluated in this report. This section draws from the forest plan assessment (USDA 2014a) conducted for the revision process. The information reported in the forest plan assessment has been updated when appropriate.

Population and Demographics

This section highlights population and demographic trends in the study area. Population is an important consideration in managing natural resources. In particular, population structure (size, composition, density, etc.) and population dynamics (how the structure changes over time) are essential to describing the consequences of national forest management on the social environment (Seesholtz et al. 2006).

Alaska is the nation’s largest state with 16 percent of the country’s land base. Although it is geographically large, Alaska has the third smallest population and the lowest population density in the country.

Within the study area, the Municipality of Anchorage, with just over 40 percent of the state’s total population, is the largest population center in Alaska. It is characterized by an urban economy and lifestyle, which is quite different from the smaller, rural communities in the Kenai Peninsula Borough and the Valdez-Cordova census area.

The Municipality of Anchorage has a majority of the population and businesses in the study area, a number of which may be affected by the Chugach National Forest. However, the potential impacts of the national forest on people in smaller communities within the study area may be more profound. For this reason, it is important to examine conditions and identify trends for the three regions in the study area individually.

Population Growth and Density

The study area population is approximately 366,000 as of 2015, with a majority in the Municipality of Anchorage (299,107) followed by the Kenai Peninsula Borough (57,221) and Valdez-Cordova census area (9,617) (Census 2016). The population of the Municipality of Anchorage has more than tripled since statehood in 1959. Figure 5 displays population trends from 1990 to 2015 for the United States, Alaska, and the study area. The Municipality of Anchorage's population increased by 32 percent (72,769 residents) between 1990 and 2015, similar to the population growth for Alaska over that time period, and slightly greater than for the United States. In contrast, populations grew by 40 percent (16,419 residents) for the Kenai Peninsula Borough and decreased by three percent (335 residents) in the Valdez-Cordova census area between 1990 and 2015.

Rapid population growth may signal expanding economic opportunities and/or desirable amenities. On the other hand, slow or negative population growth may signal an aging population (deaths exceed births) and low net migration (or out-migration). The population decline in the Valdez-Cordova census area is a result of net out-migration, rather than an aging population (Census 2016b). Forest Service management can affect both natural amenity provision and economic opportunities. Areas with large populations or rapid population growth are less likely to be acutely affected by Forest Service management, while areas with small populations or stagnant/negative growth are likely more vulnerable to Forest Service actions that may affect community appeal.

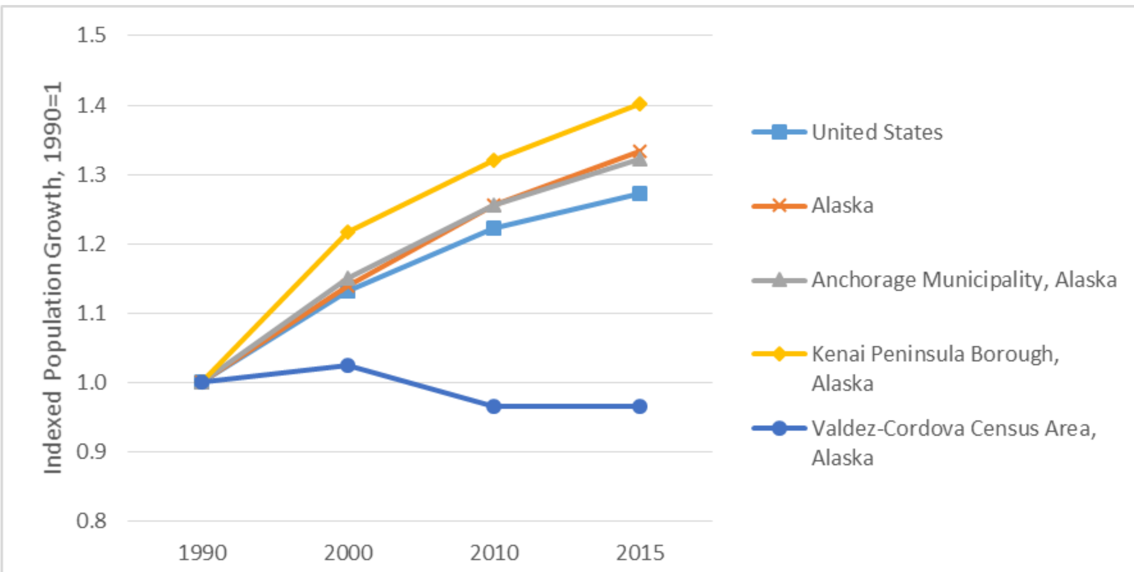


Figure 5. Population growth from 1990-2015 for the United States, Alaska, Anchorage, the Kenai Peninsula Borough, and the Valdez-Cordova census area (standardized for comparison)

Source: Census 1990, 2000, 2010; Census 2011-2015 American Community Survey 5-Year Estimates

Population density can serve as an indicator of a number of socioeconomic factors of interest: urbanization, availability of open space, socioeconomic diversity, and civic infrastructure (Horne and Haynes 1999). More densely populated areas are generally more urban, diverse, and offer better access to infrastructure. In contrast, less densely populated areas provide more open space, which may offer natural amenity values to residents and visitors.

With the exception of Anchorage, the State of Alaska is very sparsely populated (see table 14). Low population density often points to high levels of public ownership. Indeed, public lands account for 66 percent of the study area, including Forest Service, Bureau of Land Management, National Park Service, and Department of Defense administered lands. This compares to 28 percent nationally. An additional 19 percent of the planning area are State lands. That leaves only 15 percent of the planning area as private land (USGS 2016).

Table 14. Population density 2010

Area	People per square mile
Anchorage	171
Kenai Peninsula	3
Valdez-Cordova	<1
Alaska	1
United States	87

Demographics

Table 15 displays the study area's population distribution across five age categories in 2000 and 2014. Though the population of Alaska continues to be one of the youngest in the nation, the population is aging as baby boomers grow older. The population aged 45 years and older grew 37 percent between 2000 and 2014. The young adult population has also grown rapidly in the study area. In contrast, youth populations (under 18) have remained steady, while the number of residents aged 35 to 44 has declined steeply. The same trend in aging population occurs for the three separate subareas.

The 45 to 64 age group represents the highest percentage of residents in the study area. From 2000 to 2014, the age category with the largest estimated increase was 45 to 64 (24,670), and the age category with the largest estimated decrease was 35 to 44 (-12,817).

Table 15. Age distribution in 2000 and 2014 for the study area

Age	Kenai Peninsula Borough		Municipality of Anchorage		Valdez- Cordova Census Area		Study Area	
	2000	2014	2000	2014	2000	2014	2000	2014
Under 18	14,859	13,262	75,871	75,602	3,019	2,389	93,749	91,253
18-34	9,071	11,586	64,999	83,588	1,883	2,156	75,953	97,330
35-44	9,074	6,706	48,210	38,560	1,979	1,186	59,269	46,452
45-64	13,038	18,012	56,961	76,303	2,700	3,054	72,699	97,369
65 and over	3,649	7,121	14,242	24,125	614	900	18,505	32,146
Total Population	49,691	56,687	260,283	298,178	10,195	9,685	320,169	364,550
Percent of Total								
Under 18	30	23	29	25	30	25	29	25
18-34	18	20	25	28	19	2	24	27
35-44	18	12	19	13	19	12	19	13
45-64	26	32	22	26	27	32	23	27
65 and over	7	13	6	8	6	9	6	9

Source: Census 2015; Census 2000

The communities within the study area are, of course, driving the trends seen at the larger geographic levels. Many, but not all, of the communities within the Valdez-Cordova census area saw a decrease in population between Census years 2000 and 2010 (see table 16). Similarly, all communities, except the small community of Tatitlek saw the median age increase during this time period.

Table 16. Population and median age for study area communities 2000 and 2010

Geographic Area	Community	Population 2000	Population 2010	2000-2010 Percent Change	Median age (years), 2000	Median age (years), 2010
Anchorage	Anchorage	260,283	291,826	12	32	33
Valdez-Cordova census area	Chenega	86	76	-12	30	35
	Cordova	2,454	2,239	-9	37	42
	Valdez	4,036	3,976	-1	35	37
	Whittier	182	220	21	39	48
Kenai Peninsula Borough	Cooper Landing	369	289	-22	46	56
	Hope	137	192	40	47	54
	Kenai	6,942	7,100	2	32	35
	Moose Pass	206	219	6	36	42
	Seward	2,830	2,693	-5	37	38
	Soldotna	3,759	4,163	11	35	37
	Sterling	4,705	5,617	19	36	44
	Tatitlek	107	88	-18	31	30

Source: Census 2000 and 2010

In 2015, the percentage of study area populations characterized as white (68 percent) and as black/African-American (5 percent) are both lower than the United States (74 percent and 13 percent, respectively) but higher than the Alaskan state-wide average (66 percent and 3 percent, respectively) (see table 17). This is driven largely by a higher percentage of American Indian and Alaskan Natives as well as those who identify with more than one race. The percentage of the study area population characterized as American Indian and Alaska Native (7 percent) is lower than the state of Alaska (14 percent), but is still substantially greater than the United States (less than 1 percent) (Census 2016). Within the study area, the percent of population described as American Indian and Alaska Native in 2015 ranges from seven and eight percent for Anchorage and the Kenai Peninsula Borough, respectively, to 16 percent for the Valdez-Cordova census area (Census 2016).

Table 17. Population characteristics for the United States, Alaska, and study area geographies, 2015

Race	Municipality of Anchorage	Kenai Peninsula Borough	Valdez-Cordova Census Area	Study Area	Alaska	United States
White alone	194,254	48,115	7,044	249,413	484,250	232,943,055
Black or African American alone	17,511	363	zero	17,874	25,022	39,908,095
Native American/Alaskan Native	19,745	4,355	1,501	25,601	101,313	2,569,170
Asian alone	26,323	732	308	27,363	42,921	16,235,305
Native Hawaiian and other Pacific Is. alone	6,436	40	42	6,518	8,841	546,255
Some other race alone	5,226	320	115	5,661	9,273	14,865,258
Two or more races	29,612	3,296	607	33,515	61,755	9,447,883
Hispanic or Latino (of any race)	25,690	2,124	425	28,239	47,808	54,232,205
Total population	299,107	57,221	9,617	365,945	733,375	316,515,021

Race	Municipality of Anchorage	Kenai Peninsula Borough	Valdez-Cordova Census Area	Study Area	Alaska	United States
Percent of Total						
White alone	65	84	73	68	66	74
Black or African American alone	6	1	zero	5	3	13
Native American/Alaskan Native	7	8	16	7	14	1
Asian alone	9	1	3	7	6	5
Native Hawaiian and other Pacific Is. alone	2	zero	zero	2	1	zero
Some other race alone	2	1	1	2	1	5
Two or more races	10	6	7	9	8	3
Hispanic or Latino (of any race)	9	4	4	8	7	17

Source: Census 2016

Disaggregating the communities within the study areas illustrates the high concentration of Alaskan Natives in some of these communities. Particularly, Chenega and Tatitlek, which each have a majority of the population (61 percent and 66 percent, respectively) that identified as Native Alaskan, either alone or in combination with another race (see table 18).

Table 18. Percentage of select race by community 2010

Geographic Area	Community	Percent white alone	Percent American Indian and Alaska Native alone or in combination with another race
Anchorage	Anchorage	66	12
Valdez-Cordova census area	Chenega	40	61
	Cordova	70	15
	Valdez	82	13
	Whittier	70	15
Kenai Peninsula Borough	Cooper Landing	96	3
	Hope	88	7
	Kenai	80	15
	Moose Pass	94	3
	Seward	69	23
	Soldotna	86	9
	Sterling	90	7
	Tatitlek	31	66

Source: Census 2010

The forest plan assessment provides a more detailed overview of population and demographic trends (USDA 2014a). However, the previous analysis shows population growth in the study area, with the exception of the Valdez-Cordova census area, and demographic shifts, including aging populations and increased racial diversity, which signals potentially growing numbers of Chugach National Forest users, and also changes in the magnitude and types of demands for different Chugach National Forest amenities, goods, and services, as well as the manner in which the national forest contributes to social and economic sustainability. The desires and needs of an aging population are likely to differ from younger age groups, with consequences for local employment and economic development. Greater population diversity in the Municipality of Anchorage, including increasing Hispanics and Asians, as well as younger age groups and families within those minority groups, may also create new demands for Chugach National Forest amenities.

Employment, Specialization, and Income

The 2015 unemployment rate varied across the study area. Unemployment in Anchorage is similar to that of the United States (5 percent) but lower than the state-wide average (7 percent). Unemployment was highest in the Valdez-Cordova census area (9 percent) followed by the Kenai Peninsula Borough (8 percent). The unemployment rates for the study area have followed the same general trends as state and national trends over time with a few notable differences (see figure 6). The Kenai Peninsula saw the highest rates of unemployment in the early 1990s, reaching almost 15 percent in 1992, but also saw much steeper declines in unemployment rates heading into the early 2000s. The most recent impact and recovery from the 2007-08 recession varied by sub-region within the study area; the Municipality of Anchorage and the Kenai Peninsula Borough are experiencing positive growth, possibly as a result of more diverse and resilient economies, while the Valdez-Cordova census area has been slower to recover.

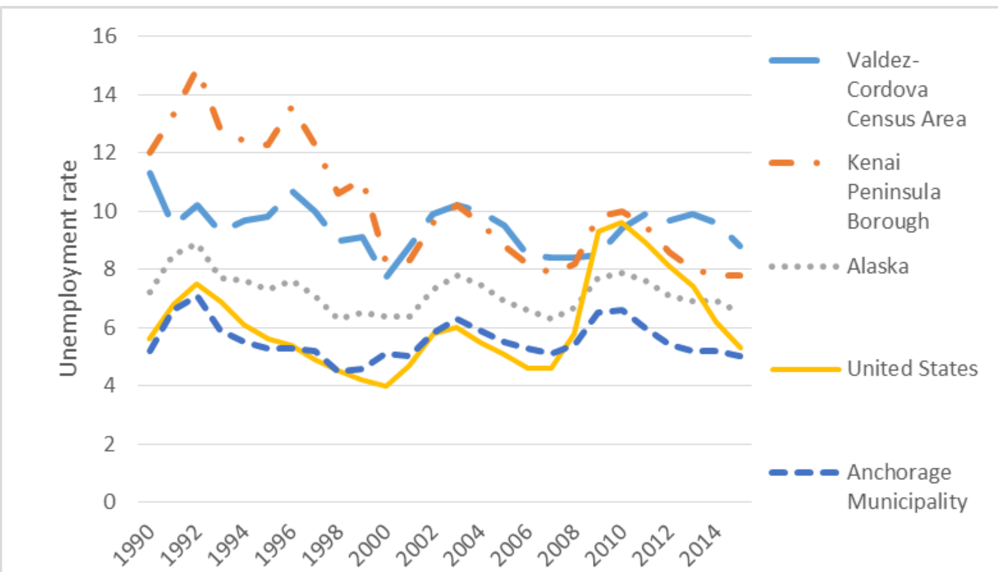


Figure 6. Unemployment trends in the study area and the U.S. 1990-2015

Source: U.S. Bureau of Labor 2017

Economic diversity generally promotes stability and offers greater employment opportunities. Highly specialized economies (i.e., those that depend on a few industries for the bulk of employment and income) are prone to cyclical fluctuations and offer more limited job opportunities. Assessing employment by sector helps identify industries that are important to the local economy surrounding the Chugach National Forest. Figure 7 displays local employment in 20 aggregated sectors as a share of total employment (IMPLAN 2014). In 2014, the government (19 percent), health and social services (12 percent), and retail trade (10 percent) sectors were the three largest employment sectors within the study area, accounting for 41 percent of total study area employment. A portion of employment in many industries can be directly or indirectly attributed to the Chugach National Forest but not all employment in figure 7 is attributable to the national forest; employment contributions are reported in detail in the forest plan assessment (USDA 2014a), and summarized in the Economic Contribution of Chugach National Forest Management section.

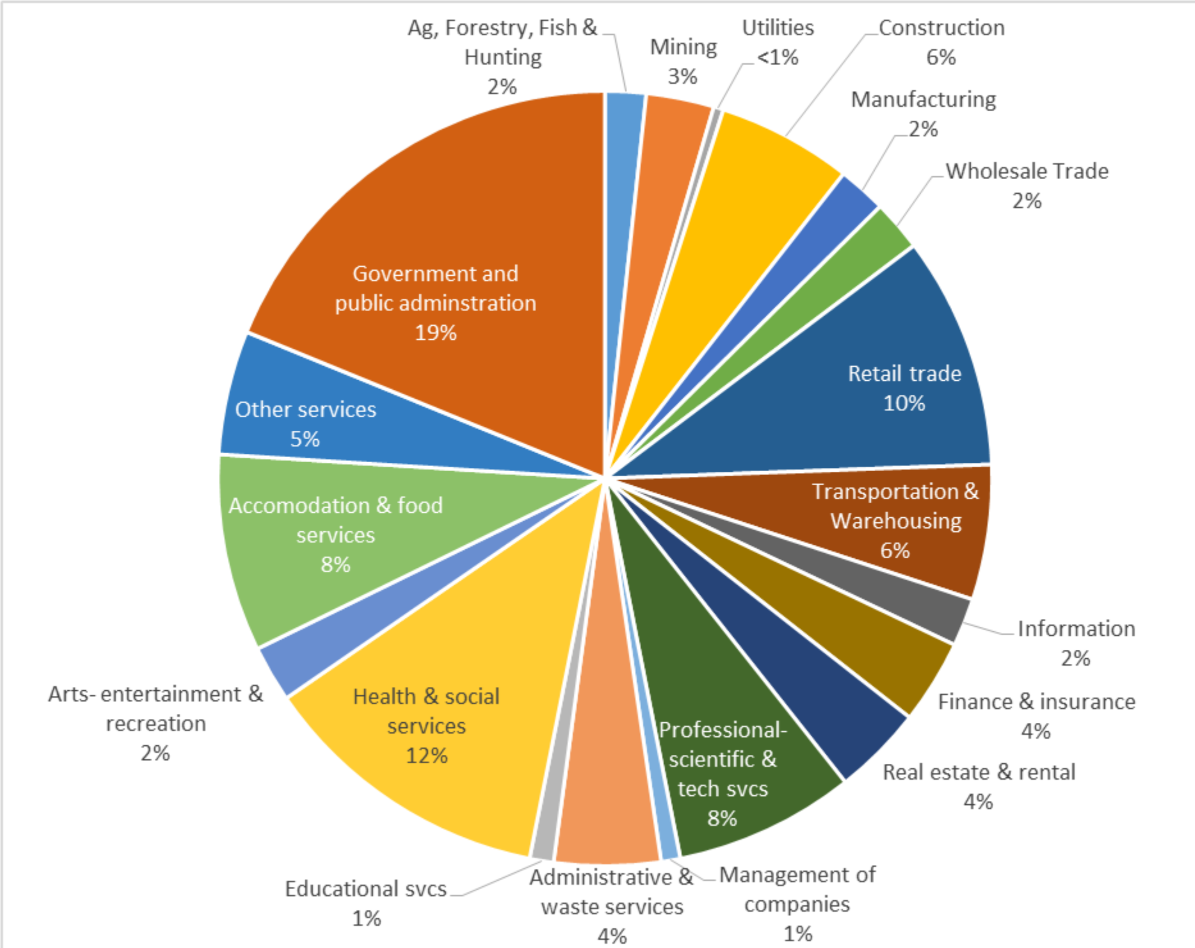


Figure 7. Employment by industry in the study area, 2014

Source: IMPLAN 2014

While employment statistics help explain overall growth in economic activity, personal income statistics more directly measure the economic benefits residents receive and is an indicator of well-being. High personal income may be a signal of greater job opportunities, highly-skilled residents, greater economic resiliency, and well-developed infrastructure, while low personal income is often a reflection of poor economic conditions and relatively few economic opportunities available within a region.

Per capita personal income measures reflect the average income per person in a region. In 2015, per capita personal income was higher in Alaska than the United States. The 2015 averages were higher in Anchorage and the Valdez-Cordova census area than the statewide average, but lower on the Kenai Peninsula Borough (see figure 8). Poverty rates are lower in Alaska than the United States. Within the plan area, the population in poverty is generally at or below state levels (see table 19).

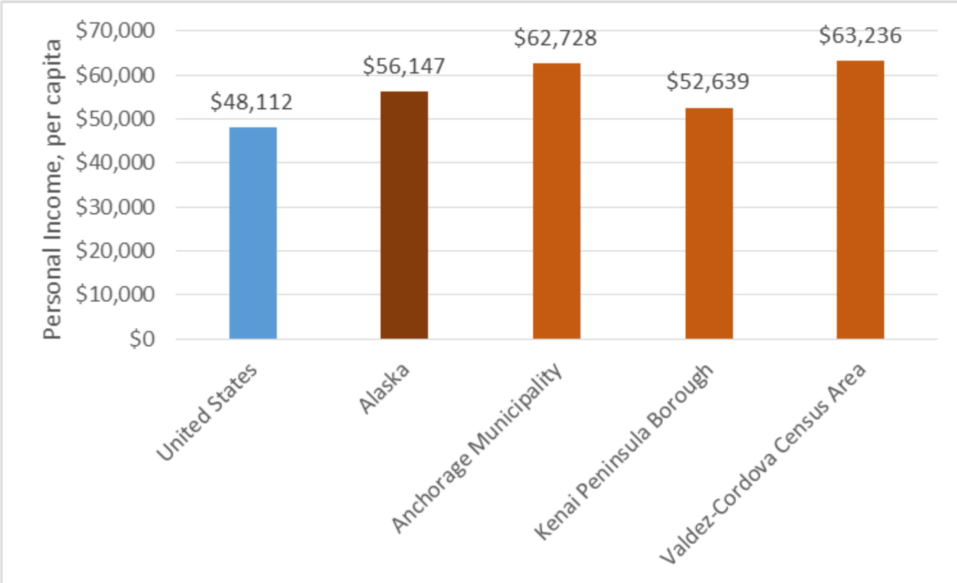


Figure 8. Personal income per capita, 2015

Source: U.S. Bureau of Economic Analysis 2017

Table 19. People in poverty 2015

Area	People in Poverty
Anchorage	8%
Kenai Peninsula	10%
Valdez-Cordova	11%
Planning Area	9%
Alaska	10%
U.S.	15%

Source: Census 2016

The Chugach National Forest is capable of contributing to the viability and stability of some production opportunities and job sectors (e.g., fishing and tourism) but has little influence over other sectors (e.g., oil and gas). The Chugach National Forest is also capable of providing amenities and services that affect the lifestyles and desire of some people to live in the region (e.g., retirees) that could influence spending in other job sectors (e.g., services and healthcare). Projecting long-term cycles or fluctuations in market conditions, government spending, and demographic trends that are all subject to uncertain environmental and social conditions is difficult. Management decisions supporting a diverse suite of opportunities over time may help mitigate risks to social and economic sustainability.

Economic Contribution of Chugach National Forest Management

The primary ways the Chugach National Forest impacts jobs and income that can be modeled quantitatively include:

- Recreational visitor spending in the local area, including wildlife and fish-based recreation (see the Forest Visitors section and the Recreation and Scenic Resources sections for more details about visitor use)

- Spending of transfer payments to states/counties (e.g., Secure Rural School payments)
- Spending of salary and non-salary Federal funds by the Forest Service (e.g., expenditures on staff, materials, contracting, etc.)

Other activities related to resource use and extraction, such as timber harvest, gathering of other forest products, and mining, occur within or can be linked to the Chugach National Forest. However, in a number of these cases, the magnitude of the activity is relatively small and hard to assess relative to the regional economy as a whole, making it difficult to accurately model economic impacts. For example, no commercial sales of saw timber have occurred in the past five years; however, wood is used as a heating source for many area homes. See the Provisioning Services section for more information on forest products as an ecosystem service and the Forestry Products section for additional details.

Recreation

The Chugach National Forest is an important attraction for regional tourism activities (USDA 2014a) with portions of the national forest within one-half hour drive from Anchorage and the Ted Stevens International Airport, which serve as major hubs for visitors entering and exiting the State by highway or by air. Tourism sector businesses, including outfitters and guides, benefit from spending by visitors.

Based on National Visitor Use Monitoring Program survey results, the Forest Service estimated about 591,000 visits to the Chugach National Forest in 2013 up from 498,000 visits in 2008 (USDA2016a, b). Due to the unique recreational characteristics of Alaska's national forests, including the Chugach National Forest, which make recreation user surveys more difficult, a supplemental survey was completed to ensure appropriate measurement of recreation use. These unique characteristics include a large share of recreation visits to the national forest as part of a broader tourism trip, for example a cruise, high amounts of dispersed and undeveloped recreation resources, and great potential for access via boats and planes (White and Stynes 2010).

Based on these supplemental surveys, White and Stynes (2010) developed multipliers for the spending of visitors to estimate the economic activity associated with every 10,000 recreation visits. These multipliers have been updated since 2010 to reflect the most recent data available (USDA 2017; White pers. comm. 20xx). When these multipliers are matched to the National Visitor Use Monitoring recreation visitation estimates for survey year 2013, estimates are derived for visitor spending, personal income, and jobs in the local economy (see table 20).Visitor spending is assumed to include expenditures on a variety of items and services, such as fuel, food, lodging, goods and souvenirs, and guided opportunities. It is estimated that the 591,000 recreational visits to the Chugach National Forest (in 2013) generated $77.3 million annually in visitor spending by both local and non-local visitors (see table 20). This level of spending is estimated to support 580 jobs in the study area annually and a corresponding $12.3 million in personal income from these jobs. Approximately 84 percent of jobs (487 jobs) are supported by visits from non-Alaskans.

Table 20. Local economic impacts of Chugach National Forest recreation visitation

Annual recreation visits to Chugach National Forest	Total annual spending resulting from visitors	Total jobs related to visitors	Total labor income related to visitors
591,000	$77,260,000	580	$12,260,000

Source: USDA 2017; White pers. comm. 20xx

Spending by non-local visitors is more likely to introduce new money into the local economy, compared to local residents who are likely to spend their money locally on other goods and services (and still support local employment), even in the absence of Chugach National Forest recreational opportunities. In 2013, an estimated 41 percent of all forest visitors traveled greater than 500 miles to visit the Chugach National Forest. Conversely, just over 28 percent of visitors traveled less than 50 miles (USDA 2016b). This distribution of forest visitors influences, in part, the spending patterns of visitors and therefore their impact on the local economy. Economic impacts from recreation are therefore often based on non-local spending.

The USDA data suggests visitors have continued to increase, and more recent data points to increases in out-of-state visitors to Alaska (McDowell Group 2016). An increase in non-local visitors would result in an influx of dollars, which would have a positive impact on local economies.

The Recreation section of this DEIS provides additional details about the types of recreational activities and the nature of recreational visits and some details on the outfitter and guide industry as well as special permits parts of the total economic contribution of recreation. Also see the ecosystem services discussion, Recreation Experiences.

Payments to Local Governments

Counties receive a portion of the revenues generated on NFS lands through the Secure Rural Schools and Community Self Determination Act (2000) and subsequent reauthorizations of this Act. Payments are allocated to counties for use in different types of programs or projects, including schools and roads (Title I), projects to benefit forest lands (Title II), and search, rescue, and Firewise community efforts (Title III). Aggregate Secure Rural Schools' payments declined from a high of seven million dollars in 2009 to less than three million dollars in 2015 (USDA 2016c).

Counties also receive Payment in Lieu of Taxes (PILT) to replace tax revenue lost due to the public nature of lands administered by federal agencies (per the 1976 Payments in Lieu of Taxes Act). The amount is based on the amount of acreage administered by certain Federal agencies, population, a schedule of payments, the Consumer Price Index, other Federal payments made in the prior year, and the level of funding allocated by Congress. Annual Payment in Lieu of Taxes associated with the Chugach National Forest has varied from 4.1 million to 5 million dollars in aggregate for the Municipality of Anchorage (15 to 16 percent of funds), Kenai Peninsula Borough (57 to 63 percent of funds), and Valdez-Cordova census area (22 to 27 percent of funds) for 2009 through 2015 (USDA 2014a).

Secure Rural Schools payments may be affected by Forest Service management, but Payment in Lieu of Taxes is less likely to be affected. As such, results from IMPLAN modeling (IMPLAN 2009) are presented here to demonstrate the potential economic impacts from use of Secure Rural Schools' payments. Assuming 2011 Secure Rural Schools payments levels of 4,496,000 dollars under Title I (50 percent allocated to schools and 50 percent allocated to roads) and 788,000 dollars under Title II (100 percent allocated to national forest projects), Secure Rural Schools payments linked directly to the Chugach National Forest are estimated to support 71 jobs (full or part-time) and approximately 4 million dollars in income (2012 dollars) in a year (USDA 2014a; U.S. Department of Interior 2017).

Chugach National Forest Spending

Spending by the Forest Service of approximately 16 million dollars (2014 Chugach National Forest budget) is estimated to support 278 full or part-time jobs and 17 million dollars in labor income in the impacted area (USDA 2014a). This result includes direct, indirect, and induced impacts. The 2014

Chugach National Forest budget was split with approximately 70 percent to salary and 30 percent to non-salary expenditures.

Special Use Permits

The wide variety of special use permits for the Chugach National Forest illustrates how the Forest Service affects local and regional economies. The authorizations span from outfitter/guide permits, recreation events, campground concessionaire, isolated cabins, telephone lines and fiber optic cables, fish hatcheries, and resorts. In addition, temporary permits are issued for filming and recreation events or other short-term uses.

Economic contributions to the local economy are facilitated by special use permits issued by the Forest Service. Some of these impacts of tourism and spending linked to recreation through outfitters and guides and recreation based special events are captured in the estimates reported above. Details about special use permits for guided opportunities are provided in the Recreation section of this DEIS.

Some of these special use permits help create infrastructure for economic growth and well-being. For example, fiber optic cables, telephone, and power lines as well as hydroelectric activities help provide electricity, infrastructure, and communication to the communities surrounding the national forest. Quantified economic impacts associated with these types of special uses are not readily available and are therefore not provided in this report.

The special use permits for fish hatcheries support, in part, the fishing industry both commercial and recreational. This in turn provides economic benefits to the region. Fishing is discussed in the Recreation and Animals and Plants as Food and Resources sections.

A more complete summary of the numbers and types of special use permits are provided in the Special Uses section of this DEIS.

National Forest Visitors

An estimated 591,000 visits were made to the Chugach National Forest in 2013 up from 498,000 visits in 2008 (USDA 2016a, b). The Chugach National Forest is recognized as a place for world class, nature-based outdoor recreation.

Fishing was the most frequently cited primary activity when visiting the national forest at 30 percent of all visits (USDA 2016b). This was followed by 18 percent of visits primarily for hiking and walking and 13 percent for viewing natural features. The remainder of visits were spread out across activities, such as viewing wildlife (seven percent), relaxing (seven percent), snowmobiling (two percent), gathering forest products (two percent), and bicycling (four percent) (see table 21).

The race and ethnicity of national forest visitors generally follows the demographic of the surrounding communities, but skews towards the white population. Ninety-three percent of Chugach National Forest visitors in 2013 were white, and four percent were Alaskan Native. Hispanic (of any race) visitors made up six percent of the total annual visits to the national forest compared to eight percent of the study area population (USDA 2016b) (see table 17).

In addition, an estimated 41 percent of all national forest visitors traveled greater than 500 miles to visit the Chugach National Forest. Conversely, just over 28 percent of visitors traveled less than 50 miles (USDA 2016b).

Table 21. National forest activity participation 2013

Activity	Percent who participated in activity during visit (more than one activity could be checked)	Percent who indicated as primary activity during visit[1]
Viewing Natural Features	69	13
Viewing Wildlife	64	7
Hiking/Walking	61	18
Relaxing	47	7
Fishing	35	30
Driving for Pleasure	16	<1
Motorized Water Activities	14	2
Nature Center Activities	14	1
Picnicking	11	2
Non-motorized Water	10	3
Developed Camping	10	2
Gathering Forest Products	10	2
Nature Study	8	<1
Bicycling	6	4
Visiting Historic Sites	5	zero
Other Non-motorized	4	1
Cross-country Skiing	4	1
Some Other Activity	3	3
Snowmobiling	3	2
Primitive Camping	2	zero
Downhill Skiing	2	1
Other Motorized Activity	2	<1
Resort Use	2	zero
Hunting	2	1
Motorized Trail Activity	<1	zero
Horseback Riding	<1	zero
OHV Use	<1	zero
No Activity Reported	zero	<1
Backpacking	zero	1

Source: USDA 2016

1 - Survey respondents were asked to select just one of their activities as their main reason for their visit. Some respondents selected more than one, so this column may total more than 100 percent.

Environmental Justice

In 1994, President Clinton issued Executive Order 12898. This order directs Federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities. The purpose of Executive Order 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations.

Environmental justice is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is for Federal agencies to identify impacts that are disproportionately high and adverse with respect to minority or low-income populations and identify alternatives that will avoid or mitigate those impacts.

In the context of forest planning, it is important to assess whether the forest plan and alternatives will affect how key societal benefits are currently distributed across populations. Specifically, the environmental justice mandate dictates that we examine whether low-income and minority groups will be disproportionately deprived of these benefits or unable to access these benefits with the same ease as the population as a whole.

Information compiled and presented, specifically in tables 18, 19, and 20 and figure 6 among others, indicates areas exist with a high percentage of minority groups (Native Alaskans), unemployment rates, and poverty rates, along with the population decline due to out-migration. Combined these suggest greater economic hardships in the Valdez-Cordova census area but also within specific communities in the Kenai Peninsula, and therefore these areas are likely to contain sensitive populations. These populations are likely more vulnerable to Forest Service actions.

Non-market Benefits and Values

The Chugach National Forest provides a range of resources and amenities (natural, built, and human capital) that contribute to a suite of goods and services valued by people living both within and outside of the study area and beyond the State of Alaska. Many of these benefits are difficult to value in dollars or justify in terms of jobs and income and are therefore categorized as non-market benefits. Beneficiaries range from local residents to the public in general, including individuals and groups outside of Alaska, and even the international community.

To help illustrate potential types of values, a comprehensive survey in 12 communities surrounding the Chugach National Forest was conducted to better understand how the local public values the national forest (Reed and Brown 2003). Public land environmental attributes are basic to community quality of life, suggesting that the protection of clean air and water, scenic quality, and open and undeveloped areas, along with providing opportunities for wildlife viewing and outdoor recreation are important. The Chugach National Forest has the ability to affect the quality of life of the communities neighboring it (Reed and Brown 2003).

A review and assessment of the full spectrum of both market and non-market benefit linked to and affected by the Chugach National Forest is interdisciplinary in scope and expertise. As such, separate specialist reports address benefits arising from difference resources, for example the Fisheries and Subsistence reports. However, the Ecosystem Services section draws from other specialist reports to highlight seven key ecosystem services identified by the Forest Service. The Ecosystem Services section discusses the human dimension of each and the market and non-market benefits arising.

Social and Economic Sustainability

National forests are productive assets that contribute to sustaining the viability of national, regional, and local communities. Uses, products, services, and visitor opportunities supported by NFS lands produce a steady flow of benefits that contribute to the robustness and sustainability of local communities. While robustness implies diversity, sustainability refers to the community’s capacity to maintain a certain level of function within the social, ecological, and economic systems it encompasses. Sustainability is a complex idea focused around intergenerational equity. This concept relates to the maintenance and enhancement of resources in order to meet the needs of current and future generations.

Furthermore, economic sustainability refers to the capability of society to produce and consume or otherwise benefit from goods and services, while social sustainability is the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another and support vibrant communities.

The Forest Service is not responsible for deciding what goods, services, networks, traditions, cultures, and activities are most needed or desired; only the public or society can define what they need today and in the future. However, information about social, cultural, and economic conditions and trends provides clues about the needs of present and future generations. When considered in combination with current resource and ecosystem conditions and trends of the Chugach National Forest, this information helps demonstrate how the national forest can provide resources that support the capabilities of society to produce and consume goods and services as well as relationships, culture, and activities that maintain vibrant communities (and therefore contribute to social and economic sustainability).

More specifically, this section of the DEIS provides information about social and economic conditions potentially affected by national forest resources and management. The Environmental Consequences section will consider management alternatives to help determine if and how the Forest Service contributes to goods and services that satisfy public needs and influences social and economic sustainability, now and into the future. Some examples of how the Forest Service might contribute to social and economic sustainability include:

- Providing opportunities to build relationships and facilitate interaction with stakeholders through activities, such as educational outreach through the Chugach Children’s Forest program and Classrooms for Climate and through subsistence harvest activities.
- Restoring/maintaining national forest resources and providing opportunities to use resources that directly or indirectly support jobs and income in communities within the study area.
- Offering a variety of unique national forest resource conditions and experiences that are valued by communities and people outside of Alaska (the existence of Chugach National Forest resources and amenities may play a role in the sustainability of social conditions well beyond areas and communities within the social and economic study area).

Ecosystem Services

The Chugach National Forest provides a broad suite of goods and services that are important to the public, help meet community needs and preferences, and sustain livelihoods. The benefits that people derive from the forest plan area are referred to as ecosystem services.

Some benefits derived from NFS lands are obtained by direct use or consumption of goods or services (e.g., wood products, water, forage, fish, wildlife, and recreational opportunities). Other services provide benefits indirectly or through non-consumptive means, as they support and regulate ecosystem integrity (e.g., climate regulation, water filtration, pollination, nutrient cycling, flood control, and biodiversity).

Ecosystem services are defined as the benefits people obtain from ecosystems and can be grouped into the following four types:

Provisioning services: The products or commodities obtained from forest ecosystems, such as clean air, fresh water, fiber, forage, fuel, minerals, and food

Regulating services: The benefits obtained from an ecosystem's ability to impact or influence environmental conditions that affect people's lives, such as carbon sequestration, water filtration and storage, and insect and disease control

Supporting services: The category of ecosystem services that are often described as intermediate services that contribute to the production of other ecosystem services and sustainability of integrated ecological, social, and economic systems

Cultural services: The nonmaterial benefits people derive from forests, such as educational, aesthetic, spiritual and cultural heritage values, recreational experiences, and tourism opportunities

An evaluation of available information from public input, reports/studies, and resource specialists resulted in the identification of seven key ecosystem services as discussed in the forest plan assessment (USDA 2014a). Table 22 displays the seven key ecosystem services grouped by the type of service they provide.

Table 22. Key ecosystem services

Type of Ecosystem Service	Key Ecosystem Service
Provisioning	Water quantity and quality
	Animals and plants as food and resources
	Wood as a renewable energy and fuel source
Regulating	Carbon sequestration and impacts of climate change
Cultural	Recreational experiences
	Education and research
Supporting	Sustaining biodiversity, intact ecosystems, and connectivity for global ecological processes

Identifying and evaluating ecosystem services in planning helps ensure the needs of present and future generation are being met. The following discussion draws from the noted specialist reports and the forest plan assessment (USDA 2014a).

Provisioning Services

Water Quantity and Quality

Water quality and quantity are important to all living things. The Chugach National Forest plays a critical role in protecting water resources not only for the people that live within and downstream from the national forest but for those who recreate on or depend on NFS lands for their livelihood. The influence of the quantity and quality of water resources is far reaching.

Most Chugach National Forest watersheds have little to no human impacts to water quantity in terms of diversions or reservoirs, and stream hydrographs are generally unaltered by human actions. Exceptions to this occur in a few localized areas near communities and along the road system. Nearly all the Chugach National Forest watersheds are in good condition and are functioning properly: 273 out of 275 watersheds (99 percent) are given a Class 1 rating (good, properly functioning) (USDA 2014a) (see the Watershed and Water Resources section of this chapter).

The main consumptive surface water uses include drinking water (primarily from groundwater wells), water use for Forest Service facilities (e.g., campgrounds, maintenance, fire, and management activities), hydropower generation, fish hatcheries, mining operations, highway construction, dust abatement, and special use permits. Ample water supplies provide for water-based recreation, including fishing, the most popular Chugach National Forest recreation activity (USDA 2016).

Wetlands comprise nearly one-quarter of the Chugach National Forest and act as water filters to remove impurities. Intact wetlands and riparian areas store water, releasing it slowly over time and reducing the probability of floods. Good quality water is provided for municipal and public water supplies, fish hatcheries, and fish and wildlife habitat. Fish hatcheries and high quality fish and wildlife habitat in turn provide ecosystem services in the form of animal and plants as food and resources. These are discussed in the following section.

The Watersheds and Water Resources and Riparian and Wetland Resources sections of this DEIS describe water quality and quantity conditions and trends in more detail.

Animals and Plants as Food and Resources

Alaskans and people from around the world use, and in many cases, depend on the fish, wildlife, and plants produced by Alaska's natural environment (Newton and Moss 2009). Collection, utilization, and transfer of wild foods are interwoven into the culture of Alaska (Brown and Burch Jr. 1992).

During 2013, the National Visitor Use Monitoring Program found that 35 percent of all visitors to the Chugach National Forest participated in fishing at some point during their visit. Almost 10 percent of visitors participated in gathering forest products and just under two percent hunted during their visit. Fishing was the most frequently cited primary activity when visiting the national forest at 30 percent of all visits (USDA 2016) (see National Forest Visitors section and see table 21).

In addition to fish and game, plants and special forest products also play an important role in Alaska's culture and economy. Alaska Natives have collected plants and mushrooms for thousands of years. Objects created by contemporary artists include basketry; beadwork; fur clothing and art; carvings in wood, bone, or antlers; and artworks created from locally-harvested materials, such as porcupine quills and salmon skin (Newton and Moss 2009). Plant fruits and berries, nuts, flowers, leaves, stems, roots, and seaweed are used for food, dye, and art objects. The wildland products of the Chugach National Forest are accessible to residents and visitors through their incorporation into commercial products sold in other areas of Alaska.

The culture and tradition of hunting, trapping, gathering, and fishing has complex social and economic implications for forest management. For instance, management of salmon habitat and watershed resources directly links to people's livelihood and survival if the community depends on the harvest of salmon from local waters. Trapping constitutes significant portions of time for participants, who are motivated not only by the collection of furs but also by the wildland experience. Hunting for food or trophies is an inherent social activity in Alaska and throughout the world by those that hunt, driven as much by the experience as by the trophy or meat harvested.

The Forest Products and Subsistence sections of this DEIS offer additional details about the availability, use and sustainability of specialty forest products.

Wood as a Renewable Energy and Fuel Source

Federal and state regulations permit bona fide settlers, miners, residents, and prospectors for minerals in Alaska to take, free of charge, green or dried timber from the national forests in Alaska for personal use, but not for sale. Free use cord wood and subsistence fuelwood can be harvested without permit and reporting (CFR 223.10). Permits can be obtained for fuelwood collection and sale of cord wood is made to commercial sellers. In addition, Title VIII of ANILCA outlines congressional policy for a subsistence priority for the consumptive use of renewable resources, including shelter fuel, by qualified rural residents of Alaska.

Fuelwood as a primary or secondary home heating source is important to local communities within and adjacent to the Chugach National Forest (see table 23). Not surprisingly, Anchorage has lower rates of wood as a primary heating fuel than other nearby more rural communities due to the ease and price of utility supplied natural gas (Nicolls et al. 2010). However, fuelwood likely plays an important role as a secondary heat fuel. Therefore high fuel costs may drive demand for fuelwood for some households, but wood use can be an important lifestyle common in Alaska. For example, as high as 65 percent of homes in Moose Pass, a community located within the national forest boundary on the Kenai Peninsula, use wood as a secondary heating source (Census 2010).

Table 23. Wood as primary home heating fuel, 2015

Area	Percent of Homes
Anchorage	1
Kenai Peninsula	13
Valdez-Cordova	20
Alaska	6
United States	2

Source: U.S. Census Bureau 2011-2015 American Community Survey 5-Year Estimates

The Chugach National Forest plays an important role in the supply of fuelwood in southcentral Alaska. Alaska free use sawtimber and fuelwood (CFR 223.10) is allowed on approximately 2.8 million acres of forest under the 2002 forest plan. However, access is a primary constraint of sawtimber and fuelwood harvests, which occur almost entirely within the roaded corridor of the Chugach National Forest. This area represents about 20,580 acres of forest cover that is reasonably accessible (within one-quarter mile of a developed road) to the Forest Service and the public for timber product removal. Virtually all of the Chugach National Forest is open to the harvest of subsistence resources except for small areas that might be restricted due to safety concerns, such as active mines or developed recreation sites. Most NFS lands that are closed to motorized vehicles remain open to motorized vehicles by qualified rural residents pursuing subsistence activities.

Given the large expanse of acres available, supply potential for subsistence and Alaska free use fuelwood and cordwood is adequate to meet the needs of the local communities (see Forest Products section). However, in practice not all those acres are accessible to most. Access to these acres constrain the actual availability of the wood. The limited access to forested acres acts to concentrate fuelwood collection along roaded corridors. Therefore the long term sustainability may be at risk.

See the Forest Products section of this DEIS for additional details about the availability and sustainability of forest products for renewable energy and fuel sources.

Regulating Services

Carbon Sequestration and Impacts of Climate Change

Carbon dioxide (CO_2) plays a critical role in climate change. Accounting for carbon sequestration, storage, and flux in forests is becoming a topic of increasing interest for forest landowners.

Live trees in the forests of the Chugach National Forest are currently a carbon sink (store more carbon than they release), sequestering an estimated 150 thousand metric tons aboveground per year (see Air Quality and Carbon section of this DEIS). Live trees within the national forest will likely continue to sequester carbon unless there is an increase in large-scale disturbance.

Climate change has the potential to influence human well-being through, for example, effects to agricultural productivity, infrastructure damage due to sea level rise, increased frequency and intensity of wildfire, increased building cooling costs and decreased heating costs, and damages to human health. These costs are global in nature. Therefore, carbon emissions or carbon storage associated with the Chugach National Forest has costs and benefits that extend far beyond the plan area.

Cultural Services

Recreation Experiences

The Chugach National Forest is recognized as a place for world class, nature-based outdoor recreation. Outdoor recreation is an essential part of the culture and economy of Alaska. Alaska's glaciers, mountains, lakes, fish and wildlife, peat bogs, muskegs, spruce/birch forests, intact landscapes, and river systems have a unique mystique to residents and tourists alike. The lives of Alaskans are intimately interwoven with their natural surroundings. Wildlife, fish, plants, and the recreational opportunities in Alaska are reflected in lifestyles, businesses, food, art, film, drama, dances, books, advertising, and other products throughout the State and abroad.

Local residents as well as non-local or non-Alaskan visitors engage in all types of recreational activities during all seasons within the Chugach National Forest (see table 21). According to the 2013 National Visitor Use Monitoring Program, 26 percent of site visits included day use developed sites, while nine percent included overnight developed use sites. A total of 17 percent of national forest visits included a visitor center or museum, 13 percent an interpretive site, and 10 percent a developed fishing site, to name a few (see table 21; USDA 2016). Most of these sites, except for the public use cabins, are accessible along the existing road system. Cabins are found mostly in more remote areas within primitive and semi-primitive ROS classes and are accessible only by trail, boat, or float plane.

Fishing was the most frequently cited primary activity when visiting the national forest at 30 percent of all visits (USDA 2016b). This was followed by 18 percent of visits primarily for hiking and walking and 13 percent for viewing natural features. The remainder of visits were spread out across activities, such as viewing wildlife (seven percent), relaxing (seven percent), snowmobiling (two percent), gathering forest products (two percent), and bicycling (four percent).

Education and Research

Local communities and schools, students, youth crews, and local and non-local visitors all derive a variety of cultural, social, and historical benefits from the many opportunities to engage with the natural, cultural, and historical resources of the Chugach National Forest through educational and interpretive programs. Local populations and communities are strengthened by cultural and historical awareness. Non-local visitors transfer and apply their experiences and awareness to their home communities in other areas of the country, thereby extending the public benefits beyond the region.

The benefits of education and research include connecting people with nature and culture; increasing place-based-awareness; expanding opportunities for community members to interact in natural settings; spiritual opportunities and experience; increasing and improving the body of scientific knowledge about ecosystem processes, fish and wildlife populations, and social and cultural resources; and reinforcing long-standing traditions and knowledge of resources, including Alaskan Native culture and traditions. Experience with NFS lands and resources can be an inspiration for art, literature, and music. Education and outreach efforts clarify the link between underlying supporting services and the more direct human benefits of the national forest that are reflected more commonly in provisioning and cultural services (Asah et al. 2012).

National forest management can impact delivery of education and research services through its interpretation and conservation education programs as well as its special use permit process. Both of these programs have evolved over the past decade. The Forest Service has been working with partners to expand educational opportunities through the hands of others and continues to be responsive to research requests.

In 2010, the Forest Service and its partners initiated the Iditarod Trail to Every Classroom Project (iTREC!) to develop place-based service learning opportunities in schools and communities along the Iditarod National Historic Trail (INHT). The year-long professional development program provides teachers with place-based service learning skills to help today's youth become lifelong stewards of Alaska's public lands, natural resources, and cultural heritage. Teachers from Cordova have also participated in this training. Community events include Kid's Fishing Days, the Fungus Fair in Girdwood, and some one-time events, such as Budburst and BioBlitz in Portage Valley.

The 2013 National Visitor Use Monitoring finds that 14 percent of visits included nature center activities (USDA 2016b). An additional eight percent of visits included nature study as an activity (USDA 2016b).

The national forest provides a wide range of research possibilities and a unique opportunity to study climate change on glaciers, hydrology and aquatic ecosystems, and in boreal and temperate forest ecosystems. Evidence of unique scientific and research opportunities was reflected by the recommendation of two and designation of one research natural area in the 2002 forest plan. A research natural area is set aside to preserve a representative sample of an ecological community primarily for scientific and educational purposes. Commercial and most public uses are not allowed.

This section borrows from the forest plan assessment (USDA 2014a). Please see that report for more details.

Supporting Services

Sustaining Biodiversity, Intact Ecosystems, and Connectivity for Global Ecological Processes

Biodiversity can be considered the foundation of an ecosystem service's condition and function. As stated by Mace et al. (2005), "direct benefits, such as food crops, clean water, clean air, and aesthetic pleasures, all depend on biodiversity, as does the persistence, stability, and productivity of natural systems." Biodiversity can also be valued for its intrinsic worth, or existence value, and may provide potential future benefits that are yet unknown or unrecognized (Tilman 1997). Loss of biodiversity impacts well-being unevenly across communities, affecting those who depend most on natural resources, such as those that practice subsistence and the rural poor (Diaz et al. 2006).

Chugach National Forest ecosystems provide habitats for many resident species of wildlife and fish as well as important habitat connections for migratory species, such as shorebirds and anadromous fish, whose migration paths cross the national forest. Except for the dusky Canada goose, for which there is a concern about the capability to persist, wildlife populations are not thought to be currently at risk due to isolation or fragmentation of habitat. Greater than 99 percent of the watersheds within the national forest are in good condition and functioning properly. The presence of five species of salmon is one of the defining features of ecosystems of the Chugach National Forest.

Commercial fishing is the largest forest resource-related sector in southcentral Alaska. Fish habitat and the supporting ecosystems within the Chugach National Forest play a vital role in sustaining fisheries that support commercial fishing and sport fishing and processing industries that account for substantial economic activity in the study area.

Management of Chugach National Forest ecosystems for ecological integrity will contribute to the resilience of forest-dependent communities as well as visitors (see Animals and Plants as Food and Resources section). Because the Chugach National Forest is recognized as a place for world class, nature-based outdoor recreation, many recreational experiences depend on the unique, intact and diverse ecosystems. In addition, as mentioned, the Chugach National Forest’s rich biodiversity, intact ecosystems, and connectivity for global ecological processes provide existence or intrinsic value and bequest value, as well as option value and altruistic values.

Environmental Consequences

The previous sections assessed social and economic conditions and trends in order to establish a baseline in which potential consequences could be measured against. The following section considers the potential consequences of alternative management scenarios on the social and economic environment, largely by considering the seven key ecosystem services.

Effects Common to All Alternatives

Economic Contribution of Chugach National Forest Management

The future prospects for timber products utilization and treatments is not expected to change in the next 15 years mostly due to economies of scale and the low quality and volume of timber. Therefore, the commercial activity and economic contribution of the sawtimber is not expected to change due to any alternatives analyzed. Similarly, no quantifiable economic impacts, such as employment or income effects, are noted across alternatives resulting from recreation, special use permitting, or forest spending. These goods and services will continue to contribute to the local economy through the generation of jobs and income while creating a variety of products for use, both nationally and locally.

Ecosystem Services

Animals and Plants as Food and Resources

None of the alternatives propose activities that would negatively affect fish, wildlife, or plant populations. Selection of alternatives B, C, or D would slightly increase the areas available for special forest products (by less than 1 percent) across the entire Chugach National Forest. The increase in available acres would occur entirely on the Kenai Peninsula where an additional 3,400 acres would be available for Alaska free use fuelwood and subsistence special forest products. However, in practice, the areas most readily available for special forest products are located nearest roads within the Chugach National Forest and the additional areas in alternatives B, C, and D are away from existing roads. Therefore, the action alternatives will have little impact on human use for animals and plants. In addition, the harvest of special forest products, such as annuals (e.g., berries, mushrooms and ferns), is typically widely dispersed. This is in contrast to heavier weighted forest products, such as fuelwood, and is discussed in the following section. Due to the dispersal of collection, the supply and sustainability of these special forest products is not a concern. The abundance and distribution of animal and plant resources would continue to provide for human uses and needs at close to current levels.

Therefore, the action alternatives will have little impact on human use for animals and plants. These uses will to contribute to subsistence lifestyles; support rural economies both locally and regionally; and enhance the quality of life and sense of place for present and future generations.

None of the alternatives affect access to public lands for the purposes of subsistence gathering activities (as defined under Title VIII of the 1980 ANILCA). Access to resources would remain unchanged as ANILCA Title VIII, Section 811 provides for reasonable access to subsistence resources for qualified rural residents of Alaska, including forms of motorized transportation, such as “snowmobiles, motorboats, and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulation.”

This information is drawn from the Forest Products and Subsistence sections, which offer additional details about the availability, use, and sustainability of forest products.

Wood as a Renewable Energy and Fuel Source

No considered alternatives will affect the accessibility of fuelwood as a provisioning service. While, selection of alternatives B, C, or D would increase the areas available for subsistence and Alaska free use fuelwood and sawtimber, these additional areas are not located near existing roads and therefore access is not improved.

Currently, supply potential for subsistence and Alaska free use fuelwood and cordwood harvesting growing capacity and available acreage is adequate to meet the needs of local communities. However, access to these acres constrain the actual availability of the wood. The limited access to forested acres acts to concentrate fuelwood collection along roaded corridors. Therefore the long term sustainability of fuelwood supply within the national forest most accessible to the general public may be at risk as continued harvest and treatment of previously treated areas will reduce the age of the forest and therefore size of available timber. Personal use of fuelwood and subsistence gathering is expected to follow the general population and recreational use trends. None of the alternatives will affect these expected trends.

The Forest Products section of this DEIS offers additional details about the availability and sustainability of forest products for renewable energy and fuel sources.

Carbon Sequestration and Impacts of Climate Change

Currently, the largest pool of above ground carbon within the Chugach National Forest is in the forests of Prince William Sound (see Air Quality and Carbon section) and a large portion of this geographic area is in the wilderness study area. The wilderness study area is managed to maintain the wilderness characteristics of the area. Continuing such management of the wilderness study area would likely contribute towards maintaining the large carbon pool in Prince William Sound. While all alternatives would continue to provide for the Chugach National Forest as a carbon sink providing the range of benefits resulting from carbon sequestration, assuming wilderness designation occurred as described in each of the action alternatives, the differences among the alternatives would likely be negligible during the plan period.

Education and Research

Research natural areas do not change across alternatives and therefore, these unique scientific and research opportunities remain for their intended use across all alternatives.

Sustaining Biodiversity, Intact Ecosystems, and Connectivity for Global Ecological Processes

Management of Chugach National Forest ecosystems for ecological integrity will contribute to the resilience of forest-dependent communities. These contributions are a vital part of the plan area communities and will continue to contribute to their community sustainability under all the alternatives.

Cumulative Effects

Past, present, and reasonably foreseeable activities in the project area include management plan revisions of adjacent State lands and national parks, a proposed hydro construction project, potential development of private mineral estates and timber extraction, and highway rehabilitation projects. Many of these actions have the potential to make economic contributions, in the form of jobs and labor income, to the local economy during construction, extraction, or harvest. Improvements or creation of infrastructure, such as hydro power or road rehabilitation, is often a necessary component of community development and economic growth. Therefore, these projects could contribute to the wellbeing and sustainability of local communities. Conversely, projects such as these can also restrict or displace recreation use. However, none of the actions are expected to measurably affect annual recreation use, visitor spending, and associated employment, income, and tax revenue stemming from the Chugach National Forest. Therefore, no cumulative effects related to economic activity from the national forest are anticipated. The temporary displacement of recreation use may affect quality of life if preferred sites or access routes are temporarily unavailable. However, such effects are expected to be infrequent or minor.

Alternative A No Action

Ecosystem Services

Water Quantity and Quality

See the Watershed and Water Quality section for details; the summary below is provided to focus attention on the human dimension.

Under the no-action alternative, alternative A, improvement of aquatic habitat conditions would continue as resources are available. There are adequate measures for providing instream flow to maintain and support aquatic life and habitat, therefore recreation, aesthetics, and other resources that benefit human use, such as fish hatcheries, can depend on such flows on NFS lands.

Alternative B

Ecosystem Services

Water Quantity and Quality

See the Watershed and Water Quality section for details; the summary below is provided to focus attention on the human dimension.

Due to a small decrease (less than 1 percent) in semi-primitive opportunities for winter and summer motorized use in alternative B, potential impacts to water resources and overall watershed conditions from snowmachines, helicopters, and OHVs would decrease negligibly compared to alternative A. Human use would therefore also be improved negligibly.

Animals and Plants as Food and Resources

None of the alternatives propose activities that would negatively affect fish, wildlife or plant populations. Selection of alternatives B, C, or D would slightly increase the areas available for special forest products (less than 1 percent) across the entire Chugach National Forest. The increase in available acres would occur entirely on the Kenai Peninsula where an additional 3,400 acres would be available for Alaska free use fuelwood and subsistence special forest products. However, in practice, areas most readily available for special forest products are located nearest roads within the Chugach National Forest and the additional areas in alternatives B, C, and D are away from existing roads. Therefore, the action alternatives will have little impact on human use for animals and plants. In addition, the harvest of special forest products, such as annuals (e.g., berries, mushrooms and ferns), is typically widely dispersed. This is in contrast to heavier weighted forest products, such as fuelwood, which is more concentrated closer to roads and is discussed in the following section. Due to the dispersal of collection, the supply and sustainability of these special forest products is not a concern. The abundance and distribution of animal and plant resources would continue to provide for human uses and needs at close to current levels.

The Forest Products and Subsistence sections offer additional details about the availability, use, and sustainability of forest products.

Wood as a Renewable Energy and Fuel Source

No considered alternative would affect the accessibility of fuelwood as a provisioning service. While the selection of alternatives B, C, or D would increase the areas available for subsistence and Alaska free use fuelwood and saw timber, the additional areas are not located near existing roads and therefore access is not improved.

Alternative C

Economic Contribution of Chugach National Forest Management

Relative to alternatives A and B, alternative C is generally more consistent with current recreation uses and current management and therefore would not change visitor experiences. Changes in recreation opportunity spectrum classes were largely made to be consistent with the Kenai Winter Access Project Record of Decision (2007) and current permitted use. Several changes in settings may require future project-level travel management analysis and decisions to change motorized use designations, which may change visitor experiences. In terms of economic impact of recreational use, snowmobile users have higher spending patterns than other recreational users (Stynes and White 2005). Therefore, potential future increases in motorized use could have positive economic impacts on the plan area. Adjustments to motorized vehicle access would better align with national forest visitor use and demand. It is likely that the overall effect on economic contribution from changes in recreation opportunity spectrum classes would be negligible. However, in practice it is not possible to quantify this effect as it is not possible to estimate any changes in forest visitor activity patterns at this time.

Ecosystem Services

Water Quantity and Quality

See the Watersheds and Water Quality sections for details; the summary below is provided to help focus attention on the human dimension.

The alternative C wilderness area recommendation has a larger number of acres withdrawn from mineral entry relative to alternatives A and B. This increase in the number of acres withdrawn from mineral activities under alternative C would reduce the acreage of potential water quantity stressors and impacts, associated with mineral development. This may avoid water quality impacts to human use, such as recreational and commercial fishing, public and private water supplies, and scenic enjoyment.

Animals and Plants as Food and Resources

None of the alternatives propose activities that would negatively affect fish, wildlife, or plant populations. Selection of alternative B, C, or D would slightly increase the areas available for special forest products (by less than 1 percent) across the entire Chugach National Forest.

Wood as a Renewable Energy and Fuel Source

No considered alternative would affect the accessibility of fuelwood as a provisioning service. While, selection of alternatives B, C, or D would increase the area available for subsistence and Alaska free use fuelwood and sawtimber, these additional areas are not near existing roads and therefore access would not be improved.

Education and Research

While all alternatives provide for education, outreach, interpretation, and research, in particular, the plan components in the action alternatives, especially alternatives C and D, place a greater emphasis on partnerships and collaborative relationships and acknowledge the values and interests in the Chugach National Forest held by Alaska Native Tribes and Corporations. In alternative C, the public would be provided opportunities to learn about Alaska Native cultural history and practices. Educational opportunities regarding Alaska Native culture are developed and/or reviewed by Alaska Native Tribes and Corporations in partnership with the Forest Service.

Alternative D

Economic Contribution of Chugach National Forest Management

Relative to alternatives A, B, and C, alternative D would recommend the largest amount of land for wilderness area designation. However, like alternative C, other changes in recreation opportunity spectrum classes were largely made to be consistent with the Kenai Winter Access Project Record of Decision (2007) and current permitted use. Several changes in settings may require future project-level travel management analyses and decisions to change motorized use designations, which may change visitor experiences. In terms of economic impact of recreational use, snowmobile users, for example, spend more than other recreational users (Stynes and White 2005). Therefore, future increases in motorized use could have positive economic impacts on the plan area. It is likely that the overall effect on economic contribution from changes in recreation opportunity spectrum classes would be minimal. However, in practice it is not possible to quantify this effect as it is not possible to estimate any changes in forest visitor activity patterns at this time.

Ecosystem Services

Water Quantity and Quality

In alternative D, the environmental consequences to water resources and overall watershed conditions would be low except at points of concentrated use. Proper management, use of BMPs, and adherence to standards and guidelines would reduce these impacts. Therefore there are very limited effects on water quantity and quality as an ecosystem service. See the Watershed and Water Resources section for a more complete review.

Animals and Plants as Food and Resources

None of the alternatives propose activities that would negatively affect fish, wildlife, or plant populations. Selection of alternative B, C, or D would slightly increase the areas available for special forest products (by less than 1 percent) across the entire Chugach National Forest.

Wood as a Renewable Energy and Fuel Source

No considered alternatives would affect the accessibility of fuelwood as a provisioning service. While selection of alternative B, C, or D would increase the areas available for subsistence and Alaska free use fuelwood and sawtimber, these additional areas are not located near existing roads and therefore access would not be improved.

Education and Research

While all alternatives provide for education, outreach, interpretation and research, in particular, the plan components in the action alternatives, especially in alternatives C and D, would place a greater emphasis on partnerships and collaborative relationships and would acknowledge the values and interests in the Chugach National Forest held by Alaska Native Tribes and Corporations.

Environmental Justice

There are no anticipated changes in employment and income as a result of the analyzed alternatives. There are no changes to the availability and access to subsistence resources. Therefore there are no anticipated effects to minority or low-income populations.

Table 24. Summary of consequences by alternative

Measurement Indicator	Alternative A No Action	Alternative B	Alternative C	Alternative D
Economic contributions of Chugach National Forest management	Quantifiable income and employment contribution from recreation, forest expenditures, and county payments	No change	No change	No change
Ecosystem Services				
Water quantity and quality	Provides drinking water, facility use, fish hatcheries, water-based recreation including fishing, mining, construction	Negligible improvement from alternative A	Decreased potential impacts to water quantity and quality and therefore avoided impacts to human use	Negligible improvement from alternative C
Animals and plants as food and resources	Traditional, cultural, subsistence, and recreational hunting, gathering, trapping, and fishing is sustainably supplied	No change	No change	No change
Wood as a renewable energy and fuel source	Fuelwood as a primary or secondary home heating source avoiding other fuel costs and providing traditional and cultural fuel source; use constrained by access	No change	No change	No change
Carbon sequestration and impacts of climate change	Forest is a carbon sink providing local and global benefits, such as avoided health and infrastructure damages	No change	No change	No change
Recreation experiences	Users value diverse nature-based outdoor recreation in largely remote setting	Adjustments to ROS classes aligned with winter access management plan and therefore user preferences	Increases to wilderness area aligned with many users' desired experience and values	No change from alternative C
Education and research	Benefits include connecting people with nature and culture, spiritual opportunities, increasing and improving the body of scientific knowledge	No change	Place a greater emphasis on partnerships and collaborative relationships and acknowledge the values and interests in the Chugach National Forest held by Alaska Native Tribes and Corporations	No change from alternative C
Sustaining biodiversity, intact ecosystems and connectivity for global ecological processes	Contribute to the resilience of forest-dependent communities as well as visitors	No change	No change	No change

Analytical Conclusions

No quantifiable economic impacts were found across the action alternatives. The future prospects for timber products utilization and treatments is not expected to change in the next 15 years mostly due to economies of scale and the low quality and volume of timber. Therefore, the commercial activity and economic contribution of the saw timber is not expected to change due to any alternatives analyzed. Similarly, no quantifiable economic impacts, such as employment or income effects, are noted across alternatives, and from recreation, special use permitting, or Forest Service spending.

While economic impact is not quantifiable at this time, the acres available to motorized use both by quantity and location could vary across alternatives due to future analyses and decisions to adjust travel management in accordance with the plan alternatives. Therefore, changes in recreational user visits and spending could occur. Any changes in recreation user spending would impact the economic contribution to the local economy of recreational users. However, in practice, these potential changes in motorized use settings across alternatives are generally made to be more consistent with the current recreation uses and travel management plan. Therefore, these proposed changes in recreation opportunity spectrum classes across alternatives may have little practical differences to user recreation experiences and resulting economic impacts. In either case, economic impacts are not quantifiable at this time.

There are limited effects to the ecosystem services across alternatives. Because recreation experience is one of the seven key ecosystem services, the largest potential effects to ecosystem services are found in this category as a result of the changes in the recreation opportunity spectrum classes and changes in recommended wilderness area acreage, which could result in additional changes if transportation management plans are adjusted in the future based on these plan changes. Changes in recreation opportunity spectrum and wilderness area could impact national forest user experiences. Some users could benefit from the increased wilderness area providing additional areas for remote, solitude experiences, while other users could be adversely affected from the removal of acres available for motorized uses.

Tribal Relations

This section summarizes the Tribal Relations Program for the Chugach National Forest and the potential impacts to Alaska Native Tribes and Corporations from the implementation of the forest plan or an alternative.

Introduction

The Forest Service recognizes its trust responsibilities and unique legal relationship with affected Alaska Native people and that the knowledge and advice of the indigenous people, with regards to cultural and natural resources as well as native knowledge, land ethics, cultural issues and sacred and culturally significant sites, are critical components in proper land management practices. Although directed by Federal law, policies, and formal agreements, the Forest Service recognizes that these responsibilities are best met through formal consultation and collaboration with Alaska Native Tribes and Corporations.

Government-to-Government Processes

Consultation and Coordination

Proper consultation begins early in the planning process with positive and developed relationships, both personal as well as professional.

The Forest Service recognizes the importance of and encourages formal consultation on a government-to-government or government-to-corporation basis in accordance with Executive Order 13175, Forest Service Policies and Regulations (FSH 1509.13, FSM 1500, USDA Departmental Regulation 1350-002) and Federal regulations (36 CFR 219.4(a), Title 40 CFR Parts 1500-1509). The Forest Service continually seeks to develop these relationships through meaningful collaborative processes.

Collaboration

The Forest Service views collaboration as a group of individuals that represent a diverse set of interests sharing knowledge, ideas, and resources while working together to achieve a common purpose. Although the Forest Service retains decisionmaking authority and responsibility on NFS lands, it encourages and recognizes the importance in these collaborations with the indigenous peoples of the lands it currently manages during decisionmaking processes in order to capture and consider all aspects of management practices for the Chugach National Forest. The Forest Service recognizes that these collaborations often go beyond formal government-to-government consultation and may involve other interested and knowledgeable individuals within the native community.

Legal Framework

Agreements and Memoranda of Understanding

The Forest Service seeks to enter into formal agreements and Memoranda of Understanding when the outcomes of such agreements and Memoranda of Understanding are mutually beneficial to the Forest Service in its management of NFS lands and to Alaska Native Tribes and Corporations.

Trust Rights and Responsibilities

The Forest Service, through official government-to-government and government-to-corporation consultation and collaborative efforts, recognizes the statutory rights and interests to private lands, subsurface holdings, and split estates under Section 14(h)(1) of ANILCA as well as its Section 17(b) easements entitlements.

Alaska Native Claims Settlement Act (ANCSA)

The ANCSA affords Alaska Native Tribes and Corporations statutory rights to land ownership through formal selections made within the State of Alaska and includes selected lands.

The Forest Service recognizes the continued rights of Cook Inlet Region, Inc. (CIRI) to select an additional 43,000 acres of yet to be determined public lands within the State of Alaska, and potentially in whole or in part within public lands managed by the Forest Service.

The Forest Service recognizes the intent of Alaska Native Tribes and Corporations to develop economic benefits of their conveyed lands, and is supportive in their legal rights to access and to development. Tribal access to land holdings within the Chugach National Forest have the potential to be affected by policy decisions, administrative actions, and physical impacts on the land. Specific concerns expressed to the Forest Service by Alaska Native Tribes and Corporations stem primarily from the designation of the Nellie Juan-College Fjord Wilderness Study Area and access rights afforded these Tribes and Corporations under the provisions of the ANCSA. It is the intent of the Forest Service to honor the statutory rights afforded Alaska Native Tribes and Corporations as outlined within the provision of the ANCSA.

Because the ANCSA legislation requires Alaska Native Corporations (ANCs) to share 70 percent of annual net profits amongst the 12 regional corporations each year, the Forest Service recognizes that the effects of its actions and decisions in managing the land extend beyond directly affected Alaska Native Tribes and Corporations and have the potential to economically affect all of the Alaska Native population. The Forest Service seeks to address and minimize or remove these issues when and as they may arise at the bequest of Alaska Native Tribes and Corporations directly affected by the implementation of this plan and resultant activities of Forest Service management practices.

Russian River Land Act

Under the provisions of the Russian River Land Act (RRLA) and its implementation of the Sqilantnu Archeological District Memorandum of Understanding, CIRI holds special interests within the Chugach National Forest. The Forest Service is an active participant in the resultant consultation group established by the RRLA and its implementation of this Memorandum of Understanding and recognizes and honors the special provisions established in providing CIRI with these special interests. Other participants of this Memorandum of Understanding group include the Kenaitze Indian Tribe and the U.S. Fish and Wildlife Service.

Alaska Native Interests in the Chugach National Forest

Native Traditional Knowledge

Affected Alaska Native Tribes have traditional and continual use of the Chugach National Forest and not only have considered this area their traditional homeland for thousands of years, but that it is also their home today. Three major groups of Alaska Natives consider this area their ancestral homeland. This includes the Ahtna, Dena’ina, and Sugpiaq people who all maintain a continued physical presence within the national forest. Other Alaska Natives also have varying interests in the management of the national forest. Interests extend beyond a view of the landscape as their traditional homeland and include connections with sacred sites, ceremonial use areas, and religious sites. The Chugach National Forest is important with regards to creation accounts and modern and traditional subsistence, which includes hunting and gathering as well as fishing practices.

Perhaps most importantly, the Chugach National Forest is viewed by affected Alaska Natives as critical to their identity and the continued welfare of their people. Alaska Native concerns with the management of the Chugach National Forest encompass all activities that have the potential to affect their traditions, beliefs, usage, and identity. Traditional Alaska Native knowledge, as well as current practices and use of the national forest, is an invaluable source of information recognized by the Forest Service as critically important in the management of this area.

Sacred Sites and Culturally Sensitive Areas

Culturally important sites held sacred or culturally sensitive by Alaska Native people may be held in trust by public lands managed by the Forest Service. The Forest Service’s responsibility to protect tribally important sites is represented in numerous executive orders, legislation, regulations, and other statutory authorities (FSM 1500). As part of joint responsibilities within Forest Service administrative structure, the Heritage Program shares often overlapping responsibility with the Tribal Relations Program with regards to protection and management of culturally important Alaska Native Sites, including sacred sites (see Cultural Resources section of this chapter for more details).

Native Subsistence

ANILCA (16 U.S.C. 3114) mandates that the taking of fish and wildlife for subsistence uses by Native and non-native rural residents in the State of Alaska on public lands shall be afforded a priority over the taking of fish and wildlife resources for other purposes, except as otherwise prohibited by other provisions within the act or other Federal law. Although the National Interest Lands Conservation Act does not provide for Alaska Native preference for subsistence in Alaska, the Federal Subsistence Board (FSB) and those delegated authority to act on behalf of the board engage in consultation with Indian tribes and ANCs (pursuant to EO 13175, the FSB's Tribal Consultation Policy, and the ANCSA Corporations Consultation Policy) (see Subsistence Resources section of this chapter for more details).

Affected Environment

The Chugach National Forest is the primary source of traditional food, medicine, building materials, heating supplies, and clothing for various affected Alaska Natives whose traditional lands and waters have been subsumed within the current management of the national forest. All Forest Service management practices have the potential to affect Alaska Natives who use these resource areas for their existence and traditional practices. The Forest Service strives to identify and work with those potentially affected by management practices and minimize or remove these effects where possible.

Environmental Consequences Common to all Alternatives

Any endeavor in the management of public lands has the potential to adversely affect the indigenous people of that region. However, because this forest plan does not authorize any specific activities or uses, there are no direct effects to interested Alaska Native Tribes or Corporations.

Alternatives C and D recommend additional lands in the Nellie Juan-College Fjord Wilderness Study Area for designation as wilderness areas. However, neither the current wilderness study area status nor these recommendations would affect the statutory rights related to traditional subsistence practices or access to lands acquired under ANILCA.

The Forest Service will continue to develop its relationships with interested and affected Alaska Native Tribes and Corporations through consultation and partnerships. Recognizing that the Chugach National Forest is the ancestral land of these people, and that they have continuously shown interest in proactive participation in the management decisions and practices of management, the Forest Service acknowledges and supports their traditional knowledge, statutory rights, and tribal interests.

Cultural Resources

Introduction

This section describes the effects of the proposed Chugach National Forest Land Management Plan and alternatives on historic properties and cultural resources. Management of culture and history is an important part of Federal land management policy and practice.

Preservation of this resource helps to give a sense of orientation to the American people whose ancestors left behind traces of their legacy as seen in archaeological sites, historic properties, traditional cultural places, and sacred sites, among others. It is this resource area that ties together the historic human use of the landscape to practices employed on it today. It tells the story of the changes in the environment and how humans benefited, impacted, or were otherwise affected by their utilization of the landscape and varying environmental conditions through time.

Methodology

Spatial Scale

All land within the Chugach National Forest boundary.

Temporal Scale

The 15-year planning period.

Measurement Indicators

Degree of degradation of historic properties and cultural resources.

Analysis Methods and Assumptions

The forest plan does not authorize impacts to cultural resources. It can be assumed that this forest plan will not alter in any way the human activities that may directly or inadvertently adversely impact cultural resources or result in the necessity of alteration in current heritage program management practices. It can further be assumed that natural degradation will continue to occur during the planning period at the same rate as the previous 2002 plan’s life and there will be no need to alter current heritage program management practices.

Affected Environment

As of December 2016, cultural resources inventories within the Chugach National Forest have resulted in 2,266 individual cultural resources identified. A cultural resource is defined as an object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic, archeological, or architectural sites, structures, places, or objects and traditional cultural properties. Cultural resources include the entire spectrum of resources for which the heritage program is responsible from artifacts to cultural landscapes without regard to eligibility for listing on the National Register of Historic Places (National Register). Historic property is defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian Tribe or Native Hawaiian organization and that meet the National Register criteria.

The National Historic Preservation Act (NHPA) requires that cultural resources discoveries be evaluated for their eligibility potential and inclusion in the National Register of Historic Places. The goal is to acknowledge and address information that may be important to history or individual groups, such as the indigenous people within the United States’ territorial possession, and is based on the quality of significance to American history, architecture, and culture that possess integrity of location, design, setting, materials, feeling, and association.

Within the management boundary of the Chugach National Forest, 121 individual historic properties have been determined eligible for inclusion in the National Register of Historic Places. Of these, 15 have been formally listed. Forest Service management directives and policies as well as current professional practice is to treat unevaluated cultural resources as if they are eligible for inclusion in the National Register. Due to temporal, budgetary, and manpower issues, the majority of cultural resource discoveries to date within the Chugach National Forest fall into this category. Of the 2,266 identified historic properties discovered to date, only 31 with eligibility determinations have failed to exhibit the required elements of integrity and have been determined ineligible for inclusion in the National Register.

Two national historic landmarks have been designated by the Secretary of the Interior as nationally significant historic places possessing exceptional quality in illustrating or interpreting the cultural resources of the United States within the managed lands of the Chugach National Forest.

1. The Palugvik site is an ancestral habitation site of the indigenous Chugachmuit Alutiiq people, who lend their name to this national forest. Palugvik was given the National Historic Landmark designation in 1962, and was formally listed on the National Register of Historic Places in 1966.
2. The second is on Kayak Island and represents the Bering Expedition of 1741, and its subsequent landing on this Island. This landing has been recognized as the first scientific investigation in northwestern North America. Georg Wilhelm Steller, the ship's surgeon and naturalist, spent 10 hours on the island exploring and recording his observations. His findings were preserved and later published. The exact location of this landing has been estimated based on Steller's notes and the ship's logs. No evidence of the actual landing has yet been discovered. This site was designated as a National Historic Landmark in 1978.

The Iditarod National Historic Trail (INHT) runs through the Chugach National Forest from Seward, Alaska to Girdwood where it leaves the national forest near Crow Pass. Numerous secondary trails connect with the INHT connecting other communities historically. This trail was originally the connection of several native use routes along the Kenai Peninsula and Turnagain Arm area. Historic use of the trail was due to the influx of gold miners around 1910. Associated with the trail system were numerous roadhouses and dog barns occurring about every 20 miles or so along its route. The trail is and was primarily a winter use trail system traversed with the aid of dogs and sleds. Numerous mines, cabins, and camps have been recorded as cultural resources that have association with the INHT along its route.

The Chugach National Forest also contains historic properties that have numerous sites and features that are in some way related to each other. These areas are often recorded as historic districts, rather than individual sites. Examples of this would include historic townsites, such as Portage, or a prehistoric village site with multiple features, such as pit house depressions, cache pits, or individual artifacts. A prehistoric rock quarry where indigenous people would have acquired tool making materials may also qualify for district designation. Several historic districts within the Chugach National Forest have been formally recorded and determined eligible for inclusion in the National Register of Historic Places. Individual examples of prehistoric designated archeological districts within the Chugach National Forest include the Palugvik Archeological District, the Rocky Bay Archaeological District, and the Sqilantnu Archeological District. An example of a historic archeological district would be the historic townsite of Portage, Alaska at the head of the Turnagain Arm of Cook Inlet.

Many eligible historic properties have been selected by ANCs for conveyance under Section 14(h)(1) of the ANCSA. Once selected properties have been conveyed to these corporations, all associated collections and records of cultural resources and management concerns become the property of the

ANCs to whom the land was conveyed. As of January 2017, 23 cultural resources sites have been removed from Forest Service management due to these conveyed lands.

The total extent of cultural resources within the Chugach National Forest is unknown. As of 2017, less than one percent of the national forest has been inventoried for the presence or absence of these resource types. These inventories have occurred primarily along modern travel corridors (existing roads and trails) and areas containing modern-use facilities (such as buildings and structures). Additionally, numerous shorelines within Prince William Sound have had more intensive inventory endeavors due to natural disaster responses. Heavier public riverine system use as travel corridors and for recreational and subsistence use has resulted in inadvertent discoveries of cultural resources that has led to further inventory endeavors in an effort to address those discoveries.

Logistical issues resulting from environmental conditions as well as budgetary and manpower issues has greatly limited the ability to inventory more than 28,000 acres of the NFS lands lying further than one-quarter mile from existing infrastructure and previously mentioned travel corridors. This figure represents less than one percent of total lands managed by the Forest Service.

Environmental Consequences

Indirect Effects

All undertakings by the Forest Service require consideration of effects to all cultural resources. Compliance with Section 106, through the implementation of the programmatic agreement among the USDA Forest Service, Alaska Region, the Advisory Council on Historic Preservation Alaska Clean Water Action Priorities (ACWA), and the Alaska State Historic Preservation Officer regarding Heritage Program Management on National Forests in the State Of Alaska (Programmatic Agreement) (2017) would be considered and completed prior to implementation of any project, special use permitting, or activity. Consultation with the Alaska State Historic Preservation Officer (SHPO), the Advisory Council on Historic Preservation, affected Alaska Native Tribes and Corporations, the public, and other stakeholders may be completed as outlined in the Programmatic Agreement and in accordance with Federal Laws and Executive Orders as well as other Memoranda of Agreement and Programmatic Agreements as applicable. Standards and guidelines in the 2002 and proposed forest plans reinforce these requirements. Indirect adverse effects are avoided or mitigated through project design and development in accordance with Section 106 of the NHPA and the Programmatic Agreement.

Because cultural resources are a non-renewable resource, destruction and damage to them cannot be undone. Care must be afforded in order to protect the integrity of cultural resources and historic properties through protection measures or mitigation plans in consultation with the above mentioned parties.

Indirect effects to cultural resources have the potential to occur as unintended consequences of management actions and authorized uses. Indirect effects to cultural resources may result from increases in public access and use of an area, and other designated special uses. Increasing human interactions in these areas increases the potential for cultural resources disturbance and destruction.

Unknown cultural resources may be discovered during project activities, resulting in unplanned and inadvertent adverse impacts to such cultural sites. Upon discovery, these cultural resources continue to be afforded protection through the presumption that unevaluated cultural resources are eligible for inclusion in the National Register of Historic Places until otherwise determined eligible or confirmed ineligible. In addition, the forest plan mandates that work be immediately stopped upon discovery of cultural resources until the appropriate protections can be put in place. Unplanned or inadvertent adverse impacts to all cultural resources, known or inadvertently discovered, are mitigated on a case-by-case basis through consultation with the State Historic Preservation Officer, affected Tribal partners, and other interested parties as well as the Advisory Council on Historic Preservation Advisory Council on Historic Preservation if they choose to participate.

The amount and degree of these kinds of impacts would not vary by alternative because management of cultural resources is almost exclusively dictated by law, regulation, and policy.

The action alternatives described in chapter two of this DEIS, as well as the assumptions made in chapter three remain consistent with the 2002 forest plan (no-action alternative) as well as with current management practices for cultural resources. None of the action alternatives would result in additional adverse effects beyond those described previously.

Cumulative Effects

No cumulative effects to cultural resources would result from any of the alternatives.

Subsistence Resources

Introduction

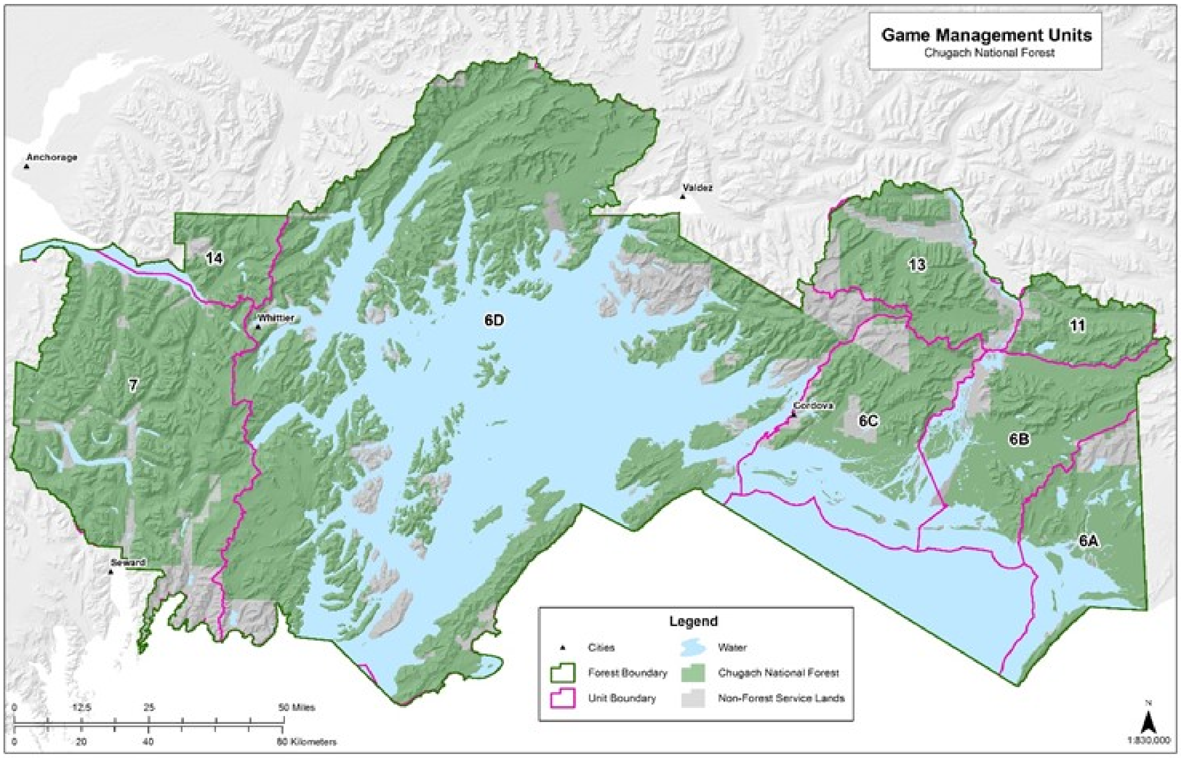
Subsistence hunting, fishing, trapping, and gathering activities are a major part of life for many Alaska residents. Some individuals participate in subsistence activities to supplement personal income and provide needed food. Nearly all rural Alaska communities depend on subsistence resources to meet some portion of their nutritional needs (fall 2016). Others pursue subsistence activities to perpetuate cultural customs and traditions. Still others participate in subsistence activities for reasons unconnected with income or tradition. For all these individuals, subsistence is a lifestyle reflecting deeply held attitudes, values, and beliefs.

Given southcentral Alaska’s seasonal and cyclical resource-based employment, subsistence harvest of fish and wildlife resources may play a major role in supplementing cash incomes during periods when the opportunity to participate in the wage economy is either marginal or nonexistent. Because of high prices of commercial products provided through the retail sector of the cash economy, especially in remote communities, the economic role of locally available fish and game takes on added importance.

Native and non-Native communities both have high subsistence participation rates and rely heavily on wild foods, with approximately 86 percent of rural Alaska households using wild game and 95 percent using fish (Fall 2016). The opportunity to participate in subsistence activities reinforces a variety of cultural and related values in both Native and non-Native communities.

Six communities that qualify as rural under Federal subsistence regulations for the harvest of fish and wildlife are located within the boundary of the Chugach National Forest: Cordova, Tatitlek, Chenega Bay, Whittier, Hope, and Cooper Landing. Household surveys have determined individuals in these communities harvest 203 pounds of consumable wild renewable resources per capita (Fall 2016). When compared to the average per capita purchase of meat, fish, and poultry of 225 pounds (National Chicken Council 2017), this indicates a high dependence on natural resources for food by these communities.

The Chugach National Forest subsistence program plays a supportive role to the Federal subsistence program by issuing harvest permits and collecting and entering harvest reports and supporting population monitoring conducted by the Alaska Department of Fish and Game.



Map 7. Portions of game managements units within the Chugach National Forest boundary

Methodology

Spatial Scale (indirect and cumulative effects analysis areas)

The entire forest plan area is being considered for this analysis. Game management units 6 and 7 comprise most of this area and are the primary management units used for fish and wildlife populations important to subsistence users (see map 7). The national forest also includes small portions of game management units 11, 13, and 14. The portions of game management units 11 and 13 within the Chugach National Forest boundary are remote and relatively inaccessible. The portion of game management unit 14 within the national forest boundary is relatively distant from the rural communities within or adjacent to the national forest. Since rural harvesters typically harvest most of their subsistence resources from areas near their communities, these portions of these units will not be considered further in this analysis.

Harvest of fish and wildlife by subsistence users from the Chugach National Forest is difficult to track precisely, but total numbers of harvested wildlife and fish from the plan area do provide an important metric of food resources produced (see figure 9). The boundaries of game management units 6 and 7 encompass most of the plan area; however, certain conditions should be noted as they apply to harvest by qualified rural residents for subsistence. The reported harvest comes from state harvest records, which includes harvest for subsistence and sport by rural and non-rural Alaska residents, as well as non-residents. While these game management units contain mostly Federal lands (71 percent Federal land in game management unit 6 and 77 percent in game management unit 7) some of this harvest is from non-federal lands. To track only the harvest that takes place under Federal harvest regulations would be misleading, as the harvest of some important subsistence resources, i.e., deer harvest in game management unit 6, takes place almost entirely under the state management system, except in times of shortage. Portions of game management units 11, 13, and 14 were excluded from this analysis. While a small portion of each of these game management units falls within the Chugach National Forest, these are relatively remote areas and are far from the rural communities of the national forest.

Temporal Scale

The temporal scale for which the effects of this analysis will be considered is the 15-year plan period.

Measurement Indicators

Three factors related to subsistence uses are specifically identified by ANILCA, and are used as indicators in this analysis: 1) resource distribution and abundance, 2) access to resources, and 3) competition for the use of resources. These factors are discussed in general terms in the following paragraphs.

Affected Environment

The communities in or adjacent to the Chugach National Forest that are currently considered rural in Federal subsistence management regulations for the harvest of fish and wildlife are Hope, Cooper Landing, Whittier, Chenega Bay, Tatitlek, and Cordova.

Hope and Cooper Landing are located on the Kenai Peninsula. Within game management unit 7, which consists largely of the Chugach National Forest portion of the Kenai Peninsula, primary wildlife resources available to these rural residents include black bear, brown bear, caribou, moose, Dall sheep, mountain goat, beaver, coyote, fox, wolf, lynx, wolverine, marten, mink, weasel, muskrat, river otter, hare, spruce grouse, and ptarmigan. The Kenai River provides spawning habitat for an abundance of fish species, including salmon, trout, Dolly Varden/char, and smelt.

While all residents of the Kenai Peninsula may harvest fish and wildlife under State hunting and fishing regulations, qualified rural residents as defined by the Federal subsistence management regulations (Hope and Cooper Landing) have additional opportunity. Both communities qualify for Federal subsistence hunts for caribou and moose that allow either longer seasons, or more liberal definitions of animals that can be harvested legally, or both. These communities also qualify for a Federal subsistence fishery that allows dip-netting of salmon, predominantly sockeye, at the Russian River Falls.

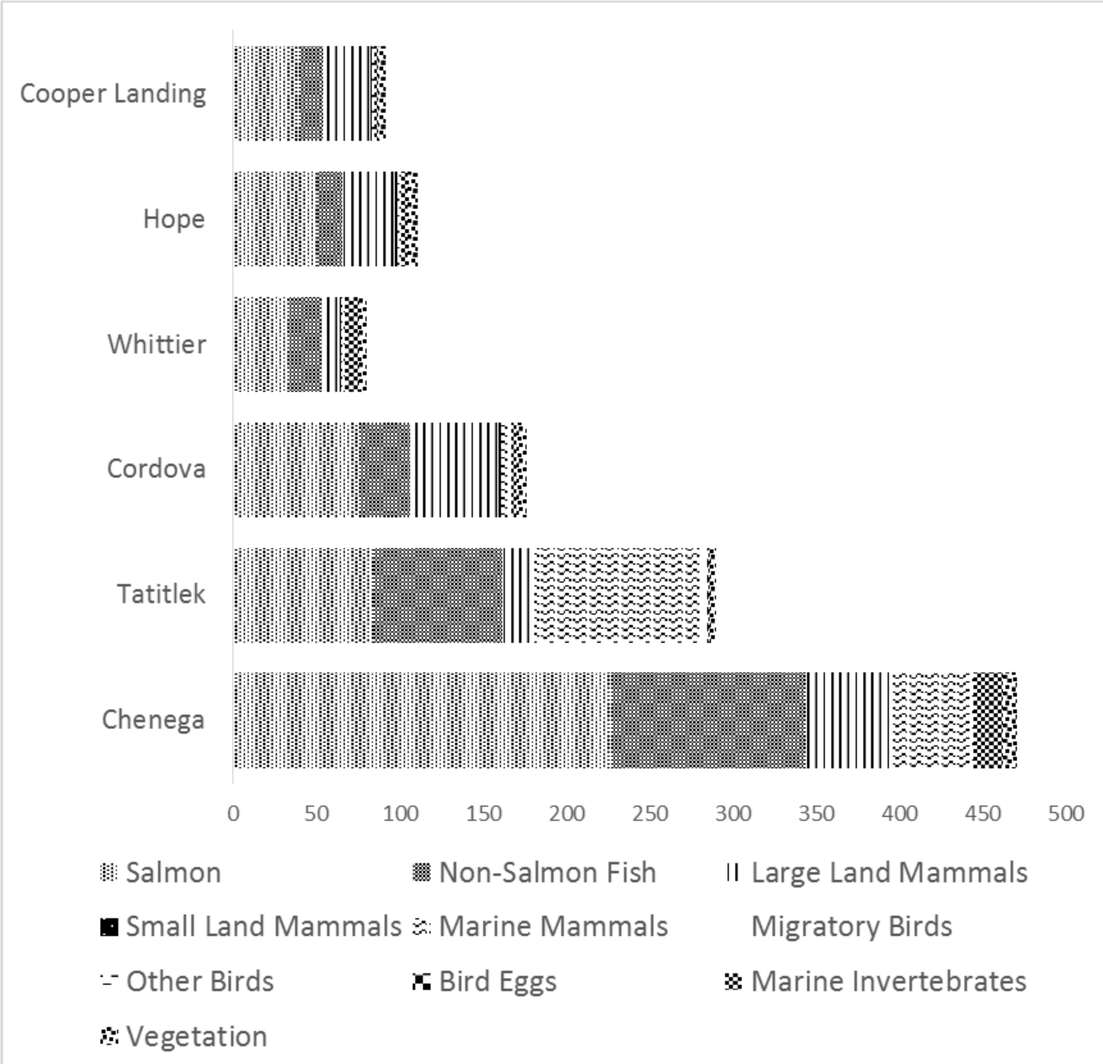


Figure 9. Pounds of subsistence resources harvested per capita by residents of qualified rural communities within the Chugach National Forest

The communities of Whittier, Chenega, Tatitlek, and Cordova are located on Prince William Sound. Primary wildlife resources available to residents of game management unit 6, which includes Prince William Sound and the Copper River Delta, include black bear, brown bear, moose, mountain goat, Sitka black-tailed deer, beaver, coyote, fox, wolf, lynx, wolverine, marten, mink, weasel, muskrat, river otter, hare, spruce grouse, and ptarmigan. The waters of Prince William Sound and the Copper River Delta provide spawning habitat for an abundance of fish species that provide for subsistence uses. Marine species, such as halibut, rockfish, lingcod, shrimp, clams, and crabs, are important resources but occur in marine waters and will not be treated in this analysis. The freshwaters of this region provide habitat for salmon, trout, Dolly Varden/char, and smelt.

All qualified rural residents of Alaska have a Federal subsistence priority for deer in game management unit 6. Residents of game management units 6C and 6D, namely residents of Cordova, Tatitlek, Chenega Bay, and Whittier, are eligible to participate in a Federal hunt for mountain goats in game management unit 6D. Of particular importance to residents of Cordova is the Federal subsistence moose hunt in game management unit 6C. Over 1,000 residents annually apply to the random drawing for the available quota of antlerless moose and 75 percent of the bull moose in game management unit 6C. Residents of Chenega Bay, Tatitlek and Ellamar qualify for a dipnet fishery for pink salmon in waters that flow into Prince William Sound. Cordova residents qualify for a Federal fishery for salmon and other species on waters of the Copper River Delta excluding the Copper River and its tributaries.

Of the six communities considered, the predominantly Native villages of Chenega Bay and Tatitlek rely upon the national forest the most, averaging 605 and 507 pounds per person of wild resources for home use in the early 1990s. This is typical of isolated rural, subsistence-dependent coastal or interior communities. In 1993, Cordova residents harvested an average of 204 pounds per person, similar to southeast Alaska rural community average of about 210 pounds per capita. Hope, Cooper Landing and Whittier harvested 111, 92, and 80 pounds per person, respectively. By comparison, non-rural areas, such as Anchorage, Matanuska-Susitna Borough, and the Kenai Borough, average 48 pounds per person. The average number of resources used per household per year ranged from 19 in Tatitlek and Chenega Bay to eight in Whittier and Cooper Landing.

Figure 9 summarizes the use patterns and amounts for the six qualified rural communities known to use the Chugach National Forest for subsistence purposes. Included are wild resources that are found within the national forest. The six communities are variable in the variety and amount of harvests, though all show a heavy use of fish, particularly salmon.

Abundance and Distribution of Resources

Resources used by qualified rural residents for subsistence are varied and include animals, plants, and even fungi. This section will focus on the effect of the forest plan and alternatives on subsistence fish and wildlife resources. Effects to other subsistence resources, including fuelwood and plants, will be treated in other sections. The most important single resource used for food by rural communities within the Chugach National Forest is salmon. Households in these communities harvest an average of 230 pounds of salmon per year. Other fish species, both fresh and salt water, mammals and birds, and marine invertebrates (crabs, clams, and shrimp) are also among the important subsistence resources used as food.

The abundance and distribution of subsistence resources within the Chugach National Forest are described in the wildlife, fish, vegetation, and other sections of this DEIS. The climate change assessment does not indicate that the abundance of wild renewable resources important to subsistence uses will change within this planning cycle (Hayward et al. 2017). While functioning ecosystems of the Chugach National Forest provide abundant resources for subsistence uses, there are a few exceptions where wild populations may not be fully supporting subsistence uses and needs. These resources are discussed separately.

The game management unit 7 moose population irrupted most recently during the 1960s after wildfires in adjacent game management unit 15A created large areas of early successional vegetation. Wolf numbers were simultaneously reduced to low levels. A rapid population decline followed in the early 1970s after three severe winters in four years. The population has fluctuated at low levels since then as predator populations have stabilized and habitat succession progressed into climax stages (Del Frate 2002). The game management unit 7 moose population is considered stable at low densities and is expected to remain at these levels unless significant habitat alteration occurs (McDonough 2010). As a result, the communities of Cooper Landing and Hope, who have had customary and traditional use determinations for game management unit 7 moose since 2008 and 2010, respectively, have harvested a total of zero to two moose annually.

Similarly, the moose population in Kings Bay, a disjointed segment of the game management unit 7 moose population, has not been capable of sustaining subsistence needs for the communities of Tatitlek and Chenega Bay, which have a Federal customary and traditional use finding for moose in this resource. The amount of moose habitat in the Kings Bay area is very small, and consists of narrow riparian areas along the Kings River and Nellie Juan River. Productivity and viability of this small segment of the game management unit 7 moose population is marginal. Moose surveys in 1997, 2001, and in 2005 have counted 20, 9, and 5 moose, respectively (Spraker 2001; OSM 2005). A 2012 survey flown in the Kings Bay portion of game management unit 7 following the severe winter of 2011-12, revealed no moose or moose tracks. As a result of these low numbers, the FSB has acted to keep the moose season closed for conservation concerns. As a result of low moose densities, abundant forested habitats that make surveys difficult and budgetary constraints, very little moose monitoring has been conducted by Alaska Department of Fish and Game in game management unit 7. Additional survey efforts would improve the management of the small population of moose in Kings Bay and help identify management opportunities in the remainder of game management unit 7.

Historical reports say caribou were abundant on the Kenai Peninsula before a series of large fires in the late 1800s (Sherwood 1974). However, caribou were extirpated on the Kenai Peninsula by 1913, and reintroductions occurred in 1965 and 1966. The Kenai Mountains segment of the current population is derived from these reintroductions. While this population has numbered as many as 500 caribou, population estimates declined sharply from 2009 to 2014 and have been below State management objectives since 2011. The small size of the Kenai Mountains Caribou Herd has become a conservation concern and the State reduced the number of drawing permits from 250 to 25 in recent years. The communities of Hope and Cooper Landing have a Federal priority for game management unit 7 caribou and the FSB has established a quota of five caribou, split between the two qualified communities. While this quota was met the first year that Cooper Landing was added to this hunt, more typically, a total of one or two caribou are harvested.

Black bears are common throughout most of the Chugach National Forest; however, hunting pressure may affect local populations. Past research has indicated that hunting pressure may have locally reduced Prince William Sound black bear populations (McIlroy 1970; Modafferi 1978). The opening of the Anton Anderson Memorial Tunnel to Whittier in 2000 facilitated access to Prince William Sound and concerns over the increase in black bear harvest has led to a series of regulatory actions starting in 2003, including season date changes, limitations on bear baiting, and the prohibition of shooting from a boat. The management objective prior to this reporting cycle of 200 bears in the harvest has been regularly exceeded since 1985 (Westing 2004). The harvest in game management unit 6D increased from less than 200 bears prior to 1997 to over 500 black bears in 2007. Additionally, the percentage of females in the harvest in game management unit 6D has exceeded management objectives since 2006. Harvest has declined since 2007 and for regulatory years 2015 and 2016, was approximately 100 black bears. The majority of this harvest (75 to 90 percent) comes from the western portion of game management unit 6D. While there is a Federal priority for black bears in game management unit 6, qualified rural residents of Prince William Sound take approximately one percent of the harvest.

Access

Access is an important component of subsistence and varies throughout the Chugach National Forest. Section 811 of ANILCA states that “rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on the public lands” and “notwithstanding any other provision of this Act or other law the Secretary shall permit on the public lands appropriate use for subsistence purposes of snowmobiles, motorboats, and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulation."

The Chugach National Forest is largely wild in character, without a well-developed road system outside of State highways. Historical access has been primarily by foot, boat, and plane. Virtually all of the Chugach National Forest is open to the harvest of subsistence resources except for small areas that might be restricted due to safety concerns, such as active mines or developed recreation sites. The only area specifically closed to motorized use, even for qualified rural subsistence users, is the Power Creek drainage within the Cordova Ranger District. Most NFS lands that are closed to motorized vehicles remain open to motorized vehicles by qualified rural residents pursuing subsistence activities.

The Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula predicts that changes in temperature and snowline, could affect winter access (Hayward et al. 2017). The predicted longer transitional period between fall and winter and winter and spring (later freeze-up and earlier thaw) would reduce the period that snowmachines could be effective for access to subsistence resources (Fresco and Floyd 2017).

Competition

Competition for subsistence resources results from demand for resources that is greater than the supply at a scale that is meaningful to subsistence users. Factors, such as abundance and distribution of natural resources, access, harvest regulations, and changes to habitat, may influence competition for resources. A large non-rural population surrounds the Chugach National Forest and may compete directly for subsistence resources by participating in harvest activities, or indirectly, by displacing rural resident harvest through recreational activities. Competition for wildlife and fisheries resources near rural communities results from the combination of these factors.

ANILCA Title VIII provides a rural preference for the harvest of fish and wildlife on Federal lands. Rural residents of the Chugach National Forest presently have Federal seasons and harvest limits that differ from those in State hunting and fishing regulations for many of the most important subsistence resources, including moose, caribou, and salmon in game management unit 7 and for deer, moose, mountain goat, black bear, and salmon in game management unit 6. These regulations are intended to provide a meaningful preference for fish and wildlife and if subsistence needs of qualified rural residents are not being met, they may submit proposals to the FSB to change these regulations.

Additionally, Section 810 of ANILCA mandates that before allowing various uses of public lands, Federal agencies shall evaluate the effects of such uses on subsistence uses and needs. This process is currently used by the Forest Service before any projects or special uses are permitted.

Subsistence harvesters use areas close to their home communities most intensively. Through household surveys, Poe et al. (2010) identified the areas most intensively used by qualified rural residents of Prince William Sound and their intentions to continue using them. While households reported using some resources less than in the past, reasons other than competition were most commonly given. However, 17 percent of these households did report that they intended to use some areas less in the future due to the presence of others. The majority of these areas are adjacent to the communities of Cordova, Whittier, Tatitlek and Chenega and likely are due in part to the fact that these are some of the most heavily used areas by harvesters.

Environmental Consequences

Abundance and Distribution of Resources

The alternatives analyzed would result in little change to the abundance and distribution of resources important to subsistence. Natural processes and wild landscapes will continue to predominate and provide habitat for fish and wildlife. Most wild renewable resources will continue to be abundant and provide for subsistence uses.

Continued forest succession, however, appears to be detrimental to the moose and caribou populations of the eastern Kenai Peninsula. Because little habitat manipulation is proposed in any of the alternatives, moose and caribou populations in game management unit 7 of the Kenai Peninsula will continue to decline or exist at low population levels that do not provide a meaningful contribution to the rural communities of Hope and Cooper Landing, unless natural disturbances alter the vegetation.

Access

None of the alternatives limit access to public lands for the purposes of subsistence gathering activities. No new road construction is proposed in this forest plan or in any of the alternatives. Motorized access for subsistence activities by qualified rural residents of Alaska would not change under the alternatives. Alternatives C and D recommend wilderness area designation on the eastern Kenai Peninsula/western Prince William Sound; however, Section 811 of ANILCA would continue to allow reasonable access for subsistence uses and motorized access subject to reasonable regulation.

Competition

The forest plan and alternatives do not recommend any new road construction or development of hardened recreation facilities. Additionally, ANILCA Title VIII provides a framework to protect subsistence resources and uses: ANILCA Section 810 outlines the process for how potential effects to subsistence resources, uses, and needs are evaluated for land use decisions; ANILCA Section 814 allows the establishment of regulations for the harvest of fish and wildlife by qualified rural residents of Alaska; and ANILCA Section 815 authorizes the restriction of non-subsistence uses to protect subsistence resources; and ANILCA Section 816 authorizes the ability to close public lands to the taking of fish and wildlife for public safety, administration, or to assure the continued viability of populations.

Cumulative Effects

The cumulative effects to subsistence uses and resources include the impact of the alternatives as well as reasonably foreseeable future activities and activities planned on adjacent lands. The preceding analysis summarizes the effects of the alternatives. Land management policies and direction of adjacent Federal and State land managers generally align with Forest Service management direction. Specific projects on CAC lands have developed mitigation measures that would reduce impacts to subsistence resources. The cumulative effects of the alternatives combined with the reasonably foreseeable future activities and activities planned on adjacent lands could result in minor localized impacts to subsistence resources or use of those resources within the Chugach National Forest.

Forest Products

Introduction

This section describes the affected environment and environmental consequences to alternatives relating to forest products management in the proposed forest plan for the Chugach National Forest. The focus of this section is to evaluate the lands where forest wood products may be obtained based on land suitability, as well as the productivity of those lands to produce forest wood products sustainably into the future. In brief, the primary areas available for forest wood products management are along existing road corridors, since much of the remaining forest is in areas inaccessible or otherwise unavailable for these purposes for a number reasons. The reasons will be addressed in this section, with further discussion and documentation in forest plan appendix B Timber and Wood Product Suitability.

In addition, special forest (non-woody) products will also be briefly discussed. Areas open to forest wood products along roadsides are also areas where special forest products are typically gathered, collected and removed. No changes are being proposed in the special forest products program, which will remain the same, more or less, as in the 2002 forest plan.

The Chugach National Forest is the most northern national forest. The forested lands that make up the national forest have been an integral part of human existence since the lands were first inhabited following the last ice age. Humans have benefited by the direct use of forest products in various ways, such as for protection from the weather, for heating, as tools, as well as indirectly through the many ecosystem services that forests provide, such as clean water, clean air, carbon storage, and wildlife habitat, to name a few. Today the national forest continues to provide forest products and ecosystem services to the local population.

Methodology

Spatial Scale

The overall area of analysis are the NFS lands within the Chugach National Forest boundary, focusing on the forested ecosystem portion. Within this area, the principal areas of analysis are the forested lands along existing roads that are accessible and available to forest products management. These forested lands can be further refined as occurring within about one-quarter mile of existing roads. These are the lands that can logically, and in some cases legally, be managed for forest products.

Temporal Scale

The basic planning horizon to assess effects for forest products management is the 15 year planning period. The first and second decade of forest plan implementation (i.e., 10 to 20 years) is also evaluated regarding potential wood volume output, as required by the 2012 planning rule.

To fully assess implications to the affected environment, a 100-year timeframe will be used. This length is needed to assess the long term effects of forest vegetation treatments on forest products availability and sustainability for public use, as well as for desirable wildlife habitat and other resource needs. A 100-year timeframe will also be considered to assess large, mature forest conditions that provide for many ecosystem services, such as providing for clean air and water, carbon sequestration, and late-seral wildlife habitat. All of these require a much longer timeframe to evaluate the effects of management than the 15-year planning period covered under this forest plan revision.

Measurement Indicators

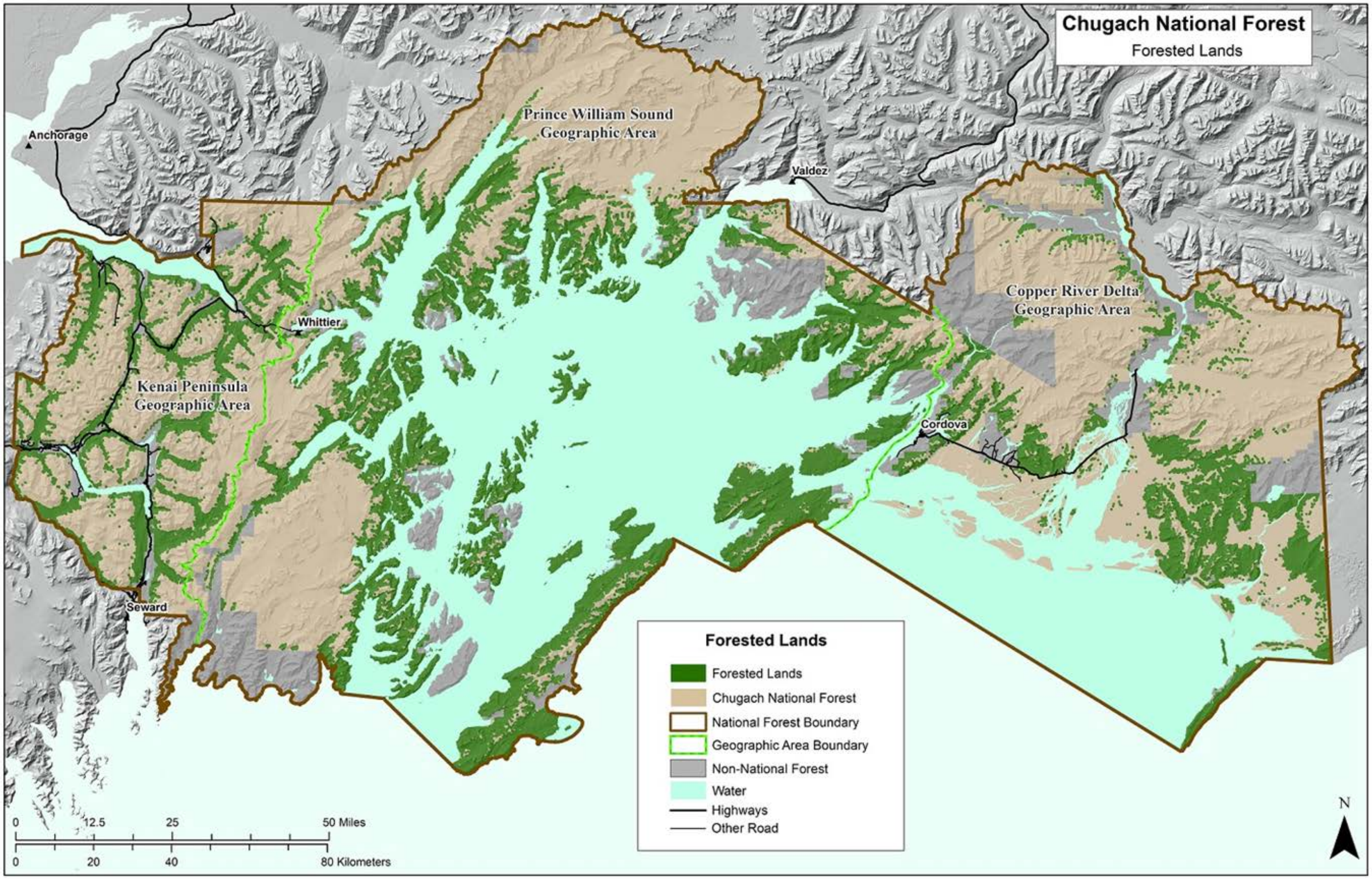
The acreage available for forest wood products management, including commercial, non-commercial and personal use/Alaska free use, as well as the volume quantities produced from those lands, are used to compare alternatives. Wood products volume harvested from the lands will be compared to growth from the same area being treated to determine sustainability of forest management.

Analysis Methods and Assumptions

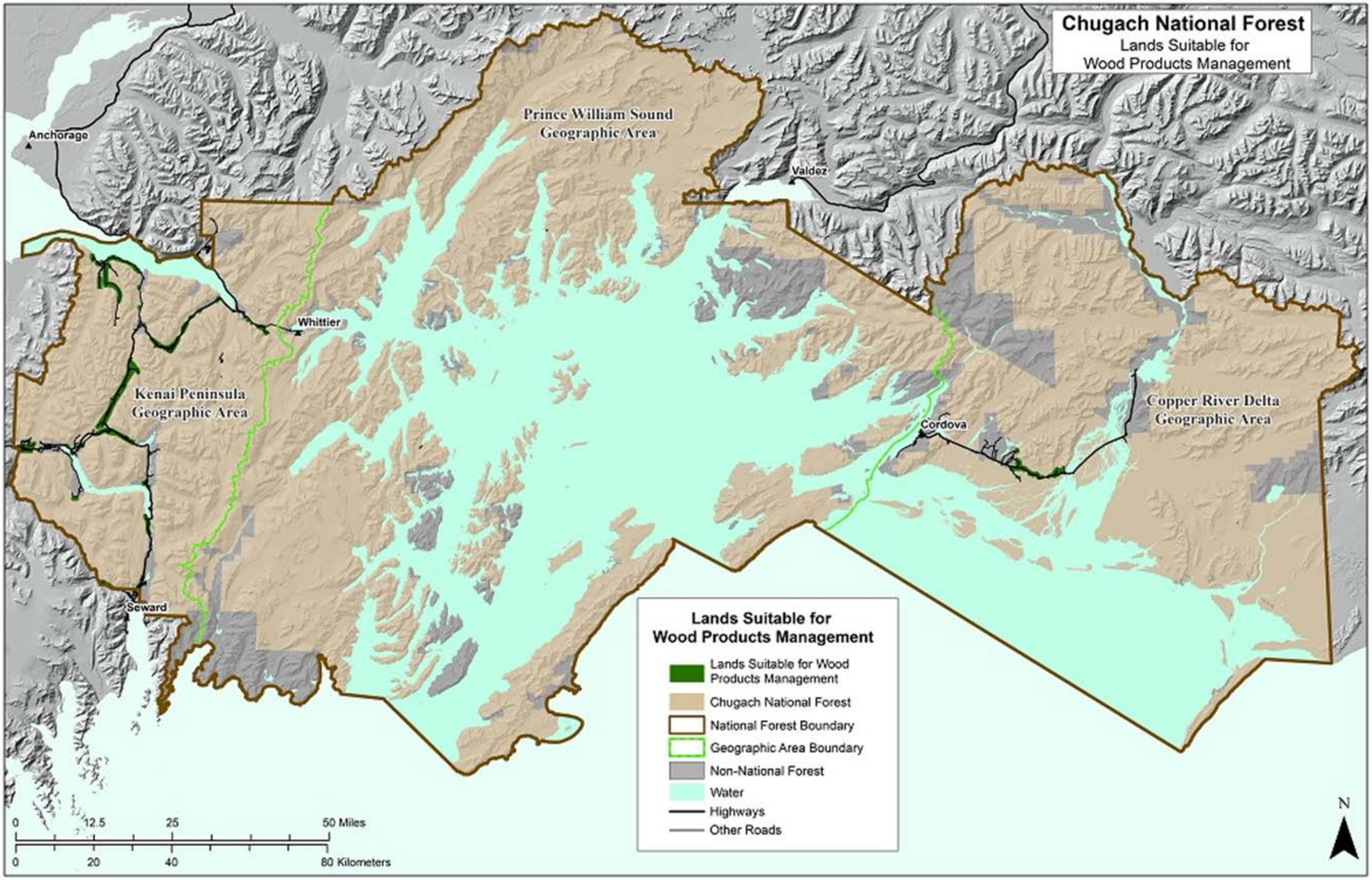
Each alternative will be evaluated by the number of acres available for forest wood products removal, whether for sawtimber, fuelwood, or other forest wood product by commercial-use contract, personal-use permit/free use or Alaska free use (permit required or not). Note that Alaska free use (green) sawtimber may only be taken by permit, per 36 CFR 223.10.

Assumptions about forest wood products use and utilization under all alternatives:

- The amount of forest vegetation treatment activities, such as hazardous fuels reduction, wildlife habitat enhancement, and watershed restoration, are expected to remain similar to those of the past 15 years. About 800 acres of wildlife habitat improvement and 450 acres of hazardous fuels treatment are planned. These treatments may be accomplished through prescribed fire or mechanical treatment methods. Wood products may or may not be removed as a part of treatment.
- The number, location, and annual volume capacity of forest wood products processing facilities in the Chugach National Forest’s working circle will remain constant. There are currently three lumber processing facilities that are about 100 miles from the national forest boundary having a combined annual capacity of less than 500,000 board feet of sawtimber.
- Population growth in the southcentral Alaska is expected to remain more or less constant.
- Increases or decreases (i.e., ingrowth and mortality) in standing tree volume and potential forest wood products production for the lands being managed for wood products, are expected to remain similar to those of the past 15 years. This represents moderate changes in climate and seasonal variability of precipitation and temperature.
- Wildfire, insects, disease and other disturbance agents would not have a major effect on the availability of forest wood products being harvested by contractors or cut, gathered, and removed by the public.
- For this assessment, the sustained yield limit is established for lands managed for wood products (one percent of the forested area of the Chugach National Forest) and is not limited to commercial timber meeting a utilization standard. Areas outside the land managed for wood products are excluded since no harvest of wood products is expected, and this would offset any level of harvest in the area being managed for forest products.



Map 8. Total forested area within the Chugach National Forest (1,081,727 acres)



Map 9. National Forest System (NFS) lands suited for wood products management (11,170 acres)

Affected Environment

Overview

The Chugach National Forest covers an area of approximately 5,415,148 acres. About 1,433,670 acres (roughly 20 percent) of the national forest are forested (see map 8). Though the national forest historically had and still has commercial-sized stands of timber (i.e., sawtimber), few acres are suitable for timber production, since about 99 percent of the forested vegetation (1,056,940 acres) is in IRAs. Commercial timber production is not allowed in IRAs per the 2001 Roadless Rule. Some vegetation management is allowed within inventories roadless areas, but commercial sale is prohibited. The roaded corridor of the Chugach National Forest includes lands within one-quarter mile of roads, and within this area, an estimated 11,170 acres are available for wood products management with ground-based equipment (see map 9). This area makes up 1.0 percent of all forested land and 0.2 percent of total lands within the Chugach National Forest.

The spruce bark beetle epidemic in the early to mid-1980s and subsequent salvage logging from 1992 to 2001 has greatly reduced the mature harvestable acres of timber on the remaining roaded forested acres.

The current low forest acreage, as well as low quantity and quality of potential and available timber, will not support a viable and sustainable commercial timber program of industrial scale. This does not preclude the continued need for forest vegetation treatments to manage forest lands to meet other resource management objectives. These planned treatments will continue to provide forest wood products on lands within and outside of the roaded area as part of meeting these other objectives. Examples of using timber harvest to enhance, improve, restore, or protect other multiple use values may include improving moose habitat, restoring fish habitat by adding woody debris to the riparian zone, and thinning to reduce hazardous fuels while providing for public safety. Results of these activities are forest wood products that help meet society's needs in many forms through direct personal use or indirectly through commercial sale operations.

Forested Vegetation

By handbook direction the Forest Service defines and classifies forest as lands at least 10 percent stocked by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use (FSH 2470). For this assessment, the National Landcover Database was used to estimate forested area on NFS lands.

The Chugach National Forest covers an area of approximately 5,415,148 acres, of which 1,081,727 acres are forested, comprising roughly 20 percent of the landscape. The national forest can be characterized as an area of coastal rain forest that transitions into an interior boreal forest cover type. The forests of the Prince William Sound and Copper River Delta geographic areas are predominantly coastal rainforest, while the Kenai Peninsula Geographic Area is transitional between coastal rainforest and boreal forest. A forest cover type is a natural aggregation of forest trees that occur over an extensive area of land (i.e., many forested stands of trees) and are commonly found in close association with each other as pure or mixed species stands. Trees occur in such associations based on various ecologic and physiographic factors, such as climate, precipitation, temperature, elevation, aspect, and soils. The general characteristics of vegetation types of the Chugach National Forest are summarized in the Terrestrial Ecosystems section.

Forests on the Chugach National Forest are further classified into three general forest types defined as follows:

- *Coniferous or evergreen forest:* Forested lands dominated by tree species (greater than 75 percent) that retain the vast majority of their foliage (needles) year round.
- *Deciduous forest:* Forested lands dominated by tree species (greater than 75 percent) that shed the vast majority of their foliage (leaves) simultaneously at the end of the growing season.
- *Mixed forest:* Forested lands with a mixed coniferous and deciduous tree species composition between 25 percent and 75 percent. Lands less than or greater than these amounts are classified as either pure coniferous or pure deciduous forest, as applicable.

Across the national forest, evergreen forest types are by far the most abundant, at 19.1 percent of the landscape (see table 25). The majority of the evergreen forest type occurs in the Prince William Sound Geographic Area (12.6 percent of the total area of the Chugach National Forest), followed by the Copper River Delta and Kenai Peninsula geographic areas, with 3.6 percent and 2.9 percent of the evergreen forest area respectively (see table 25).

Characteristic coniferous trees are Lutz spruce (hybrid between white and Sitka spruce) and occasional black spruce on the Kenai Peninsula, mountain hemlock on the Kenai Peninsula and Prince William Sound, and Sitka spruce and western hemlock in the Prince William Sound and Copper River Delta. Prince William Sound is the northwestern range limit of western hemlock and yellow-cedar.

Deciduous forests are least common in Prince William Sound with occasional occurrences of black cottonwood. Alaska and Kenai paper birch are major components of the mixed forests of the Kenai Peninsula, where quaking aspen forests occur sporadically on southern side slopes. Black cottonwood is commonly found in the valley bottoms of the Kenai Peninsula and on the Copper River Delta.

Table 25. Area and percent cover of forest types across the national forest and by geographic area

	Chugach National Forest Total Area	Kenai Peninsula Geographic Area	Prince William Sound Geographic Area	Copper River Delta Geographic Area
Forest Type	**Acres (percent of national forest)**	**Acres (percent of national forest)**	**Acres (percent of national forest)**	**Acres (percent of national forest)**
Deciduous forest	38,165 (0.7)	13,237 (0.2)	15,112 (0.3)	9,816 (0.2)
Evergreen forest	1,035,278 (19.1)	156,507 (2.9)	681,966 (12.6)	196,806 (3.6)
Mixed forest	8,283 (0.2)	8,103 (0.1)	114 (0.0)	65 (0.0)
Total forest	1,081,727 (20.0)	177,847 (3.4)	697,192 (12.9)	206,687 (3.8)
Total national forest area	5,415,148			

Forested acreage is projected to increase over time through afforestation, or the process of establishing a forest on land not previously forested. Afforestation has been naturally occurring since glacial retreat and is expected to continue as part of natural succession in recently deglaciated terrain and also in upper elevations where treeline is gradually moving upward in elevation, particularly on the Kenai Peninsula. An increase in average mean annual temperature and lengthening of the growing season has supported and possibly enhanced the process of afforestation.

Natural Disturbance

Forest vegetation patterns across the Chugach National Forest are primarily the result of natural disturbance and successional processes. Natural disturbances within the national forest include broad or landscape scale events, such as wildfire ignited by lightning, native insect and disease epidemics, snow avalanches, landslides, earthquakes, volcanic ash fall, and glacial action, as well as more localized scale disturbances, such as windthrow, floods, and beaver activity.

Fire Regime

Owing to the generally cool, moist climate and low incidence of lightning, natural fires are infrequent within the Chugach National Forest. When fire does occur, it is usually during dry and droughty periods that generally results in stand replacement events with near 100 percent overstory mortality. However, many of the deciduous trees and shrubs, such as birch, willow, aspen, and cottonwood, have the ability to resprout rapidly from root crowns or underground parts. The fire return interval on the western portion of the national forest is estimated to be 600 years (Potkin 1997). The trend of increasing temperatures during the principal fire season in southcentral Alaska would lengthen the traditional fire season. A predicted decrease in low elevation snow fall will also increase the early season fire potential by making fuels available earlier in the year for combustion. See the Wildfire and Fuels section in this chapter.

According to the Fire Regime Condition Class classification for the Chugach National Forest, the forest cover and sub types along with the estimated mean fire return interval and characteristic fire severity are displayed in table 26 (NWCG 2014).

Table 26. Mean fire return interval and percent overstory mortality by forest type

Forest Cover Type and Subtype	Mean Fire Return Interval in Years	Percent Overstory Tree Mortality (Fire Severity)
Coastal rainforest	600 to 3,000	90
Coastal rainforest/boreal forest transition	600 to 800	90
Boreal forest (Kenai Mountains hemlock)	600 to 3,000	80
Boreal forest (southcentral black spruce)	80 to 200	90
Boreal forest (Kenai riparian spruce/hardwoods mix)	650	10

Native Insects and Diseases Outbreaks

Spruce bark beetles (*Dendroctonus rufipennis*) occur commonly on the national forest at endemic levels, and occasionally rise to epidemic levels resulting in high spruce mortality. A spruce bark beetle infestation killed the majority of mature spruce trees across at least 40,000 acres (16,000 hectares) of the Kenai Peninsula Geographic Area. The infestation began in the 1980s and peaked in the late 1990s (USDA 2012b). Based on tree core evidence, Berg et al. (2006) found that a spruce bark beetle infestation occurred on the Kenai Peninsula in the late nineteenth century, similar to the recent outbreak in both magnitude and size. Current status and trends are summarized in the Forest Insects and Diseases section.

Snow Avalanches

The vegetation patterns on many mountain slopes of the Chugach National Forest are shaped by snow avalanches. Many locations otherwise capable of supporting forest vegetation are maintained in early successional shrubland and herbaceous states by periodic snow avalanches. The climate change assessment (Hayward et al. 2017) predicts increases in snow pack at elevations greater than 1,000 meters and greater ranges of winter temperatures. These changes may increase the frequency of avalanches in known avalanche terrain.

In addition to contributing to avalanches, snow and ice accumulations on stems and branches can cause breakage resulting in fine scale (and less noticeable) alterations to vegetation composition and structure. Stem breakage is particularly acute in late seral spruce and pole sized aspen stands.

Landslides

Landslides are not a common occurrence in the Chugach National Forest. They occur most frequently on steep slopes with soils that have a layer restrictive to downward water flow, usually bedrock or compact glacial till. Natural landslides have been noted in Prince William Sound and scattered across the Kenai Peninsula. Landslides associated with past logging activity have been noted on Montague Island and in the Knowles Head area in Prince William Sound. Increased precipitation in the form of rain and snow in winter months may increase the potential for natural landslides, as well as put more stress on past logging development sites already predisposed to landslides (Hayward et al. 2017).

Windthrow

Windthrow is important in forest succession within the Chugach National Forest, but has not been rigorously studied or documented. In the forests of southeast Alaska, which are similar to the coastal rainforests of the Chugach National Forest, Nowacki and Kramer (1998) and Kramer et al. (2001) found a continuum of wind disturbance intensity grading from small scale canopy gaps predominating in wind protected areas to stand replacement in areas exposed to large scale wind events.

Human-caused Disturbance

The present forest vegetation pattern of the Kenai Peninsula Geographic Area reflects human-caused fires that occurred during the last 100 years or so, creating areas of early successional plant communities, including large stands of broadleaved forests. See the Wildfire and Fuels section of this chapter for more details on fire history.

Most of the human activity on the Chugach National Forest occurs along railroads, powerlines, developed and decommissioned roads and trails, and areas open to snow machines, skiing, heli-skiing, and OHV use. Additional human disturbances occur around water developments, rivers used by boaters and anglers, beaches and boat launches, and small developments, such as electronic transmission sites, cabins, airplane landing strips, dispersed campsites, signs, and fences. Human activity and use varies greatly by season, extent, and duration. Because many of these activities do not require permits from the Forest Service, it is difficult to estimate the amount or extent of use.

Vegetation Treatments

The largest amount of ongoing vegetation treatment within the Chugach National Forest is hazardous fuel reduction on the Kenai Peninsula, where an average of about 875 acres has been treated annually from 1970 to the present. Current treatments from 2012 to 2016 vary from 78 to 253 acres per year.

Recent treatments have been addressing forest heath and wildlife habitat improvements. Both hazardous fuels and wildlife treatments consist of tree thinning, pruning, piling, burning, and removal, especially in the wildland-urban interface, high use areas, and transportation routes. Invasive plant treatment projects also occur within the national forest, where annual invasive plant control has ranged from 25 to 120 acres from 2004 through 2013. These treatments involved the removal of non-native invasive herbaceous and woody plants through mechanical and chemical means.

Based on the Forest Service Activity Tracking System (FACTS) database, which is used to plan and record treatment accomplishment, the annual forest vegetation establishment (tree regrowth) and improvement (tree thinning) treatment acreage has ranged from about 200 to 680 acres over the past decade or longer. Based on the current managed stands layer in the activity tracking system, 2,530 forested acres have been treated in the roaded corridor since about 1980. Prior to 1980, treatments were documented in timber sales reporting but few records were recorded into the FACTS.

Of the 1.1 million acres of forested land within the Chugach National Forest, approximately 11,170 acres along the road corridor are suited for wood product management (see forest plan appendix B table 3). In this area, 8,950 acres are near existing access roads, and the remaining 2,220 acres would require the construction of new access roads for wood products management. Satellite imagery along with ongoing vegetation mapping projects and field observations indicate that an estimated 75 percent of the 8,950 acres is in early and mid-seral stages or with stocking of less than 100 trees per acre. This low stocking and young age is based on 50 years of harvest, salvage of beetle-killed trees, and vegetation treatments. This would leave an estimated 2,240 acres with an adequate volume and stocking that would allow for feasible outputs of wood products (fuelwood). New vegetation mapping and other historical data research will refine this estimate.

Forest Products

Commercial Sales

Currently, no lands within the Chugach National Forest are determined to be suited for timber production. After analysis, it has been determined that the area that may be suited for timber production is 6,060 acres (see forest plan appendix B). These limited acres meet the site conditions that could allow for the sustainable growth and harvest of timber for commercial purposes; however, this area is determined not to be compatible with timber production primarily because a sustainable flow of timber cannot be planned and scheduled on a reasonably predictable basis owing to the limited acreage available. Based on this determination, timber production is inconsistent with desired condition and objectives established by the forest plan (FSH 1909.12. CH60 61.2). The primary management objectives for these lands are to enhance wildlife habitat, provide a source of fuelwood for local communities, and to reduce fire risk.

Additional reasons for this determination include:

- lands that may be suited for timber management are of general low productivity, low quality, and thus not economical from a timber production standpoint,
- no commercial and industrial-sized timber production manufacturing facilities/mills exist within 100 miles of the Chugach National Forest,
- the standing volume of sawtimber is low within the area available for timber management (less than 1.25 thousand board feet per acre estimated), and

- the need to provide for a sustainable fuelwood program (on the small amount of available acres) to meet local community needs outweighs the use of wood for other purposes.

Harvests have been occurring since the 1900s based on mining and railroad development demand as documented in early Forest Service reports and journals. Spruce bark beetle mortality and subsequent salvage sales through the 1990s have severely reduced the potential standing volume and acreage of sawtimber available for harvest in the foreseeable future.

No commercial sawtimber sales have been sold from the Chugach National Forest over the past 15-plus years. Although a small volume of sawtimber has been reported sold in four out of the past 16 years, these sales represent volumes sold from vegetation and fuels treatments. Treatments are applied as service contracts because the value of the material resulting from the treatment does not cover the cost of implementation. Fuelwood from these treatments may be sold commercially when the community need is partially met through free use. These volumes are reported as sale of timber meeting the size specification of sawtimber and not the end use. This material was sold as volume decks and utilized mostly for fuelwood, since the quality and quantity along with the cost of transport to mills prevents higher value utilization. In 2014, forest stewardship contracting authority (P.L. 108-7 16 U.S.C. 2104) was used as a contracting tool to implement forest vegetation treatments to develop early successional wildlife habitat. This resulted in approximately 250 cords (125,000 board feet converted) of sawtimber being exchanged for services provided (i.e., goods for services), which represented 20 percent of the total treatment volume. Also associated with this project, 1,500 cords of fuelwood were sold to commercial fuelwood contractors over the past five years as part of meeting land management objectives other than timber production. From 2012 to 2016, the annual harvest of sawtimber sized material averaged 77 thousand board feet, most of which was utilized as fuelwood by the public. On the Kenai Peninsula from 2006 to 2011, fuelwood harvest by commercial contractors has averaged 650 cords per year. From 2012 to 2016, fuelwood harvested by commercial contractors has averaged 300 cords per year.

The reduction is due to both limited opportunities (tapering off of bark beetle salvage) as well as less focus in preparing sales for commercial offer. Fuelwood cut and removed by commercial contractors is later resold to the public for personal consumption. Contractors provide a valuable service to those who do not have the ability or wherewithal to cut and remove fuelwood on their own.

Other non-Forest Service sources of fuelwood for commercial use are available from private lands, Kenai Peninsula Borough lands, and State of Alaska lands. These lands often have similar physical site limitations and economic constraints as the Chugach National Forest has in harvesting forest wood products.

The capability of the Chugach National Forest to provide sawtimber to a milling industry has varied across the years since the early 1900s. Two high-production dimensional sawmills were active in the 1980s and into the early 2000s. The mill in Seward was supplied by the Chugach National Forest from both the Seward and Cordova Ranger District, but mostly from ANILCA transferred lands in Prince William Sound. During the height of the spruce bark beetle salvage period, a commercial stud mill in Anchor Point was partially supplied by Chugach National Forest but at a lesser level than the clearcut/salvage taking place in the central and western Kenai Peninsula. Eventually harvests declined as suitable timber ran short. In the 1980s, small processing and portable mills in the Anchorage Municipality, Kenai Peninsula, and Cordova areas numbered 18, nine of which were producing sawtimber products as late as 2011. The remaining facilities were engaged in the manufacture of house logs and other non-dimensional products. Current data (2016) from the State of Alaska Economic Corporate and Business Licensing Bureau shows only three active sawtimber mills in the same area, within a 100-mile drive of the national forest boundary. One is in Anchor Point and two are north of Anchorage. These mills are supplied by non-federal forest land, and only one operates continuously throughout the year. The combined annual production from these active mills is estimated at less than 500,000 board feet (or about 1,000 cords). This reduction in mills follows a general decline in wood products harvesting and manufacturing in southcentral Alaska that began in 2011 (Berg et al. 2014) predominantly due to the spruce bark beetle infestation and subsequent mortality and salvage harvest. Local decline is due to a lack of overall merchantable sawtimber supply (Parent pers. comm. 2016). Current demand for commercial timber sales to saw mills is being met from State of Alaska lands (Division of Lands, Mental Health, and University Trust ownerships) as well as private holdings.

Individual Free Use and Alaska Free Use Fuelwood and Timber

Two authorities address access to fuelwood and sawtimber beyond the commercial sale of wood products. These are Alaska free use fuelwood and sawtimber and individual free use. Alaska free use (36 CFR 223.10) allows bona fide settlers, miners, and residents to harvest 10,000 board feet of green or dried timber from the national forest for personal use but not for sale. This is otherwise referred to as Alaska free use sawtimber. Additionally, 25 cords of fuelwood maybe accessed without permit unit under this authority.

Free use to individuals (36 CFR 223.5) allows the Forest Service to permit additional fuelwood primarily to aid in the protection and silvicultural improvement of the national forest. Removal of wood products under this authority can occur on approximately 1.1 million (1,081,727) acres of forested land.

Fuelwood

In the vicinity of the Chugach National Forest there are about 2,900 households that use fuelwood as either a primary or secondary heat source (Census 2010). The total amount of fuelwood needed is estimated to be between 2,000 and 2,500 cords. The forest plan assessment (USDA 2014a) estimates that between 1,200 and 1,500 cords of fuelwood are being provided by the national forest. Past trends show that as supply increases so does the volume permitted. Since fuelwood is not a perishable commodity the excess of supply is stored for future years. For these reasons a true annual consumption based on permitting is not reliable.

The eight communities within or adjacent to the Chugach National Forest in southcentral Alaska have 639 homes that use fuelwood as a primary heat source and an additional 2,306 homes use fuelwood as a secondary heat source. Households acquire needed fuelwood from NFS lands and also from other sources such as harvest from private land, State lands, and new technologies like pellet fuel. Land conversions and highway/utility projects also contribute to the supply. It is difficult to estimate the actual consumption of fuelwood beyond the known quantities permitted from the Chugach National Forest.

The average number of cords of fuelwood permitted (permit issued and without charge) each year from the Chugach National Forest has been slightly more than 600 cords over the last five years but has increased to approximately 1,300 cords per year over the last three years. The increase over the last three years is the result of increased fuelwood availability due to wildlife enhancement and hazardous fuels reduction treatments. These treatments have made more free-use fuelwood readily accessible and available through coordinated roadside decking of wood removed as part of these treatment activities. The total fuelwood cut and removed as part of the Alaska free use fuelwood program authorized by 36 CFR 223.10, which is unpermitted and therefore lacks documentation and records, is estimated to be about 300 cords per year (Chugach Law Enforcement Officers anecdotal observations). The Chugach National Forest has contributed about 1,600 cords (1,300 plus 300) per year over the past three years to the fuelwood needs of local communities. Fuelwood and other wood product harvest is entirely from the road accessible areas of the national forest and from other land ownerships mentioned earlier.

Table 27. Estimated use of fuelwood in communities within or adjacent to the Chugach National Forest

Community	Primary Home Heating (households)	Secondary Home Heating (households)
Moose Pass	37	148
Seward	112	448
Hope	11	44
Sterling	143	572
Portage	0	0
Cordova	79	316
Native Villages	100	150
Girdwood	111	444
Cooper Landing	46	184
Totals	**639**	**2,306**

Fuelwood census (data from U.S. Census Bureau, 2010-2014 and Alaska Wood Energy Task Force)

The area available for wood products management is 11,170 acres, and it is estimated that this area is capable of growing approximately 2,180 cords per year (see forest plan appendix B).

For forest planning purposes, the annual local community need for fuelwood is estimated to be 2,000 cords per year. Based on the development of a long term sustainable harvest program, the Chugach National Forest should be able to provide an average of 1,000 cords of fuelwood for the next decade (not including free use harvest estimated at 300 cords per year). For long term sustainability on the 11,170 acres available for wood products management, the volume removed would be less than the growth for the first decade, but more volume would be available towards the end of the plan period in larger trees and through intermediate treatments as the forest recovers volume lost to spruce bark beetle mortally (see forest plan appendix C table 2).

Special Forest Products

In this section, plant species commonly gathered within Chugach National Forest and used by the public for various purposes are summarized. The conditions and trends for these species along with the contribution of these species to social and economic sustainability are discussed.

Native people of southcentral Alaska have used a variety of plants for thousands of years for food, shelter, fuel, medicine, crafts, and spiritual purposes (Russell 2011). Some present day uses of these plants include Christmas trees, transplants (for landscaping), cuttings (for restoration), burls, boughs, and medicines along with edible leaves, berries, fruits, stems and roots.

Mushrooms are a highly sought after special forest product within the Chugach National Forest as a source of food, pigments for dyes, and for aesthetic enjoyment. There are more than 300 species of mushroom producing fungi documented within the national forest and many more undocumented species that are likely to exist. The species most often collected for consumption include: angel wings (*Pleurocybella porrigens*), gypsy (*Cortinarius caperatus*), shaggy mane (*Coprinus comatus*), winter chanterelle or yellow foot (*Craterellus tubaeformis*), blue or black chanterelle (*Polyozellus multiplex*, rare), king bolete (*Boletus edulis*), sulfur shelf or chicken of the woods (*Laetiporus conifericola*), hedgehog or sweet tooth (*Hydnum repandum*), bear's head (*Hericium coralliodes*), gray fire morel (*Morchella tomentosa*) and other morels (*Morcella* spp.). The most common commercially harvested species are king bolete and hedgehog.

The demand for some special forest products is increasing. There is anecdotal evidence of increased harvest of fiddlehead ferns and mushrooms. Based on public reports, the Forest Service is monitoring the intensive harvest of lady fern (*Athyrum filix-femina*) in the Girdwood area. The demand for edible mushrooms appears to be increasing based on public interest in informational presentations. There has not been an increase in requests for commercial harvest of species, yet several restaurants and shops sell or serve locally harvested species. Interest in large-scale harvesting of berries in the early 2000s resulted in Chugach National Forest policy development, but no large commercial salable amounts were permitted. Concerns have been made about potential commercial harvests occurring on NFS lands (Mohatt pers. comm. 2013). Region 10 Special Forest Products and Forest Botanical Products Policy (April 2015) establishes commercial rates, prioritization of allocation, and localized harvest guidelines based on monitoring and inventory when allocation concerns arise. No commercial berry harvest permits have been requested since the policy was developed.

The Forest Plan Review 2002-2012 (USDA 2012b) noted that demand for commercial special forest products from the national forest was low in 2002 and has remained low. Twelve special forest products commercial permits have been issued since 2002, all on the Kenai Peninsula. These permits allowed collection of 100 pounds of mushrooms, more than 350 spruce transplant trees, 200 alder transplants, 5,800 hardwood transplant trees, burls, willow cuttings, spruce boughs, blueberry transplants, and miscellaneous landscaping plants. In addition, an average of two permits are issued each year to collect botanical specimens for scientific research (not directed toward development of a commercial product).

Personal use gathering of special forest products, such as berries, mushrooms, and Christmas trees, is a popular activity within the national forest. A 1997 survey found berry picking to be among the most popular activities among Alaska adults (61 percent participation), and that participation is expected to grow (Bowker 2001). Additionally, interest among agencies, tribal governments, traditional users, landholders, businesses, and scientists in sustainable special forest products in Alaska is documented by the Alaska Boreal Forest Council.

Environmental Consequences

Indirect Effects

General

There is no difference in the areas available for the management of forest wood products among alternatives, therefore the effects across all alternatives will be discussed together.

The harvest of fuelwood and personal use sawtimber would continue across all alternatives. The average annual harvest of fuelwood would remain the same, about 1,000 cords per year (plus volume removed as part of Alaska free use). Alternative A establishes an average volume of fuelwood and personal use sawtimber harvest. Alternatives B, C, and D would increase fuelwood harvested from intermediate treatments, such as thinning and hazardous fuels treatments, and decrease harvest for regeneration treatments, such as salvage, clearcutting, seedtree, and shelterwood harvests. Rregeneration treatments would be reduced due to a lack of suitable and accessible forest stands. Regeneration harvest would be conducted to meet specific forest management objectives and provide a sustainable supply of fuelwood to the public on an annual basis.

Of the entire national forest, only 11,170 acres are available for the management of wood products through harvests. This area is within the roaded corridor of the national forest and represents one percent of the entire forested portion of the Chugach National Forest. Additional forested areas are available for free use and personal use forest wood products and special forest products.

Commercial-use, personal use/free use and Alaska free use forest wood products (i.e., fuelwood and sawtimber) are the major products harvested. Regardless of whether the public cuts, gathers, and removes the wood as fuelwood or purchases it from a commercial fuelwood contractor, the use and end result is the same: home heating purposes and a limited amount of Alaska free use sawtimber. Sawtimber-sized trees are rare due to past insect outbreaks and are often requested as part of Alaska free use. Due to the rarity and limited access, both within and outside the IRA, sawtimber availability is limited in all alternatives.

The indirect effects are essentially the same for all alternatives therefore, all alternatives will be evaluated collectively regarding forest wood product harvest management on the 11,170 acres of lands identified.

Proposed forest management will continue to provide fuelwood, personal sawtimber, and special forest products, as well as maintain a variety of forest cover types and seral stages. Benefits will be a continued source of wood products, increasing volume and quality of residual trees, wildlife habitat for different species, and recreational opportunities for the community.

Approximately 2,180 cords per year is the total growth for the entire forested area available for management (see forest plan appendix B table 3). The current distribution of trees sizes and ages within this area is skewed toward younger and smaller diameter trees. This is a result of a 100-year history of harvesting and the spruce bark beetle salvage harvest of the 1980s and 1990s. Very few acres contain enough larger trees to support a fuelwood harvest. The projected wood products removed from the same area is planned at 1,000 cords per year over the first decade plus additional volume removed as part of Alaska free use (see forest plan appendix C table 2).

Only harvesting one-half of the sustainable harvest (one half of 2,180 cords) from the area being managed for wood products would allow for an increase in the size of the residual trees. This is reflected in the management activities detailed in table 1 of forest plan appendix C, which suggests conducting regeneration harvests (clearcuts, seed tree, and shelterwood treatments) on an average of 35 acres per year for the first 10 years of the plan period. This 35 acres would supply 500 to 750 cords of the annual projected harvest of 1,000 cords per year. The remaining volume would be available through unpermitted Alaska free use, intermediate treatments, such as thinning, hazardous fuel reduction, and from permanent conversions of land use from forested to non-forested, such as highway and other infrastructure development. The second 10-year period would allow an increase of harvest to 1,400 cords per year (plus volume removed as part of Alaska free use). Because this amount is below the sustainable harvest, volume would continue to increase on residual trees. This would increase the average sizes of trees and make future harvest more feasible.

The current condition of the 11,170 acres managed for wood products is under stocked, with an age distribution heavily weighted towards early growth with low volume. Because the time a stand needs to achieve culmination of mean annual growth is approximately 125 years, harvesting less than the estimated annual volume would maximize growth on individual trees. As the forest on these 11,170 acres matures, the annual harvest would meet the sustainable amount entirely on stands approaching 125 years of age. At that time the volume removed as part of intermediate thinning would provide additional volume above the calculated 2,180 cords of annual growth.

Over time, balanced treatments, including harvest of mature stands, intermediate thinning, and selection harvest, will reduce hazardous fuels and produce a forest more resilient to fire and insect damage within the roaded corridor of the national forest across all alternatives.

Commercial, Personal Use, and Alaska Free Use Accessibility

Personal use/free use and Alaska free use activities are largely contained to areas along road corridors and limited by the distance an individual is willing to hand transport products to roadways. Trees would be felled and cut by hand using a chainsaw. Products would largely be removed by carrying them by hand to a roadway. Where off-road winching, ATV or pickup use is authorized, the distance products are retrieved would be restricted by landscape, ground travel and operability considerations and obstructions, equipment type used, and Forest Service off road travel restrictions. For these reasons, wood removal activities are expected to be greatest along and within about 200 feet on both sides of road and progressively less beyond 200 feet. As time goes by, wood products would be more difficult to find, cut and remove, reducing opportunities and creating a challenge and would encourage readily harvested fuelwood and wood products from along roadways and access areas. These types of impacts are largely low impact and isolated. The gentle, flat, easier ground would get picked over, some individuals may move to more steep and sensitive ground near roadways to retrieve their free use wood products, or extend deeper beyond the roughly 200-foot distance. Other lands may be increasingly impacted over time, further reducing the quantity and quality of wood removed for future free use sawtimber or commercial purposes.

Similarly, if commercial activities are increased, the potential supply of acres and wood products available for personal use and Alaska free use cutting, gathering, and removing would decrease and again move harvests of fuelwood to unpermitted areas.

Small commercial activities would use existing roads and trails to access lands for treatment. Some temporary road construction (resulting in ground disturbance) may be needed to remove products and would be decommissioned following use using BMPs.

Activity slash may be piled and burned to achieve acceptable hazard fuels reduction, following a prescribed burn plan. Alternately, some slash may be left on the ground to achieve coarse woody debris objectives for site protection and soil development, among other benefits.

A limited number of acres is expected to be treated annually (i.e., less than 100 acres total), and so the potential ground impacts are anticipated to be relatively low to moderate overall.

Opportunities for treatments outside of the roaded area may exist but are unlikely due to lack of access for ground based mechanical treatments. Treatment activities in the IRAs may be feasible, as allowed by the 2001 Roadless Rule and proximity to accessible adjoining roaded areas. Treatments that are applicable but do not allow for access, such as prescribed burning, may be feasible but would not allow for ease of access to wood products.

Forest Composition and Structure

Excessive personal use harvest of areas previously treated and readily accessible for wood products, would make future entries for wood more marginal over time due to the reduced tree size and wood volume supply. Longer term impacts beyond the plan period would likely lead to a decline in accessibility of preferred fuelwood and sawtimber. Though a current timber inventory and updated forest cover type map are not yet available to quantify this hypothesis, recent trends in the public use and utilization in wood products indicate a shift in species utilized. The shift in species from spruce to birch and then to hemlock for fuelwood is occurring, as indicated by permitted fuelwood records. This indicates a decline in availability of preferred fuelwood, spruce, to a less desired species, hemlock. The impact of frequent return harvest through unpermitted and prescribed harvest would lead to a decline in trees species diversity.

Forest stand structure would be expected to experience a decline in tree diameter size with repeat harvesting in highly accessible areas, resulting in a decline in the amount of larger trees. Total standing volume could continue to increase over time, but the distribution of the biomass would be distributed over a larger amount of trees. The forest would have smaller diameter trees, resulting in fewer opportunities for regeneration type harvests (clearcutting, seedtree, and shelterwood) in the future.

Utilization of thinning treatments could reverse this trend by increasing the size of trees in the forest, but would not supply as much suitable fuelwood. Thinning smaller trees and leaving larger stems that are more vigorous and dominant trees would increase the total volume growth and provide a constant supply of thinning that may be used for fuelwood.

By maintaining a managed output of wood products below the sustainable harvest level and limiting repeat harvests of individual stands, added growth would improve standing volume for future harvest treatments. This would increase individual tree size and produce sawtimber with the potential for small commercial timber sales in the future as well as diversify the forest structure within the management area.

Presence of Large Tree Snags and Large Wood Debris

Traditional free use harvest of fuelwood consisted of the harvest of dead snags. Dead snags are a dry source of ready to burn fuel wood. Even with a managed fuelwood program, dead and dying trees will always be preferred by some members of the public. The lack of accessible opportunities for free use fuelwood harvest will continue to deplete the number of snags and downed woody material. A current visual inventory of dead snags and downed woody debris along roadsides indicates intensive utilization of snags and downed logs that provides specialized wildlife habitat for certain species. The effects across the national forest will be limited due to the forested roaded corridor being less than one percent of the national forest area. Nonetheless, these areas are also the location for most of the developed recreational areas frequented by motorized tourists and the loss of snag trees and downed woody debris will have an impact on wildlife habitat in the roaded corridor.

Commercial and Noncommercial Harvest of Special Forest Products

Special forest products are harvested for personal use and recreationally by many forest users without permit. Large scale commercial harvest interest (removal of more than 1000 lbs) has been expressed for berries but none have developed beyond the exploratory stage. Currently commercial harvest is focussed on mushrooms, plant materials for conservation/restoration projects, and boughs for holiday wreaths. The removal of willows cuttings for revegetation purposes is the only use that exceeds

200lbs. Expansion of the commercial harvest of special forest products is possible but is limited by the availability and accessiblity to highly productive sites and distance to local markets.

No indirect effects would occur since the current areas that provide commercial and personal harvest of special forest products are essentially available for harvest. Most of the available areas are not readily accessible from highways and roads, thus access is the major limitation to harvest. The demand for both personal and commercial harvest of special forest products is currently low compared to supply and not expected to change over the plan period.

Alaska Free Use Sawtimber

Alaska free use sawtimber is in constant demand and the difference between alternatives is negligible since the limitations for harvest are based on availability and accessibility, which applies to all areas equally. Since Alaska free use sawtimber harvest is a permitted activity, the effects of harvest are limited by availability and access as mentioned previously and also by a request for specific evaluation of the site specific impact of access and removal.

Lands Suited for Timber Production

The process of determination of lands suitable for timber production is referenced from appendix B of the forest plan and displayed in table 28.

Table 28. Lands suited for timber production[1]

Land Classification Category	Acres
A. Total NFS lands in the plan area	5,415,148
B. Lands not suited for timber production due to legal or technical reasons	5,409,088
C. Lands that may be suited for timber production (A-B)	6,060
D. Total land suited for timber production, because timber production is compatible with the desired conditions and objectives established by the plan	0
E. Lands not suited for timber production, because timber production is not compatible with the desired conditions and objectives established by the plan (C-D)	6,060
F. Total lands not suited for timber production (B+E)	5,415,148

1 - Timber production is defined as commercial sawtimber harvest.

Table 29 compares the areas suitable for timber production by alternative. Alternative A (no action) lists 282,600 acres of potentially suitable land; however, the 2002 forest plan allocated all of those lands for uses other than commercial timber production. The main differences between the 2002 analysis for Alternative A and the other three alternatives were the inclusion of productive forested land within the wilderness study area and also the inclusion of IRAs in the estimate of lands potentially suited for timber production in alternative A. The exclusion of the wilderness study area and IRAs, and lands excluded for legal and technical reasons (EVOS and ANILCA 501B easements, non-productive forest land, and lands with slopes greater than 35 percent) resulted in an estimate of 6,060 acres potentially suited for timber production (DeVelice 2015). Other lands excluded for legal reasons included land with conservation easements limiting commercial harvest and EVOS and ANILCA 501B easements. Non-productive lands and lands with slopes greater than 35 percent were further excluded from consideration ((For a detailed explanation of the analysis see forest plan appendix B Timber and Wood Products Suitability for details of the analysis).

No lands are identified as suited for commercial timber production under any of the alternatives. This determination was made because the low acreage of potentially suitable land (after removing lands restricted for technical and legal reasons) precludes planning and scheduling a predictable supply of lumber for commercial timber production. Further reducing the feasibility of commercial timber production is the low standing volume of sawtimber (less than 1.25 thousand board feet per acre estimated), and economic limitations due to out of state market competition and distance to working saw mills (see forest plan appendix B Timber and Wood Products Suitability).

Table 29. Comparison of lands identified as potentially suited and suited for timber production by alternative (in acres)

Area Suitability	Alternative A No Action	Alternative B	Alternative C	Alternative D
Lands that may be suitable for timber production	282,600	6,060	6,060	6,060
Lands suited for timber production	0	0	0	0

Analysis of Alternatives Wood Product Acres

Table 30 displays the acres suitable and available for forest wood products management by use category.

Table 30. Acres suitable and available by use category

Use Category	Group	Alternative A No Action	Alternative B	Alternative C	Alternative D
Commercial timber production	1	0	0	0	0
Commercial wood products other than for timber production within the roaded corridor	2	Not Calculated[1]	9,840	9,840	9,840
Non-commercial forest wood products within the roaded corridor.	3	Not Calculated[1]	11,170	11,170	11,170
Personal use fuelwood (Alaska free use)	4	1,196,040	1,081,727	1,081,727	1,081,727
Personal use sawtimber (Alaska free use)	5	1,196,040	1,081,727	1,081,727	1,081,727
Special forest products	6	1,196,040	1,081,727	1,081,727	1,081,727

1 - 2002 forest plan under amendment 1909.12-2006-7 FSH revised chapter 60.

Alternative A: no specific acres were identified in the 2002 forest plan for Groups 2 and 3 (commercial and non-commercial wood product harvest within the roaded corridor). Because the roaded corridor remains unchanged, and legal limitations on commercial harvest are also unchanged, the acreage estimated for commercial and non-commercial wood product removal woud be the same under Alternative A as the other three alternateves. As described above, the 2002 forest plan did not identify any land as suited for commercial timber production. Forest wood products removal was authorized by the 2002 forest plan for personal use and commercial use, but not under the auspices of commercial timber production.

Alternatives B, C, and D: there is no difference in area available for wood products management among these three alternatives. Zero acres are identified as suited for timber production.

For Groups 4, 5, and 6 in table 30, the difference in acres between alternative A and alternatives B, C, and D is the result of a mapping protocol differences between the 2002 forest plan and the proposed revised forest plan.

Analysis of Alternatives Wood Product Volume

Table 31 shows the volume of forest wood products removed by use category. See also forest plan appendix B Timber and Wood Products Suitability for further discussion on how the quantities were derived.

Alternative A: volume estimates were developed for Alternative A based on average harvest and permitting data recorded between 2002 and 2016 (volume by use category was not developed as part of the 2002 forest plan).

Alternatives B, C, and D: an estimated 1,000 cords of wood would be cut, gathered, and removed annually during the first decade (400 cords of commercial wood products and 600 cords of permitted personal-use fuelwood). This estimate does not include AK free use fuelwood which may be harvested without a permit. There is no difference among these three alternatives.

Table 31. Volume of forest wood products removed annually by use category (see forest plan appendix C Proposed and Possible Actions)

Use Category	Alternative A No Action	Alternative B	Alternative C	Alternative D
Commercial timber production	0	0	0	0
Commercial forest wood products other than for timber production	370 cords	400 cords	400 cords	400 cords
Non-commercial forest wood products[1]	925 cords	900 cords	900 cords	900 cords
Personal-use fuelwood permitted	650 cords	600 cords	600 cords	600 cords
Alaska free use wood (fuelwood)[2] unpermitted	225 cords	225 cords	225 cords	225 cords
Alaska free use sawtimber[3]	25,000 board feet (50 cords)	35,750 board feet (75 cords)	35,750 board feet (75 cords)	35,750 board feet (75 cords)

1 – The volume estimated for Non-commercial forest wood products is the sum of Personal-use fuelwood, Alaska free use wood, and Alaska free use sawtimber.

2 – The Alaska free use allocation under 36 CFR 223.10 is 25 cords of fuelwood and 10,000 board feet of sawtimber, per family per year. Quantities of fuelwood that may be removed are unknown, since no permits are issued for Alaska free fuelwood use outside planned treatments and therefore volumes listed are estimates

3 - Alaska free use sawtimber is based on accessibility and land suitability, and is limited by other Federal regulations and Forest Orders that protect other forest resources and values.

The quantities of special forest products potentially removed is not known, since permits are not issued and therefore no records and little documentation exists.

Harvest of small quantities of sawtimber would meet the current requests for Alaska free use sawtimber through the provisions of 36 CFR 223.10 based on current requests fulfilled.

Timber production is defined as the purposeful growing, tending, harvesting, and regeneration of regulated crops of trees. Commercial timber production is the purposeful management and sale of sawtimber on commercial scale that provides sufficient volume on a continuing basis to support a milling industry. Commercial timber production is not compatible with the desired conditions and objectives of the 2002 forest plan or any of the proposed alternatives for the following reasons: 1) the acreage available for timber production is limited, 2) there is a high level of demand for personal and Alaska free use fuelwood and sawtimber, and 3) the standing volume of sawtimber is low within the area available for timber management (less than 1.25 thousand board feet per acre estimated).

The industry has struggled since the early 1900s due to the lack of accessible timber resources on the national forest and economic limitations, out of state market competition, distance to existing sawmills, low timber quality, and insufficient timber volume to sustain the commercial processing capacity. All of the proposed alternatives prioritize supplying wood products for Alaska free use and personal needs through vegetation management treatments for other purposes (e.g., wildlife habitat enhancement and hazardous fuels reductions).

Cumulative Effects

Sterling Reroute and Seward Highway Realignments

Highway corridor realignments will have a short term impact on the availability of forest products. Land use changes, from forested to non-forested land uses, such as highway right of way development and realignments and utility right of way maintenance, will occur through the plan period and may be used to supplement wood product needs. New roads may have a positive effect on the ability of the public and the Forest Service to access areas that were previously difficult for undertaking both personal harvest and vegetation treatments. The clearing of land will also provide opportunities to meet public and commercial need for fuelwood and sawtimber both on and off the forest management area.

Kenai Hydro LLC Grant Lake Hydroelectric Project

The development of the Grant Lake hydroelectric project will have little impact on the availability of forest products. The project is currently being planned but future access to the facility will be gated and will be limited. Any potential harvest material resulting from road development and from lake level increase could be made available to the public as part of the project. Longer term impacts may be increased access to areas for potential vegetation management projects.

Foreseeable Development of Chugach Alaska Corporation (CAC) Lands

Future development of CAC lands may entail the construction of roads if accessed from the public road and rail system of Alaska or from beachhead if by water. Wood product removed from road development could be made available to the public and roads may provide access to areas of the national forest for future vegetation management projects.

Analytical Conclusions

None of the alternatives will change the number of acres accessible for wood products management or the area available for Alaska free use on the Chugach National Forest. Harvest volume of Alaska free use and personal use fuelwood is self-regulated by accessibility via roads and restrictions on motorized uses. Individual and Alaska free use fuelwood growing capacity and available acreage are adequate to meet the needs of local communities.

The potential fuelwood need is estimated to be between 2,000 and 2,500 cords per year. This estimate is based on volume of fuelwood removed from public log decks, past fuelwood sales, areas where free use harvest is available, and fuelwood disposals from land conversions. The current annual harvest from NFS lands averages 1,300 cords per year. The proposed fuelwood harvest (1,000 cords per year plus free use volume) would meet about half of the estimated need, which is now being met through the use of management treatments. The remainder is likely provided from non- NFS lands. Availability of fuelwood is limited to areas accessible by existing roads. The number of large tree and high volume stands is currently low; thus management should occur in conjunction with other treatments as the area is allowed to increase in size and volume. Harvesting up to 2,500 cords per year would not be sustainable on NFS lands because suitable stands (those meeting a minimum size for public use as fuelwood, six to eight inches diameter at breast height) would be completely harvested in 10 to 15 years. Annual total growth for the area managed for wood products (11,170 acres) is estimated at 2,180 cords per year. This growth occurs on all trees and is greatest on smaller stems, deemed not suitable or desirable for fuelwood. Harvesting only the largest trees for an extended period would reduce the acres of mature trees, leaving most future fuelwood stands in an undesirable and understocked condition that would need more time to grow in size.

Meeting the potential fuelwood need from NFS lands would be attainable in the future by following the management actions proposed in appendix C of the forest plan. This would be accomplished by continuing to provide fuelwood from harvests on limited areas: 30 to 40 acres annually on the areas with mature suitable size trees (greater than 75 years of age), increasing intermediate treatments in middle-aged stands (20 to 75 years), and providing opportunities in areas currently inaccessible by roads and trails. This could produce an annual volume of 1,000 cords per year for the first 10 years and followed by an increase the following 10 years (plus additional volume harvested through free use). This harvest level is sustainable over a long period of time. In 25 to 50 years, an increase of standing volume would result in larger trees and a potential increase in future harvest of larger fuelwood and sawtimber for Alaska free and personal use and for small commercial sales.

Harvest of fuelwood and personal free use harvest of sawtimber would be sustainable within the planning period. These conclusions are consistent with the sustained yield calculations in appendix B of the forest plan.

None of the alternatives will change the number of acres accessible for commercial and personal use special forest product harvests from the Chugach National Forest. Current supply can meet demand and no foreseeable increase of harvest will impact the sustainability of special forest products. Current levels of personal and commercial removal of special forest products are sustainable, and future increases are not anticipated.

Recreation

Introduction

Alaska has often been described as the great land in tourism literature. The word Alaska is derived from the Native Alaskan Aleut word Alyeska, which means great land. Visitors from all over the world are drawn to Alaska to experience the many unique recreation opportunities this land has to offer: viewing spectacular mountainous glacial scenery and abundant wildlife; participating in sport fishing in rivers, lakes, and the ocean; kayaking, rafting, hiking and camping; and participating in educational opportunities to learn about the natural and cultural resources of the state. Between October 2014 and September 2015, more than 2 million visitors from out-of-state traveled to Alaska. Alaska's 2015 volume of summer out-of-state visitors was the highest ever recorded at 1.78 million people (McDowell Group 2016).

Outdoor recreation plays a significant role in the health and well-being of the American people with Federal lands contributing significantly to the provision of these opportunities (White et al. 2016). In southcentral Alaska, out-of-state visitors and local residents seek out recreation opportunities within the Chugach National Forest as well as on other public lands, including the Wrangell St. Elias National Park to the north and Kenai Fjords National Park and the Kenai National Wildlife Refuge to the south and west of the national forest. The State of Alaska manages a variety of lands that provides recreation opportunities in southcentral Alaska. These include heavily used state parks, such as the Chugach State Park adjacent to the city of Anchorage, the Kenai River Special Management Area on the Kenai Peninsula, and state campgrounds and day use areas along the Seward and Sterling Highways. Other state managed areas that are more remote include the State Marine Parks in Prince William Sound and Resurrection Bay, and other general state lands.

The Chugach National Forest is an important attraction for regional tourism activities (USDA 2014a) with portions of the national forest within a half-hour drive from Anchorage and the Ted Stevens International airport, which serve as major hubs for visitors entering and exiting the state by highway or by air. An estimated 591,000 visitors participate in recreation activities annually within the Chugach National Forest (USDA 2013). In addition to out-of-state visitors, local Alaskan residents use the national forest for recreation activities. Over 44 percent of the total number of visitors who recreate within the Chugach National Forest are local residents who live less than 100 miles from the national forest (USDA 2013).

Methodology

Spatial Scale (indirect and cumulative effects analysis areas)

Indirect effects: The boundary for indirect effects is the Chugach National Forest boundary. This area was chosen because the indirect effects of providing varying levels of recreation opportunities and settings is determined at a national forest level.

Cumulative effects: The boundary for cumulative effects is the Chugach National Forest boundary. A larger area was considered, including all of the Kenai Peninsula, Chugach State Park, a portion of the area around Valdez managed by the State of Alaska, and the Wrangell-St. Elias National Park and Preserve. The areas within this boundary encompass public lands that offer varying types and settings for outdoor recreation and changes in management direction can influence what recreation opportunities are available and ultimately where the recreating public chooses to go. After reviewing the pertinent management plans for the various agencies, no specific management direction alterations are foreseen that would add to the cumulative effects of changing recreation opportunities within the Chugach National Forest.

Temporal Scale

Indirect and cumulative effects: the timeframe is the plan period (15 years). This timeframe was chosen because the forest plan would be revised after 15 years and different decisions about providing recreation opportunities could be made during the next forest plan revision process. The same 15-year timeframe was chosen with regard to cumulative effects. How the land management decisions of other agencies may change and affect recreation opportunities within the Chugach National Forest is too speculative beyond 15 years.

Measurement Indicators

The measurement indicator for the recreation resource is the number of acres of each recreation opportunity spectrum class forestwide and by geographic area.

These indicators can show how the alternatives offer different levels of recreation opportunity spectrum classes from primitive to rural across the national forest. This indicator directly relates to the significant issue of where various recreation opportunity spectrum classes and settings should occur.

The second indicator is the presence of plan components that address sustainable recreation. This measure was chosen because the 2012 Planning Rule directs the Forest Service to ensure forest plans provide social and economic sustainability, including sustainable recreation.

Analysis Methods and Assumptions

This section analyzes the change in availability of recreation opportunity spectrum classes both forestwide and within the geographic areas from the recreation opportunity spectrum classes currently available.

Assumptions:

- Copper River Highway will remain closed at mile 36 during the plan period (15 years)
- Lands currently open to motorized access under existing travel management decisions will remain open, unless or until modified through new travel management decisions.
- Future travel management decisions will tier from the recreation opportunity spectrum classes established by the revised forest plan.
- Not all lands identified in the recreation opportunity spectrum classes as potentially suitable for motorized access are open for motorized use or will necessarily be designated by subsequent travel management decisions as open to motorized use.

No assumptions were made in the analysis about project-level travel management decisions that may be made in the future that could directly affect availability of motorized access for recreation purposes.

Affected Environment

Recreation Opportunity Spectrum

Managing recreation settings is a foundational element to providing diverse opportunities for recreation experiences on national forests. Since the early 1980s, the Forest Service has used the recreation opportunity spectrum as a framework for identifying, classifying, planning, and managing a range of recreation settings. Each setting provides opportunities to engage in activities (motorized, non-motorized, developed, or dispersed on land or in water) that result in different experiences and outcomes. The settings are described in six classes with specific physical, managerial, and social criteria (USDA 1986). These classes are as follows:

- Primitive
- Semi-primitive non-motorized
- Semi-primitive motorized
- Roaded natural
- Rural
- Urban

Recreation settings range from highly modified, developed places (multi-site campgrounds with paved roads and electricity) to remote, natural areas with no roads or trails. Attributes typically considered in describing settings are: type and degree of access; remoteness; level of recreation development; social encounters; and the amount of on-site management.

Recreation opportunity spectrum classes are the objectives that guide recreation management. The classes depict, in broad terms, the level of recreation development and the amount and kind of recreation use that is appropriate for any given area. They guide project level decisions regarding recreation management. Travel management decisions are project level decisions that determine the specific areas and routes open for motorized recreation, Travel management decisions must be consistent with the recreation opportunity spectrum class attributes for access. For example, if an area is in a semi-primitive motorized recreation opportunity spectrum class, motorized recreation access may be allowed through a project-level travel management decision and recreation visitors using that area would expect to see motorized vehicles, hear motorized noises, and potentially see recreation infrastructure that supports motorized uses. A decisionmaker may decide that a portion of the same area needs to be closed to motorized use to protect certain resources. This closure would be part of a project-level travel management decision but the broader recreation class would not change.

Table 32 displays current recreation opportunity spectrum classes and acreages as mapped forestwide.

Table 32. Existing recreation opportunity spectrum acreage for the Chugach National Forest

Recreation Opportunity Spectrum Class	Acres	Percent of National Forest
Primitive[1]	2,498,666	46
Semi-primitive Non-motorized[2]	1,535,709	28
Semi-primitive Non-motorized (Winter Motorized Allowed)	704,998	13
Semi-primitive Motorized	583,284	11
Roaded Natural[3]	85,810	2
Rural	6,681	Less than 1

1 - The primitive I and primitive II classes have been combined for this table.
2 - Semi-primitive groups were combined with this class.
3 - Roaded modified was combined with this class.

The Chugach National Forest has been divided into three distinct geographic areas: Kenai Peninsula, Prince William Sound, and Copper River Delta. Table 33 shows the recreation opportunity spectrum classes divided across the geographic areas.

The Kenai Peninsula Geographic Area has the most miles of roads and trails, which corresponds to having the largest area of roaded natural and rural classes per geographic area (six percent) with very little primitive (one percent) and the remaining area in one of the semi-primitive classes (93 percent). The Prince William Sound Geographic Area encompasses the wilderness study area and large, remote islands, and has a much higher percentage of primitive and semi-primitive non-motorized classes (96 percent). The Copper River Delta Geographic Area has the highest acreage of the primitive class (80 percent) per geographic area across the national forest with large, remote areas west and east of the Copper River. More detailed descriptions of recreation classes and opportunities by geographic area can be referenced in the forest plan assessment for the Chugach National Forest (USDA 2014a).

Table 33. Existing recreation opportunity spectrum class acreage by geographic area

Recreation Opportunity Spectrum Class	Acres	Percent of Area	Percent of National Forest
Kenai Peninsula Geographic Area			
Primitive	5,945	<1%	<1%
Semi-Primitive Non-motorized	191,562	17%	4%
Semi-Primitive Non-motorized (Winter motorized allowed)	516,601	45%	10%
Semi-primitive motorized	365,176	32%	7%
Roaded Natural	68,045	6%	1%
Rural	6,681	<1%	<1%
Totals	1,154,010		
Prince William Sound Geographic Area			
Primitive	1,162,432	45%	21%
Semi-Primitive Non-motorized	1,325,190	51%	24%
Semi-Primitive Non-motorized (Winter motorized allowed)	83,347	3%	2%
Semi-primitive motorized	22,114	1%	<1%
Roaded Natural	569	<1%	<1%
Rural	0	0%	0%
Totals	2,593,651		
Copper River Delta Geographic Area			
Primitive	1,330,289	80%	24%
Semi-Primitive Non-motorized	18,957	1%	<1%
Semi-Primitive Non-motorized (Winter motorized allowed)	105,050	6%	2%
Semi-primitive motorized	195,994	12%	3%
Roaded Natural	17,196	1%	<1%
Rural	0	0%	0%
Totals	1,667,487		

Recreation Infrastructure and Access

Recreational infrastructure and access are two important components in delivering a suite of recreation opportunities. The Forest Service manages 109 recreation sites with developed infrastructure to provide a variety of recreation opportunities across the national forest. These sites include campgrounds, public use cabins, visitor centers and information sites, trailheads, boat ramps, and day use areas. Most of these sites, except for the public use cabins, are accessible along the existing road system and are within the roaded natural recreation opportunity spectrum class. Cabins are found mostly in more remote areas within primitive and semi-primitive recreation opportunity spectrum classes and are accessible only by trail, boat, or float plane. More detailed information about the variety of recreation sites is within the forest plan assessment (USDA 2014a).

The type of access generally determines the type of recreation infrastructure and opportunities that are available. There are a total 95 miles of NFS Roads, and another 210 miles of state highways and major state roads throughout the Chugach National Forest. Most of the roads are concentrated within the Kenai Peninsula Geographic Area with the Copper River Delta Geographic Area having one highway and several spur roads. Prince William Sound Geographic Area has no public roads. The lack of roads has resulted in a large amount of the national forest being within IRAs (99 percent) (USDA 2014a). More than 98 percent of the national forest is within primitive and semi-primitive recreation opportunity spectrum classes, which reflects the roadless character of the national forest.

Trails provide access to some of the remote areas of the Chugach National Forest, typically beginning from an existing road or saltwater shore. The national forest has approximately 487 miles of NFS Trails, including both terra and snow trails. Several trail systems also provide links to and between roads and communities, such as the 36-mile Resurrection Pass Trail that connects the communities of Cooper Landing and Hope. Access to fishing and hunting activities, Forest Service cabins, and winter skiing and snow machining is facilitated by trails.

Guided Opportunities

Outfitters and guides offer services to assist visitors with participation in many recreation activities across the national forest, which are often in remote settings, over rugged terrain, or require specialized equipment. Examples of guided activities offered within the national forest include river rafting, fishing, glacial hiking and climbing, horseback riding, riding all-terrain vehicles, heli-skiing, flight-seeing, dog sled tours, sea kayaking, and road based nature tours, such as hiking, birding, and bicycling. Guiding companies are required to obtain a special use authorization to provide commercial services to the public within the national forest. As of 2017, the Forest Service permits 131 outfitter and guide companies for guided activities within the national forest. Prospectuses are completed for areas that are in demand for outfitter and guide use and where a capacity has been established. Several prospectuses are planned for the future, including guided opportunities on Resurrection Pass Trail, Portage Lake, and Pyramid Peak areas.

The variety of guided activities reflect the broad range of recreation opportunity spectrum classes, from road based nature tours to backpacking occurring in remote areas of the national forest. Guided activities should be consistent with the characteristics of the recreation opportunity spectrum classes regarding what type of activity is permitted, mode of access, and group size allowed.

Kenai Peninsula Geographic Area

There are a wide variety of guided opportunities on the Kenai Peninsula in both summer and winter. In the summer, some examples include viewing Portage Glacier by boat; rafting trips on Sixmile Creek and Placer River; jet boat tours on Twentymile River; ice climbing in Portage Valley and

Spencer Glacier; hiking tours on several trails; tours of the Begich, Boggs Visitor Center; horseback riding; and helicopter supported dog sled tours to name a few. In the winter, snowmachine tours, backcountry skiing, and heli-skiing are the most popular activities. Currently, the only guides operating on the Kenai River under special use permit with the Forest Service are those that leave the river and take their clients above the high-water mark to fish or participate in other guided activities.

Prince William Sound Geographic Area

Most special use permit holders operating in Prince William Sound enter the area through Whittier or Valdez. Most of the kayak supported camping and boat-based hiking and day uses under outfitters and guide permits are based out of Whittier and Valdez. Hunting is another outfitted and guided activity commonly occurring in Prince William Sound.

Copper River Delta Geographic Area

Hunting is the predominant use for outfitter and guide permits issued in the Copper River Delta area. Other authorized outfitter and guide uses include hiking and sightseeing experiences on the developed trails and recreation areas. There is one special use permit authorized for heli-skiing and one for guided backcountry skiing. Several Copper River guides are authorized to camp at sites along the shoreline during the summer months and provide access to the Childs Glacier Campground.

Resorts

Two facilities are authorized as resorts under special use authorization. The Portage Glacier Lodge and Portage Glacier Cruises facilities are both authorized on the Glacier Ranger District in Portage Valley. The Montague Island Lodge is authorized on the Cordova Ranger District, but has never been developed.

Recreation Events

A recreation event is defined in the Code of Federal Regulations as a recreational activity conducted on NFS lands for which an entry or participation fee is charged. As of 2017, five events are authorized under multi-year permits. These events include running races and retriever dog trials. In addition, an average of five temporary permits (one-year or less) are issued annually for recreation events. These include a whitewater festival, mountain bike and running race, and other events.

Wilderness Study Area

The Chugach National Forest does not have any designated wilderness areas. Congress designated the Nellie Juan-College Fiord Wilderness Study Area in 1980 through passage of ANILCA. This area is being managed to retain its existing character and potential for inclusion in the National Wilderness Preservation System. The wilderness study area offers visitors outstanding primitive recreation opportunities within 1.9 million acres in the western part of Prince William Sound.

Changes that Affect Current Recreation Opportunities

Past and present activities that potentially affect recreation opportunities include those that change the recreation setting and landscape, change the recreation infrastructure available, or change access to an area. These changes are described by geographic area.

Kenai Peninsula Geographic Area

The Kenai Peninsula is the geographic area with the most road and trail access and corresponding human activity across the national forest. Past and present projects that potentially change the recreation setting include hazardous fuel reduction projects along the Seward Highway and Hope Highway where vegetation has been removed for reducing the risk of wildfire and producing wood products, large scale placer gold mining along the Resurrection Road near Hope, and smaller scale suction dredging within many creeks along the road systems. Expansion of gravel pits, realigning powerlines, and major stream restoration work have also changed landscape settings by removal or alteration of vegetation along the road system in several areas. Visitors seeking more naturally appearing landscapes with less visible modifications by humans may choose to recreate in other areas within the national forest or on other State or Federal lands. Use trends over the past 10 years in nearby Forest Service campgrounds and trailheads, however, indicate that recreation use has remained static (USDA 2014a), and that these projects along the road system have not seemingly affected the overall numbers of people seeking recreation opportunities on the Kenai Peninsula. The changes in landscape and increased human presence are still consistent with recreation opportunity spectrum classes of roaded natural and semi-primitive motorized where most of the projects have occurred.

One of the projects that affected winter motorized access distribution on the Kenai Peninsula Geographic Area was Kenai Winter Access Project. This project started as an attempt to resolve an appeal to the 2002 Record of Decision for the Final Environmental Impact Statement for the Revised Land and Resource Management Plan, which closed the Carter Lake and Crescent Lake area to winter motorized access. The project scope expanded to most of the Kenai Peninsula Geographic Area when the planning team and forest supervisor began to understand per members of the public that any acceptable solution for resolving the appeal for motorized and non-motorized winter access would be developed by considering a larger area than just the Carter Lake and Crescent Lake drainage. This decision was an amendment to the 2002 forest plan, which changed the corresponding winter travel management elements of the plan but did not address changing the mapped 2002 recreation opportunity spectrum classes. Since 2007, the recreation opportunity spectrum classes for some areas on the Kenai Peninsula have been inconsistent with mode of access allowed by the travel management decisions made through the Kenai Winter Access Project Record of Decision.

The Forest Service received a Transportation Alternatives Program grant from the State of Alaska in 2016 for seven miles of proposed trail and associated trailheads along the Seward Highway from Twentymile Creek to Ingram Creek and for a trail segment connecting to the Trail of Blue Ice in Portage Valley. This proposed recreation infrastructure is part of the INHT Southern Trek project and would provide a critical link for the Iditarod trail system and to other recreation venues, such as the Alaska Railroad and Whistle Stop recreation areas and the Alaska Wildlife Conservation Center near Portage. This proposed project is within the roaded natural class along the Seward Highway and Portage Valley Highway.

Prince William Sound Geographic Area

Prince William Sound has predominantly primitive and semi-primitive non-motorized recreation opportunity spectrum classes. The main access points are via boat from Whittier, Valdez, Seward, and Cordova, or by aircraft (float plane or helicopter) from any of these communities and Anchorage. One of the key activities that changed access to recreation opportunities in Prince William Sound was the opening of the Anton Anderson Memorial Tunnel (Whittier Tunnel) that connects the port city of Whittier on Prince William Sound to the Seward Highway and southcentral Alaska. The tunnel opened to vehicle traffic on June 7, 2000, and summer traffic increased from 127,554 vehicles in 2001 to 194,944 vehicles in 2007. This represents a 53 percent increase and has remained relatively static since 2007 at an average of 177,000 vehicles using the tunnel in the months of May through September. This information suggests a corresponding initial increase in boat traffic in Prince William Sound and then staying relatively static since 2007. Many companies in Whittier and Valdez are offering glacier sightseeing tours, fishing, sea kayaking, and other marine based recreation. The Forest Service has permitted commercial guided activities, such as camping accessed by sea kayaking, hiking, and hunting, and the reported guided use has remained relatively static over the past five years.

Analysis of data from over 40 different sources found that use levels are higher in the western half of Prince William Sound than the eastern half, and use in the summer is more widespread than use in the spring or fall, which tends to be more concentrated near access ports and public use cabins (Poe et al. 2010). This is most likely due to ease of access from Whittier, which is close to Anchorage, Alaska's major population center. Valdez is also a popular access port accessible from the Richardson Highway, which connects Prince William Sound to interior Alaska communities. Interestingly, a substantial portion of recreationists entering Prince William Sound from Valdez use the western half. The highest use levels were found at areas closest to Whittier (particularly Blackstone Bay) and Valdez. Public use cabins, both Forest Service and State of Alaska, act as nodes of concentrated use. Designation and developments at State Marine Parks also appear to increase overall human use (Poe et al. 2010).

Many areas were mapped with semi-primitive non-motorized recreation opportunity spectrum classes in the 2002 forest plan in anticipation of higher levels of visitation and potentially more recreation development opportunities. Some of these areas included Blackstone Bay, Harriman Fiord, Port Wells, College Fiord, Esther Island and Esther Passage, Culross Passage, Columbia Bay, and Knight Island. Some of the anticipated increased use has been realized, particularly in areas closest to the port towns of Valdez and Whittier. Twardock et al. (2010) studied beaches consistently for more than a decade and found that the number of campsites increased by 27 percent and total impacts at existing campsites expanded from 43 to more than 73 square meters (Twardock et al. 2010). Some established campsites in Blackstone Bay and other popular areas were reinforced with native materials to reduce further expansion of vegetation impacts.

The increase in recreation use is still consistent with the broad recreation opportunity spectrum classes for Prince William Sound. Some areas, such as the popular Blackstone Bay, may be approaching the upper thresholds for number of parties encountered per day and visibility of campsites from one another for the Semi-primitive Non-motorized recreation opportunity spectrum class on the busiest days in the summer, but for much of the year, the use is well below the thresholds for this class.

There has been a decrease in the overall level of development within the Nellie Juan-College Fiord Wilderness Study Area portion of the geographic area. Monitoring of the area's character from 2012 through 2016 showed a decline in the non-recreational development features from 803 in 2012 to 722 in 2016 and the number of sites was reduced from 254 to 198 (Lydon 2016). The decrease in development is consistent with the recreation opportunity spectrum classes for the geographic area. Overall development in the eastern half of the geographic area has not been monitored but is thought to have remained static over the past decade.

Access from Valdez and Cordova has not changed significantly over the past 10 years. Hunting and fishing opportunities on Montague, Hinchinbrook and Hawkins islands and along the shoreline of the east part of the geographic area remain available to local residents. One area that has seen an increase in use is the Columbia Bay area near Valdez. Over the past three decades, the glacier terminus retreated more than 20 kilometers (12 miles) to the north, moving past Terentiev Lake and Great Nunatak Peak. In some years, the terminus retreated more than a kilometer, though the pace has been uneven (Voiland 2017). With the glacial retreat, more terrain has been exposed for hiking and camping opportunities.

One of the events that has had long lasting effects in the Prince William Sound area was the oil spill in 1989. At least 10,800,000 gallons of crude oil spilled from the *Exxon Valdez*, resulting in the stranding of oil on an estimated 2,100 kilometers of shoreline. Recreation and tourism dramatically declined in 1989 in the spill area in Prince William Sound. Areas that were unoiled became more heavily used as activity was displaced from the oiled areas (EVOSTC 2014). Extensive cleanup efforts from 1989 through 1991 and natural wave action on the shoreline removed much of the stranded oil. Recreation and tourism rely on both consumptive and non-consumptive uses of natural resources. Although these activities have increased since the spill, several resources have not yet recovered, and beaches used for recreation contain lingering oil. Recreation and tourism are recovering from the effects of the spill, but are not yet fully recovered (EVOSTC 2014). While some recreation opportunities, such as wildlife viewing for some species, are not at pre-spill levels, most recreation opportunities are available in Prince William Sound.

Copper River Delta Geographic Area

The Copper River Delta Geographic Area has vast areas of primitive and semi-primitive recreation opportunity spectrum classes with a small area of roaded natural class along the Copper River Highway. New recreation development has been minimal throughout the geographic area over the past 10 years with the exception of the Childs Glacier day use site, which was expanded to include pavilions, recreational vehicle sites, and tent campsites in 2004, and the Eyak Boat launch, which was reconstructed with new parking and launching facilities in 2015. Childs Glacier recreation development changed the type of recreation opportunities from a day use type of experience to an overnight camping opportunity but did not influence the broad recreation opportunity spectrum class characteristics.

A major access change occurred in 2011 when the Copper River Highway Bridge at mile 36 was closed due to a bridge failure. It is uncertain when this bridge will be replaced, so road access to the Childs Glacier campground and day use site is currently unavailable. The campground and day use site remain open, with access currently provided by private boats or permitted outfitters and guides (USDA 2014a). The recreation use of the Childs Glacier developed site has decreased from a range of approximately 7,000 to 9,000 visitors prior to the highway closure to about 1,500 visitors annually. The levels and type of recreation use remain consistent with the recreation opportunity spectrum classes of roaded natural and semi-primitive motorized.

Recreation activities have also shifted in the past decade in the Tasnuna River area and area north of Scott and Sheridan Glacier. Heli-skiing was originally permitted in the Tasnuna River area in 1998. The level of permitted heli-skiing use has decreased from the original permitted amount of 800 client days to the current allocation of 400 client days. Over the past decade, a steady increase in snowmachine use has been observed in the Tasnuna River area and on the glaciers south of the river (Zastrow pers. comm. 2017). Improved technology allows visitors using snowmachines to access the challenging glacial terrain from Thompson Pass north of Valdez. In addition, organizations within the community of Valdez have marketed events during the winter, such as ice climbing, snowmachine races, fat-tire biking, and extreme skiing events. While the events do not take place within the national forest, people become familiar with the areas around Valdez and may choose to recreate within the national forest during subsequent visits. The increase in winter motorized activities (heli-skiing and snowmachine use) is not consistent with the current primitive recreation opportunity spectrum class (primitive II in the 2002 forest plan), which has non-motorized access as the mode of access with the only exception being winter motorized access for traditional activities on conservation system units. The existing winter motorized use is consistent with the current travel management decision which allows all types of motorized uses.

Another area that has become popular with recreating visitors on snowmachines is the Solomon Gulch Trail. This trailhead and the first segment of trail is on non-NFS lands, but recreating visitors can access portions of the national forest from this trailhead. The portions of Jack Bay that are within the national forest have a semi-primitive non-motorized recreation opportunity spectrum class. The current travel management plan also has this area closed to motorized use in the winter except for subsistence use. Current winter motorized recreation use is not consistent with either the mapped recreation opportunity spectrum class or with current travel management. The recreation opportunity spectrum class would not change in any alternatives and resolution of this issue would require public outreach and education in addition to potential law enforcement to monitor winter recreation access in this area.

The Copper River Delta south of the Copper River Highway is accessible via boats and snowmachines from the Copper River Highway, and has seen increased airboat activity in the summer months and increased snowmachine use in the winter months. The recreation use of airboats in small non-navigable waterways or non-marine areas is not consistent with the mapped semi-primitive non-motorized (winter motorized allowed) recreation opportunity spectrum class and is not consistent with current travel management, which closes this part of the Copper River Delta to summer motorized use except for subsistence access. Further east along the Copper River Highway, all-terrain vehicle use has been increasing on the islands south of the Copper River Highway. Long Island is mapped with a semi-primitive motorized recreation opportunity spectrum class that is consistent with this type of summer motorize use, while groups of islands north and south of Long Island are mapped with the semi-primitive non-motorized (winter motorized allowed) recreation opportunity spectrum class and use of all-terrain motor vehicle use in these areas would not be consistent with this recreation opportunity spectrum class.

The area east of Copper River is an undeveloped and primitive area that sees very light use, much of it for subsistence use. The recreation use levels in these vast areas have not changed substantially over the past decade. One notable change for this area is the only public use cabin east of Copper River on Martin Lake is closed to public use as of 2012. The cabin sustained damage in the winter of 2011-12 due to record snowfall and has not been repaired.

Trends

This section is focused on key trends that influence or affect recreation use opportunities across the national forest.

Recreation and Tourism in Alaska

Participation in outdoor recreation activities within the State of Alaska is expected to increase in the foreseeable future. Studies conducted in the past decade show that participation in outdoor recreation is higher per capita in Alaska than in the rest of the U.S. and that activities that are currently popular may continue to be popular in the future (Bowker 2001; Hall et al. 2009). Alaska's population is also increasing, so demand for recreation by residents will also likely increase. The number of out-of-state visitors to Alaska has been increasing since 2007, and in 2015 Alaska had a record number of out-of-state summer visitors (1.78 million) (McDowell Group 2016).

The demand for existing activities may change, and new activities may emerge and become popular. National trends in outdoor recreation based on the National Survey on Recreation and the Environment show that traditional winter activities have declined while activities oriented to viewing scenery and photography, and physically challenging activities, such as kayaking, snowboarding, and surfing, have increased substantially (White et al. 2016). How national trends relate to popularity of activities in Alaska is uncertain, but age demographics of out-of-state visitors and Alaska residents may partially explain why some activities see an increase in demand. An example of changing recreation activities and demand in southcentral Alaska is the increase in use of fat tire bicycles in winter months on frozen trails and waterways, particularly during the lower snowpack years of 2013-2015. Providing a diverse range of recreation opportunity spectrum classes across the national forest provides flexibility to address new uses and activities over the plan period.

Recreation Use within the Chugach National Forest

The Forest Service uses a recreation sampling methodology called National Visitor Use Monitoring to provide reliable information about visitors recreating on NFS lands. Information about the quantity and quality of recreation visits is required for forest plans, Executive Order 12862 (Setting Customer Service Standards), and implementation of the National Recreation Agenda. These visitor monitoring surveys are conducted every five years. The Chugach National Forest has accomplished three rounds of data collection to date (2001, 2008, and 2013) and is scheduled to survey for a fourth time in fiscal year 2018 (see table 34). The methodology changed between 2001 and 2008 for both visitation estimates and visit characteristics making comparisons of the first round of surveys to subsequent surveys difficult.

Table 34. National visitor use monitoring results for the Chugach National Forest

Survey Year	Total Recreation Site Visits[1]	National Forest Visits[2]
2001	903,505	630,000
2008	657,000	498,000
2013	884,000	591,000

1 - A site visit is the entry of one person onto a national forest site or area to participate in recreation activities for an unspecified period of time

2 - A national forest visit is defined as the entry of one person upon a national forest to participate in recreation activities for an unspecified period of time. A national forest visit can be composed of multiple site visits.

National forest visits increased between 2008 and 2013 by 18 percent and site visits increased by 34 percent. Based on anticipated increasing visitor use, recreation use within the Chugach National Forest is anticipated to increase, which may result in more competition for cabin reservations, campground site availability, and increasing levels of use along trails and backcountry areas.

In 2013, the following activities were most frequently listed as the visitors' primary activity: fishing (30 percent), hiking/walking (18 percent), and viewing natural features/scenery (13 percent) (USDA 2013), and it is anticipated that these would continue to be popular. One of the questions visitors are asked relates to substitute behavior (i.e., if for some reason they were unable to visit this national forest, what would they do?). Nearly 75 percent of the visitors surveyed in 2013 said they would go somewhere else for the same activity or go somewhere else for a different activity. These responses shows that visitors make choices as to where they recreate.

Alaska residents use guides and outfitters very infrequently during visits to the national forest. The most common type of service residents utilized were day cruises. The majority of non-resident visits to the Chugach National Forest involved the use of a guide or outfitter. Nearly one-third of non-resident visits involved a local day cruise and about one in five involved the use of a guide or outfitter for wildlife viewing and/or flightseeing. Guided fishing was also very popular among non-residents visiting the Chugach National Forest (White 2010).

Trends in Recreation Special Uses

From January 2014 to present, new outfitter/guide permit proposals have not been accepted by the Forest Service due to a backlog of applications and a shortage of staffing. It is not known at this time when new proposals will be accepted. Administrative capacity to complete needs assessments, prospectuses and other required administrative analyses will affect future growth in certain areas for commercial services.

Kenai Peninsula Geographic Area

Overall guided use peaked in 2014, but trends for various guided activities differ. Interest in being permitted for guided heli-skiing has increased among guiding companies. There has been a decrease in guided snowmachine use in low elevation drainages due to low snow levels over the last three years. Aircraft supported summer glacier activities, including flightseeing, glacier hiking, and glacier dog sled tours has been relatively stable. Non-motorized boat supported activities, including rafting, canoeing, and kayak day trips, has shown a slight downward trend from 2011 through 2015. Road based day use includes picnicking, photography, interpretation, and gold panning. These uses appear to be on an uptrend, with the lowest use in 2010 and highest use in 2015.

Prince William Sound Geographic Area

For outfitters and guide use from 2010 through 2015, the majority of the use occurs mid-May through August. The three most common commercial activities include kayak based camping, charter boat based hiking, and boat based hunting.

Charter boat based hiking numbers show an overall upward trend with the highest use reported for the 2014 season. Boat based guided big game hunting occurs within the Alaska Department of Fish and Game’s Guide Use Areas: 06-04, 06-05, and parts of 06-03 and 06-06. The reported use has been fairly flat over the six-year period, with the highest reported use in 2011 and lowest use in 2013. Kayak supported camping and day use activities’ reported numbers indicate that it is the highest commercial use in this geographic area. The data show an upward trend and over 30 percent increase from the use reported in 2010 compared to the numbers reported in 2015.

Competing Demands and Conflicts

Alaska’s landscape is vast with enormous acreages seemingly available for recreation, but with the rugged terrain and limited access, most of the recreation use occurs along the limited highways, trails, and accessible waterways. Within the Chugach National Forest, a relatively small part of the landbase is used for the majority of the recreation infrastructure and use, and the public has expressed desires for more access to both motorized and non-motorized recreation opportunities. Recreation opportunity spectrum classes set broad direction and are the objectives for how recreation use is managed. Travel management decisions allocate areas for types of motorized and non-motorized access (specific areas and routes that are available, seasons, and types of use) and occur at the project level.

Based on public comments, conflicts include those between horse users and bicyclists on trails, trapping of furbearers within popular winter recreation areas, and motorized and non-motorized watercraft uses on river and lake systems. The broad level planning with recreation opportunity spectrum classes does not directly address these types of conflicts. Site specific analysis based on public input and corresponding travel management decisions are required to implement solutions for resolving some use conflicts.

Sustainability of Recreation Opportunities

The 2002 forest plan provided direction for major reconstructions of aging facilities and building new recreation facilities to address increasing demands. Based on national forest monitoring, national visitor use monitoring survey results, and trends described in the forest plan assessment (USDA 2014a), the Chugach National Forest has been successful in the past decade at providing a wide range of recreation opportunities while sustaining ecological integrity of the intact ecosystems. In this plan period, there are unprecedented challenges in continuing to provide quality recreation into the future. These include aging recreation assets resulting in an increase in a backlog of maintenance needs; unmanaged recreation in areas that degrade recreation settings; damage to heritage sites that cause unacceptable resource impacts; conflicts between users; and financial demands that underscore the inadequacy of traditional funding sources to meet growing needs. Forest Service leaders in the Alaska Region recognized that visitors value the national forests in Alaska for recreation experiences. The regional forester and both forest supervisors developed a regional strategy for future management of recreation resources to address how best to keep delivering unique recreation experiences in Alaska but address the issues of increasing maintenance needs for facilities, increasing recreation use, and decreased capacity with reduction of Federal budgets. The strategy includes working closer with partners and communities to help deliver recreation services and to balance the number of recreation facilities and infrastructures at a level that the Forest Service, with partners and communities, can sustain socially, financially, and environmentally. In addition, the strategy promotes the need for developing citizen stewards and partnerships to protect special places, and unique natural, heritage, and wilderness resources (USDA 2014b). Developing forest plan direction that will continue to transition recreation management business practices towards these strategies will be critical to future success in providing recreation opportunities.

Climate Change and Recreation Opportunities

Researchers over the past 20 years have studied and modeled the effects of climate change on ecosystems within Alaska. Many decisions regarding the availability of recreation opportunities are shorter term but some decisions regarding recreation infrastructure should be informed by considering potential changes in environmental conditions due to climate change over the longer term. These include design of facilities, such as cabins and campgrounds, and locations of trailhead and roads. A focused assessment, Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula, by Hayward et al. (2017) evaluates the effects of future climate change on a select set of ecological systems and ecosystem services in Alaska’s Kenai Peninsula and Chugach National Forest regions. Salient points from this climate change assessment that are pertinent to understanding effects of climate change on recreation infrastructure, recreation access, and recreation opportunities over the next several decades have been summarized.

The climate change assessment area covers all of the Kenai Peninsula, Prince William Sound, Copper River Delta, Chugach State Park, and areas immediately north of and adjacent to the Chugach National Forest. Southcentral Alaska experiences a high degree of variability in the regional climate due to the difference in elevation (sea level to 12,000 feet) and intersection of two climate regions

(Cook Inlet, southcentral) but additionally the area has substantial short term variability due to geographic location (Gulf of Alaska and North Pacific) and location of mountain ranges interacting with storm paths, and longer term variability with non-cyclical variation in ocean circulation patterns and the Pacific Decadal Oscillation (PDO) and El Nino-Southern Oscillation (ENSO). Natural variation in the local region makes climate change effects difficult to ascertain in the short term (i.e., the plan period) but more evident 30 to 50 years from now (Hayward et al. 2016).

One of the key climate change effects for recreation is that winter warming (4.5 to 6° F) will be greater than summer warming. This will affect lower elevations specifically where precipitation will more often occur as rain rather than snow. Storm frequency and intensity is likely to increase, which may mean more snow in the higher elevations during winter months and larger rainfall events in the summer, spring, and fall. Furthermore, while winter rain will be more common at low elevations, large snow events and even exceptional snow years could occur as a consequence of the interaction of regional variation in climate and the increased intensity of individual storm events. Also predicted are earlier springs, later autumns, and shorter, less severe winters. Winters similar to the warm, low-snow years experienced from 2012 to 2015 throughout southcentral Alaska may be more common in the coming decades.

The frequency of low snow years will affect how people recreate in the winter months and the length of the summer recreation season. Winters with low snowpack or no snowpack in the lower elevations may mean people who want to access backcountry areas with snowmachines may be limited to using trailheads at higher elevations or choosing different places off the national forest to recreate, such as Hatcher Pass, Talkeetna, Cantwell, and Thompson Pass. People who typically ski or snowboard may have to hike up to snow line before using their skis or snowboards, ride fat tire bikes, or hike on lower elevation trails.

For the Forest Service and other agencies that manage recreation sites, any construction or reconstruction of recreation infrastructure will need to consider deeper snowpacks in higher elevations and lack of snow in lower elevations for cabins, bridges, and trail tread design. Concern about damage to exposed trail infrastructure (bridges and waterbars) and vegetation in low snow years has prompted the Forest Service to delay opening of winter motorized recreation use or entire winter closures for snowmachine access in the past five years.

Recreation-oriented businesses would need to use a flexible business model to cater to multiple types of recreation venues and equipment to cover those years with lower snowpacks. For companies offering heli-skiing, more snow in the higher elevations may be beneficial to their ability to offer premium skiing conditions.

Changes in glaciers may also affect recreation opportunities. Over the past decade, all glaciers in the region lost mass except one. Non-tidewater glaciers are anticipated to thin about 10 feet per year at their terminus and most are retreating. Columbia Glacier is likely to retreat nine miles in next 20 years (Hayward et al. 2016). As noted, more shoreline has been exposed with Columbia Glacier's retreat, leaving new areas available for anchoring and camping. The dynamics of tidewater glaciers, like Columbia Glacier, are more complex; not all are retreating but most are thinning. Viewing tidewater glaciers in Prince William Sound has been very popular with visitors, including the large number of people on cruise ships, and changes to these glaciers are uncertain. Glaciers retreating to where they become non-tidewater glaciers may eventually diminish visitors' ability to view and experience their grandeur.

Environmental Consequences

Indirect Effects Common to Alternatives B, C, and D

Recreation Settings and Opportunities

Travel management direction would be separated from the forest plan for these alternatives and would be contained in a stand-alone document, as described in chapter 2. As travel management issues arise in the future, project level NEPA analysis completed and decisions made would not require a forest plan amendment unless changes to the recreation opportunity spectrum class were necessary (i.e., changing from a motorized setting to a non-motorized setting over a broad area).

Recreation Infrastructure and Access

No new recreation infrastructure is being proposed. Recreation infrastructure that was included as part of the past project level decisions, such as trail development on the INHT and development of trails and cabins within the Whistle Stop area, would continue to be implemented where funding and partner support is available for sustainable operations. With a trend in increasing recreation demand, existing Forest Service recreation facilities will likely have higher occupancy rates and more competition for reservations at popular campgrounds and backcountry public use cabins. With increasing numbers of recreation visitors using recreation facilities and trail systems, conflict between user groups and within user groups may also increase. These conflicts would be more likely in areas where the conflicting uses are not separated spatially or temporally. With increased competition for recreational resources and user conflicts, there may be an increase in unauthorized routes/uses (e.g., user-created trails, motorized incursions in areas where motorized uses are not allowed for all or a part of the year). In most areas across the national forest, the recreation use falls well within the recreation opportunity spectrum class criteria (such as encounter rates, group size, etc.) so there is some room for increases in recreation use.

It is also likely that new recreation trends will emerge that may require different types of facilities and needs for access than what is currently offered. Addressing these new trends would require coordination with partners, communities, and other agencies, particularly with anticipated reduction of Federal funding. All action alternatives retain a range of different recreation opportunity spectrum classes that allow some flexibility in addressing emerging trends in recreation use. But in some of the trend areas, such as increasing recreation use overall, it may be more difficult to add flexibility. The number of recreation facilities won’t be increasing other than those recreation facilities currently being built (Whistle Stop and INHT). In fact, the number of facilities may decrease as Federal funding for operation and maintenance decreases.

Sustainability of Recreation Opportunities

The forest plan for these alternatives would have direction to consider sustainability of recreation infrastructure and could affect what type of infrastructure would remain and which infrastructure may need to be decommissioned if not found to be sustainable. The forest plan would also direct the Forest Service to work with partners to help deliver services and recreation opportunities, which may in turn slightly increase business opportunities in local communities.

Cumulative Effects Common to All Alternatives

Foreseeable projects that are not under Forest Service jurisdiction, such as the implementation of the hydropower project at Grant Lake on the Kenai Peninsula and realignments of State highway systems (Seward Highway miles 75 to 90, Sterling Highway miles 45 to 60), would have similar effects of changing recreation opportunities from a more remote, primitive or semi-primitive recreation opportunity spectrum class to a class more consistent with rural or roaded natural due to the amount of buildings and road infrastructure required for these projects. These projects may also affect recreation visitor experience on nearby trail segments and may require relocation of recreation infrastructure, such as trailheads, but should not eliminate any recreation opportunities currently available. The location of the new highway alignment or increased parking capacity may increase ease of access to areas that are currently more remote (Seward Highway Milepost 75 to 90 Project).

Other potential projects that may affect recreation opportunities within small local areas would include development of subsurface estates on parcels purchased as part of the EVOS settlement (Port Gravina in eastern Prince William Sound as an example) or other split estate lands (such as on Knight Island at the head of Drier Bay) and access to privately held lands within the wilderness study area. Depending on the level of development and infrastructure needed, the recreation opportunity spectrum class could change to a class more consistent with rural or roaded natural for the duration of the projects or permanently in the case of road access to private land, but in all cases, it would affect a relatively small area of the national forest.

Another effect to recreation opportunity spectrum classes is when adjacent lands are managed for different recreation opportunities than NFS lands. An example of this is where recreation visitors on State lands may utilize snowmachines but their use can affect visitors on adjacent NFS lands where the recreation opportunity spectrum class is non-motorized. Boundaries between lands are sometimes not readily visible in winter months and visitors using snowmachines can inadvertently travel onto NFS lands that are non-motorized. This effect is more common on the Kenai Peninsula where state lands are along the highway systems and NFS lands are beyond the state lands (Summit Lake and Cooper Landing area).

Alternative A No Action

Recreation Settings and Opportunities

Under the 2002 forest plan, the primitive recreation opportunity spectrum class covers the largest area of the national forest (46 percent), followed by semi-primitive non-motorized (28 percent), semi-primitive non-motorized (winter motorized allowed) (13 percent), semi-primitive motorized (11 percent), roaded natural (two percent), and finally rural (less than one percent) (see alternative A ROS map in the map package). Table 35 displays recreation opportunity spectrum class acreage and percentage of the national forest by alternative.

The 2002 forest plan describes a desired condition of having undeveloped, dispersed recreation opportunity spectrum classes over most of the national forest along with a mix of motorized and non-motorized recreational opportunities (primarily non-motorized in summer and motorized in winter). Table 36 displays the mix of classes by summer and winter motorized and non-motorized access for alternative A.

Recreation opportunity spectrum classes in alternative A are not consistent with existing travel management decisions in 13 areas across the national forest; six of these areas are where the Kenai Winter Access Project Record of Decision (2007) changed winter motorized access on the Kenai Peninsula Geographic Area but the recreation opportunity spectrum class was not changed to be in alignment with the change in motorized/non-motorized access. Travel management is an integral part of the 2002 forest plan and any change to travel management requires a plan amendment.

Table 35. Recreation opportunity spectrum classes for all alternatives

Recreation Opportunity Spectrum Class	Alternative A Acres (Percent)	Alternative B Acres (Percent)	Alternative C Acres (Percent)	Alternative D Acres (Percent)
Primitive	2,498,666 (46)	2,498,666 (46)	2,899,932 (54)	2,943,228 (54)
Semi-primitive Non-motorized	1,535,709 (28)	1,557,772 (29)	840,944 (16)	797,819 (15)
Semi-primitive Non-motorized (Winter Motorized Allowed)	704,998 (13)	692,316 (13)	1,134,683 (21)	1,134,550 (21)
Semi-primitive Motorized	583,284 (11)	574,556 (11)	449,129 (8)	449,151 (8)
Roaded Natural	85,810 (1)	85,730 (1)	89,992 (1)	89,931 (1)
Rural	6,681 (<1)	6,110 (<1)	469 (<1)	470 (<1)

Table 36. Alternative A summer and winter non-motorized and motorized classes

Recreation Opportunity Spectrum Class	Percent of National Forest	Kenai Peninsula Geographic Area (percent)	Prince William Sound Geographic Area (percent)	Copper River Delta Geographic Area (percent)
Summer Non-motorized	87	62	99	88
Summer Motorized	13	38	1	12
Winter Non-motorized	74	17	96	81
Winter Motorized	26	83	4	19

Wilderness Area Recommendation

The 2002 forest plan recommended 1,387,510 acres within the wilderness study area for wilderness area designation. By policy, the entire wilderness study area is currently managed very similarly to ANILCA designated wilderness areas. Visitors would likely not see any perceptible changes with wilderness designation and will still have opportunities for remote recreation experiences.

The areas not recommended for wilderness would be managed according to the management areas described in the 2002 forest plan (backcountry, EVOS, research natural area, and wild river). Should Congress release the non-recommended areas from wilderness study area status these areas would no longer have the management direction to manage to retain the area’s character for potential inclusion in the National Wilderness Preservation System.

Sustainability of Recreation Opportunities

The 2002 forest plan has a goal of maintaining the current recreational capacity through maintenance of existing recreational facilities and trails and expansion of recreational capacity by developing new recreational facilities and trails in response to user demands. The focus for management in the 2002 forest plan is to use traditional means of maintaining recreation facilities (allocated funding) and to expand recreation opportunities where possible to accommodate public demands. Sustainability of recreation facilities is not addressed within the 2002 forest plan.

2002 forest plan components do not address the need for providing diverse recreation opportunities in cooperation with partners, nor does the 2002 forest plan have components that address the current understanding and uncertainties associated with a changing climate and its effects on timing and location of recreation opportunities and associated infrastructure.

Cumulative Effects

Several closures of State operated recreation facilities due to fiscal constraints is currently increasing the demand for similar facilities within the Chugach National Forest. With the lack of forest plan direction for sustainability of Forest Service managed recreation facilities and a need to develop cooperative partnerships to address the operation of recreation infrastructure across boundaries, the unexpected swings in demand on public facilities could continue to be problematic and potentially lead to some public facilities not being open for public use.

Alternative B

Recreation Settings and Opportunities

The recreation opportunity spectrum classes for alternative B are similar to those of alternative A, except alternative B has a slight increase in semi-primitive non-motorized areas (see alternative B recreation opportunity spectrum map in the map package). Primitive still covers the largest area of the national forest (46 percent), followed by semi-primitive non-motorized (29 percent), semi-primitive non-motorized (winter motorized allowed) (11 percent), semi-primitive motorized (10 percent), roaded natural (one percent), and rural (less than one percent). Table 37 displays the mix of classes by summer and winter non-motorized and motorized access for this alternative.

Table 37. Alternative B summer and winter non-motorized and motorized recreation opportunity spectrum classes

Recreation Opportunity Spectrum Class	Percent of National Forest
Summer Non-motorized	88
Summer Motorized	12
Winter Non-motorized	75
Winter Motorized	25

Kenai Peninsula Geographic Area

The change in recreation opportunity spectrum classes between alternatives A and B reflects the change in motorized access on the Kenai Peninsula Geographic Area analyzed through the Kenai Winter Access Project (2007). The two other geographic areas did not have any changes between alternatives A and B. Table 38 displays the Kenai Peninsula Geographic Area classes for alternatives A and B and the percent change for the geographic area.

Table 38. Comparison of recreation opportunity spectrum classes between alternatives A and B for the Kenai Peninsula Geographic Area

Recreation Opportunity Spectrum Class	Alternative A (acres)	Alternative B (acres)	Percent change of Kenai Peninsula Geographic Area
Primitive	5,945	5,945	zero
Semi-primitive Non-motorized	191,562	213,556	2 percent more
Semi-primitive Non-motorized (Winter Motorized Allowed)	516,601	503,904	1 percent less
Semi-primitive Motorized	365,176	356,477	1 percent less
Roaded Natural	68,045	68,020	zero
Rural	6,681	6,110	zero
Totals	1,154,010	1,154,012	NA

Slightly less summer and winter motorized classes would be available in alternative B than alternative A within the Kenai Peninsula Geographic Area. While the number of acres and percent change are not large, the distribution and variety of locations did change for both winter non-motorized and motorized access.

Recreation visitors would not perceive any differences in available recreation opportunities within the Kenai Peninsula Geographic Area as the main changes in this alternative from alternative A are to align recreation opportunity spectrum classes with the current Kenai Winter Access Project decision that was implemented in 2007. Seven areas would still have inconsistencies between travel management and recreation opportunity spectrum across the national forest, five being within the Kenai Peninsula Geographic Area.

Prince William Sound Geographic Area

There are no changes to recreation opportunities within this geographic area from existing conditions. Recreation visitors would have the same range of recreation opportunities that currently exist.

Copper River Delta Geographic Area

There are no changes to recreation opportunities within this geographic area from existing conditions. Recreation visitors would have the same range of recreation opportunities that currently exist.

Wilderness Recommendation

The recommended areas for wilderness designation in alternative B are the same as alternative A, and the effects of wilderness area designation, should Congress so designate, would be the same as alternative A.

Sustainability of Recreation Opportunities

Alternative B includes desired conditions, objectives, and a goal that addresses achieving sustainability of recreation opportunities. Sustainability and predictability of goods and services, including recreation and tourism opportunities, are described within these desired conditions. This alternative also includes nine objectives that address facets of sustainability where management actions will be focused to meet the desired conditions. Some of these include reducing deferred maintenance on priority recreation assets, decommissioning financially unsustainable assets, and working with the State to develop a strategy for managing all public facilities along the highway system on the Kenai Peninsula in a sustainable manner.

These plan components would focus management actions on seeking out ways to make recreation facilities more sustainable, working more closely with partners, communities, and other agencies and decommissioning facilities that are not sustainable and don't have partner or community support. While the recreation visitors may have fewer facilities to choose from, the focus of these plan components is to continue to offer visitors a range of recreation opportunities (defined and described by recreation opportunity spectrum classes) and type of recreation facilities that are maintained and operated in a safe and acceptable condition.

Cumulative Effects

Cumulative effects for alternative B are disclosed in those common to alternatives B, C, and D.

Alternative C

Recreation Settings and Opportunities

One of the key changes in the distribution of recreation opportunity spectrum classes across the national forest in alternative C would be a greater number of acres in the primitive recreation opportunity spectrum class with a corresponding reduction in acres of the semi-primitive non-motorized class (see alternative C recreation opportunity spectrum map in the map package) (see table 35 for comparison of alternatives by recreation opportunity spectrum classes). There would be more acres in the semi-primitive non-motorized (winter motorized allowed) class than currently, and slightly fewer acres of the semi-primitive motorized class. The forestwide allocation of non-motorized and motorized classes for summer and winter are displayed in table 39.

Table 39. Alternative C summer and winter non-motorized and motorized classes

Recreation Opportunity Spectrum Class	Percent of National Forest
Summer Non-motorized	90
Summer Motorized	10
Winter Non-motorized	69
Winter Motorized	31

Alternative C would have slightly more acres of the summer non-motorized recreation opportunity spectrum class and slightly more acres of the winter motorized class than alternative A.

The recreation opportunity spectrum classes in alternative C would generally be more consistent with current travel management direction than alternative A. Only one area of the 13 areas that were inconsistent in alternative A would still be inconsistent with travel management (the entire area east of the Copper River). A separate travel management NEPA analysis and decision would be required to make the change in motorized use. Two other desired changes in recreation opportunity spectrum would require changes in motorized uses and would be implemented in separate travel management NEPA analyses and decisions. Specific changes for alternative C are noted under each geographic area section.

Kenai Peninsula Geographic Area

Table 40 displays the recreation opportunity spectrum classes for alternative C compared to those for alternative A.

Table 40. Comparison of recreation opportunity spectrum classes between alternative C and alternative A for the Kenai Peninsula Geographic Area

Recreation Opportunity Spectrum Class	Alternative A (acres)	Alternative C (acres)	Percent change of Kenai Peninsula Geographic Area
Primitive	5,945	84,911	6 percent more
Semi-primitive Non-motorized	191,562	156,302	3 percent less
Semi-primitive Non-motorized (Winter Motorized Allowed)	516,601	687,906	15 percent more
Semi-primitive Motorized	365,176	151,937	19 percent less
Roaded Natural	68,045	72,485	Less than 1 percent more
Rural	6,681	469	Less than 1 percent less
Totals	1,154,010	1,154,010	

Two drainages would be changed to the primitive recreation opportunity spectrum class (Snow River and Mills Creek), which would match the current experience visitors have, meet the public desire to have primitive recreation opportunities accessible from the road system, and align with the Kenai Winter Access Project decision.

One of the changes in recreation opportunities is the conversion of most of the semi-primitive motorized class to semi-primitive non-motorized (winter motorized allowed), semi-primitive non-motorized, or primitive classes. About two-thirds of the current semi-primitive motorized areas within the Kenai Peninsula Geographic Area are open to helicopters and closed to off-highway vehicles and the remaining areas are open to helicopters and off-highway vehicles (on designated routes only). There would be 18 percent less acreage available for summer motorized recreation activities, particularly summer helicopter supported activities. One area affected is the Godwin Glacier area near Seward, which is only accessible by aircraft in the summer months. The State currently permits helicopter supported guided dog sledding and hiking on the State land portion of Godwin Glacier. This area is currently in the semi-primitive motorized class, and with alternative C, this area would be in the primitive class. Opportunities are still available on the State land portion of Godwin Glacier for permitted activities supported by helicopter. The amount of other summer helicopter supported recreation activities not tied to special use permits is not known but is estimated to be very minimal. Where helicopter supported activities are under current special use permit, the semi-primitive motorized class has not been changed. The recreation setting for the two off-highway vehicle routes (Crown Point Mining Road and Falls Creek Road) would not change, but other areas adjacent to them would change to the semi-primitive non-motorized (winter motorized allowed) class. Winter motorized access within the Kenai Peninsula Geographic Area would not change.

In alternative C, the recreation opportunity spectrum setting for the Spencer Glacier Whistle Stop recreation complex would be changed to roaded natural to be more consistent with the social encounters expected and level of infrastructure development (campground, roads, a group camping site, and whistlestop sidings structures). This recreation opportunity spectrum class change would not alter the current visitor experience.

This alternative also eliminates the rural recreation opportunity spectrum class from the 2002 mapped mining claims. Mining claims change frequently as do the level of operations (operations range from none to large scale mechanical mining). The one exception is an area south of the town of Hope where large scale placer mining is planned for the next 20 years; the rural recreation opportunity spectrum class is proposed in this area. The environmental consequences of this change would be negligible because the recreation opportunity spectrum class does not affect mining operations and would not change current visitor experiences.

The management area direction around the Grant Lake/Ptarmigan Lake area and the area west of the Hope Highway corridor changed in this alternative from the current fish, wildlife, and recreation management area to the backcountry management area. The recreation opportunity spectrum class of semi-primitive non-motorized (winter motorized allowed) is more consistent with this management area direction and would not change current visitor experiences.

The management area direction was changed for a third area, from the current fish and wildlife conservation management area direction, to a combination of front country management area in a corridor along either side of the Palmer Creek road and backcountry management area for the remaining part of the drainage. The management direction change creates consistency with the recreation opportunity spectrum class for Palmer Creek Valley. A forest plan guideline was added in this alternative to maintain the lower level of desired recreation infrastructure and road development in the Palmer Creek Valley. These changes in recreation opportunity spectrum class and management areas would not change visitor current experiences.

Prince William Sound Geographic Area

Table 41 displays the recreation opportunity spectrum classes for alternative C compared to those for alternative A.

Table 41. Comparison of recreation opportunity spectrum classes between the alternative A and alternative C for the Prince William Sound Geographic Area

Recreation Opportunity Spectrum Class	Alternative A (acres)	Alternative C (acres)	Percent Change of Prince William Sound Geographic Area
Primitive	1,162,432	1,904,197	28 percent more
Semi-primitive Non-motorized	1,325,190	665,805	25 percent less
Semi-primitive Non-motorized (Winter Motorized Allowed)	83,347	5,969	3 percent less
Semi-primitive Motorized	22,114	17,085	Less than 1 percent less
Roaded Natural	569	595	Less than 1 percent more
Rural	0	0	zero
Totals	2,593,652	2,613,651	

Most of the wilderness study area would be in the primitive recreation opportunity spectrum class, which more closely aligns with the area’s existing characteristics: very little recreation development, very light recreation use, a high sense of solitude away from coastlines, especially as distance increases away from Whittier and Valdez. A small portion of the wilderness study area would retain a fringe of the semi-primitive non-motorized class from the edge of mean high tide to approximately 500 feet elevation along the coastline fringe of Blackstone Bay, Harriman Fiord, Cochrane Bay, and

Culross Passage. Recreation opportunities away from the coastline would reflect the area's existing primitive nature and remoteness, and the semi-primitive non-motorized class would better accommodate slightly higher use levels along the beaches and in camping areas closer to Whittier. This alternative is consistent with management studies within Prince William Sound that recommend concentrating use to already impacted areas (e.g., attractants, destinations points, glaciers, cabins, trails, and hardened sites).

For the eastern Prince William Sound, the only change would be on Hinchinbrook Island, changing the mix of primitive and semi-primitive motorized classes to semi-primitive non-motorized and semi-primitive motorized classes. Recreation classes for the three big islands would be more consistent and would continue to have semi-motorized classes for those areas on Hinchinbrook Island that provide summer motorized opportunities and provide for higher levels of encounters in those areas used for deer and black bear hunting. Visitors would not experience any changes in recreation experiences than what is available currently.

Copper River Delta Geographic Area

Table 42 displays the recreation opportunity spectrum classes for alternative C compared to those of alternative A.

Table 42. Comparison of recreation opportunity spectrum classes between alternative A and alternative C for the Copper River Delta Geographic Area

Recreation Opportunity Spectrum Class	Alternative A (acres)	Alternative C (acres)	Percent Change of Copper River Delta Geographic Area
Primitive	1,330,289	910,824	25 percent less
Semi-primitive Non-motorized	18,957	18,837	Less than 1 percent less
Semi-primitive Non-motorized (winter motorized allowed)	105,050	440,808	20 percent more
Semi-primitive Motorized	195,994	280,107	5 percent more
Roaded Natural	17,197	16,912	Less than 1 percent less
Rural	0	0	Zero
Totals	1,667,487	1,667,488	

Recreation opportunity spectrum classes would change from primitive to semi-primitive non-motorized (winter motorized allowed) in a large remote area south of the Tasnuna River (north of Sheridan and Scott Glaciers). Winter recreation opportunities would be more consistent with current winter travel management direction, which allows all types of winter motorized use, and would also be consistent with currently permitted helicopter skiing. Winter recreation visitors would have the same experience as is available currently. The amount of summer helicopter supported recreation activities not tied to special use permits is not known but is estimated to be very minimal in this area. This change would also be consistent with desired winter motorized recreation use in the area along the Tasnuna River from Thompson Pass north of Valdez.

The recreation opportunity spectrum class south of the Copper River Highway would change to semi-primitive motorized from semi-primitive non-motorized (winter motorized allowed) to be consistent with current recreation with airboats in summer months and snowmachines in winter months, which meets community desires for a variety of recreation opportunities on the Copper River Delta. Some types of summer motorized use in this area are restricted by travel management regulations to protect sensitive vegetation and wildlife habitat and specific areas are closed to winter snowmachine use by Forest Order due to resource concerns. All of these restrictions are still consistent with the broad recreation settings and do not change current visitor experience.

The recreation opportunity spectrum class for the entire area east of Copper River is currently primitive and would not change in this alternative. However, the current travel management lists this area as open to motorized access in the winter, which is not consistent with a primitive recreation opportunity spectrum class. A separate travel management analysis and decision would be required to change the current winter motorized access to non-motorized access.

Wilderness Recommendation

For alternative C, 1,819,700 acres would be recommended for wilderness area designation, and the area is completely within the wilderness study area. If designated by Congress, the Wilderness Act of 1964, as modified by ANILCA, would apply to these lands and they would be managed to preserve five qualities of wilderness character: untrammeled, undeveloped, natural, outstanding opportunities for solitude or primitive and unconfined recreation, and other features of value. By policy, the entire wilderness study area is currently managed very similarly to ANILCA designated wilderness areas. Many of the popular beaches are included in the wilderness recommendation and managing use of campsites within these areas would become more critical so as to maintain a sense of solitude and limit the number of campsites within sight of one another under a primitive or semi-primitive non-motorized recreation opportunity spectrum class.

Assuming Congress would release the remaining area from being in a study area, management direction for the areas not recommended for wilderness designation would be determined by a plan amendment at the time the rest of the recommended wilderness area is designated.

Sustainability of Recreation Opportunities

The forest plan for alternative C is similar in nature to what was in the 2015 version of the revised plan. Wording of desired conditions and objectives have been altered but essentially would lead to the same outcome as under alternative B.

Cumulative Effects

The Affected Environment section listed several anticipated changes with climate change over the coming decades with the key change being warmer winter temperatures and less snow for lower elevations. In alternative C, the recreation opportunity spectrum classes for the Tasnuna River drainage are consistent with current travel management, which would allow winter motorized use in the higher elevations. This area is accessible from Thompson Pass, which is at an elevation of 2,805 feet northeast of Valdez. It is one of the snowiest places in Alaska, recording about 550 inches of snow per year on average. In the State’s Prince William Sound Area Management Plan, Thompson Pass was identified as an important winter recreation use area, particularly for winter motorized use (Alaska DNR 2017). Changing the recreation setting to semi-primitive non-motorized (winter motorized allowed) provides consistency in recreation settings across agency boundaries and continues to provide a high elevation area for winter motorized use.

Alternative D

Recreation Settings and Opportunities

The indirect effects for alternative D are the same as alternative C with the exception of those listed under the Kenai Peninsula Geographic Area and the Prince William Sound Geographic Area.

Kenai Peninsula Geographic Area

The effects are the same as alternative C except that the management area direction for the Palmer Creek valley would change from the existing fish, wildlife and conservation to backcountry management area. This change reflects a desire from the public to keep the recreation development within the Palmer Creek valley at the same levels as exist presently. The backcountry management direction would not be consistent with the recreation opportunity spectrum class for the corridor along the Palmer Creek Road, which is mapped as roaded natural for this alternative. A roaded natural setting would allow a higher level of recreation infrastructure development along road systems, unlimited number of social encounters, and the visitors could expect to see modifications of the environment by human activity. The backcountry area would be managed to emphasize a variety of recreational opportunities in primarily backcountry settings in natural appearing landscapes.

Prince William Sound Geographic Area

Table 43 displays the recreation opportunity spectrum classes for alternative D compared to those of alternative A.

Table 43. Comparison of recreation opportunity spectrum classes between alternative A and alternative D for the Prince William Sound Geographic Area

Recreation Opportunity Spectrum Class	Alternative A (acres)	Alternative D (acres)	Percent Change of Prince William Sound Geographic Area
Primitive	1,162,432	1,947,467	30 percent more
Semi-primitive Non-motorized	1,325,190	622,689	27 percent less
Semi-primitive Non-motorized (Winter Motorized Allowed)	83,347	5,837	3 percent less
Semi-primitive Motorized	22,114	17,086	Less than 1 percent less
Roaded Natural	569	566	Less than 1 percent less
Rural	0	0	zero
Totals	2,593,652	2,593,645	

The main change from alternative C is the entire wilderness study area would be in the primitive class, which would eliminate the semi-primitive non-motorized recreation opportunity classes in areas closest to Whittier and Valdez. This change would limit future outfitting and guiding opportunities in popular areas, such as Blackstone Bay, Harriman Fiord, Port Wells, and Culross Passage, to stay within the limited number of social encounters described in the recreation opportunity spectrum table in the forest plan. In addition there would be limited ability to develop recreation infrastructure, such as hardened campsites, to direct camping use on more heavily used beaches.

Wilderness Recommendation

For alternative D, 1,884,200 acres are recommended for wilderness area designation, and it is entirely within the wilderness study area. If designated by Congress, the Wilderness Act of 1964, as modified by ANILCA, would apply to these lands and they would be managed to preserve five qualities of wilderness character: untrammeled, undeveloped, natural, outstanding opportunities for solitude or primitive and unconfined recreation, and other features of value. By policy, the entire wilderness study area wilderness study area is currently managed very similarly to ANILCA designated wilderness areas. All of the popular beaches are included in the wilderness area recommendation and managing the use of campsites within these areas would become more critical to maintain a sense of solitude and to limit the number of parties encountered under a primitive recreation opportunity spectrum class.

Assuming Congress releases the remaining area from being in a study area, management direction for the areas not recommended for wilderness designation would be determined by a plan amendment at the time the rest of the recommended wilderness area is designated.

Sustainability of Recreation Opportunities

Same as alternative C.

Cumulative Effects

Alternative D cumulative effects are the same as alternative C.

Analytical Conclusions

The Chugach National Forest offers visitors a variety of recreation opportunities that are predominantly within the primitive and semi-primitive recreation opportunity spectrum classes due to the fact that the vast majority of the national forest remains unroaded. Developed recreation infrastructure is mostly adjacent to the road system, which is within the roaded natural and rural recreation opportunity spectrum classes.

The effects of alternative B on recreation opportunities are very similar to alternative A except where changes in recreation opportunity spectrum classes are made to address the 2007 Kenai Winter Access Project decision that changed access for winter motorized recreation (see table 44). There would be no effects to recreation visitors as the changes in recreation opportunity spectrum classes would match current travel management decisions. Alternatives C and D have more acres in a primitive class and less in the semi-primitive non-motorized, semi-primitive non-motorized (winter motorized allowed) and semi-primitive motorized classes. The amount of roaded natural and rural classes changed very minimally across the alternatives. Alternatives C and D are generally more consistent with current recreation uses and current travel management and would not change current visitor experiences. Several changes in settings may require further project level travel management analysis and decisions to change motorized use designations, which may change visitor experiences. Alternatives B, C, and D all include revisions to the 2002 forest plan that address the need to work with partners, communities, and other agencies to deliver a suite of sustainable recreation opportunities.

The focus for recreation opportunity spectrum class changes across the three geographic areas is by alternative. For the Kenai Peninsula Geographic Area, alternative B is similar to current recreation opportunity spectrum classes as mentioned above; alternative C and D adds a moderate amount of acreages of the primitive class and changes a larger area of semi-primitive motorized to semi-primitive non-motorized (winter motorized allowed) class foregoing opportunities for summer motorized recreation in the form of helicopter supported activities in some locations.

For the Prince William Sound Geographic Area, alternatives C and D would have much higher acreages in the primitive class. For the Nellie Juan-College Fiord Wilderness Study Area, alternative C has a fringe of semi-primitive non-motorized class placed on the coastline within the popular bays closest to Whittier to allow for additional recreation use and some minimal recreation infrastructure. Alternative D is entirely in the primitive class.

For alternatives C and D, the Copper River Delta Geographic Area has fewer acres in the primitive class, which was changed to semi-primitive non-motorized (winter motorized allowed). There are more semi-primitive motorized acres for motorized activities, such as the use of airboats and snowmachines. Most of the recreation opportunity spectrum class changes in this geographic area make the recreation settings more consistent with current travel management and current and desired recreation use and will not substantially change current visitor experiences.

Table 44. Summary of consequences by alternative

Recreation Opportunity Spectrum Setting	Alternative A No Action	Alternative B	Alternative C	Alternative D
Primitive	46 percent	46 percent	53 percent	54 percent
Semi-primitive non-motorized	28 percent	29 percent	16 percent	15 percent
Semi-primitive non-motorized (winter motorized allowed)	13 percent	13 percent	21 percent	21 percent
Semi-primitive motorized	11 percent	11 percent	8 percent	8 percent
Roaded natural	2 percent	2 percent	2 percent	2 percent
Rural	<1 percent	<1 percent	<1 percent	<1 percent
Recreation Opportunity Spectrum Changes		Minor changes on the Kenai Peninsula to align with Kenai Winter Access Project decision	Moderately less semi-primitive motorized and moderately more semi-primitive non-motorized (winter motorized allowed) on Kenai Peninsula, considerably more primitive and considerably less semi-primitive non-motorized within Prince William Sound, considerably less Primitive and considerably more semi-primitive non-motorized (winter motorized allowed) on Copper River Delta	Same as alternative C with slightly more primitive class in Prince William Sound
Sustainability of recreation opportunities and infrastructure	No plan components	2015 version of the revised plan has 1 Goal, 8 Desired Conditions and 9 Objectives that address working with partners and communities to achieve recreation sustainability	Revised plan has 2 Goals, 10 Desired Conditions and 6 Objectives that address working with partners and communities to achieve recreation sustainability	Same as alternative C

Wilderness

Introduction

The forest supervisor for the Chugach National Forest is required by the planning rule (36 CFR 219.7 (v)) to "identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System, and determine whether to recommend any such lands for wilderness designation." Any lands the forest supervisor recommends for wilderness area designation through forest plan revision would be a preliminary administrative recommendation and are referred to here as recommended wilderness areas. Nearly 99 percent of the Chugach National Forest is eligible for recommendation for wilderness area designation due to having ecosystems generally appearing to be affected primarily by the forces of nature; outstanding opportunities for solitude or for a primitive and unconfined type of recreation; are of sufficient size to make preservation and use in an unimpaired condition practicable; and can be managed to preserve wilderness characteristics. Additionally, many areas of the national forest contain ecological, geological, or other features of scientific, educational, scenic, or historical value. The national forest does not have any designated wilderness areas. The Nellie Juan-College Fiord Wilderness Study Area in Prince William Sound, designated in 1980 by Congress through ANILCA, has been managed to maintain the area's character and potential for designation into the National Wilderness Preservation System. This section describes the effects of the different alternatives.

The actions and activities that affect the existing character of the wilderness study area are disclosed in the Affected Environment section along with how climate change may affect the character of the area in the future. The alternatives represent various options for wilderness area recommendation within the current wilderness study area boundary.

Methodology

Spatial Scale

Indirect effects and cumulative effects: the boundary is the current wilderness study area within the Chugach National Forest. This area was chosen because the indirect effects of analyzing various areas for wilderness recommendation would occur only within the wilderness study area boundary as other areas across the national forest have been eliminated from consideration (see appendix A Chugach National Forest Wilderness Area Inventory and Evaluation).

Temporal Scale

Indirect effects and cumulative effects: the timeframe for the environmental consequences is dependent upon whether the preliminary administrative recommendations are addressed by Congress. The timeframe for the environmental consequences related to any recommended wilderness area would be the expected life of the forest plan, or 10 to 15 years, unless the recommended wilderness area is designated by Congress, in which case the timeframe for environmental consequences would be the long term, or more than 15 years. The timeframe for the environmental consequences related to potential areas that are not recommended for wilderness area designation in the record of decision is the expected life of the forest plan, or 10 to 15 years. These timeframes were chosen because the wilderness area recommendation made in the record of decision for the current plan revision process could be changed with the next forest plan revision process.

Measurement Indicators

There are two measurement indicators. The first is the number of acres to be considered for wilderness area recommendation. This indicator shows how much area would be managed as a designated wilderness area if the recommendation is acted upon by Congress.

The second measurement indicator is the number of acres of the primitive recreation opportunity spectrum class within the area being recommended for wilderness area designation. This measure was chosen because managing for the primitive class characteristics aligns the recreation opportunities most closely with maintaining wilderness area character.

The amount of area recommended for wilderness area designation was identified as an issue through public scoping and internal review. Many public comments during pre-scoping public meetings and during the formal scoping period addressed concerns and opportunities connected with recommending wilderness areas both within the wilderness study area and in other areas across the national forest.

Analysis Methods and Assumptions

The basis of a wilderness area recommendation is determining what part of the national forest landscape would be managed to maintain wilderness area characteristics into the future until Congress passes legislation designating wilderness areas. Across Federal agencies, five qualities are used to define wilderness character in designated wilderness areas: untrammeled, undeveloped, natural, outstanding opportunities for solitude or primitive and unconfined recreation, and other features of value (Landres et al. 2015). Regional policy requires the Chugach National Forest to manage the wilderness study area in the same manner as designated wilderness areas, as modified by ANILCA. The Forest Service manages the wilderness study area to preserve its existing character and to maintain its potential for inclusion in the National Wilderness Preservation System. The Affected Environment section describes how past and present activities and events have affected the area’s character and describes what is anticipated in the future.

The analysis for each alternative will have both the size of recommended wilderness area relative to the rest of the wilderness study area and remaining portions of the national forest and the amount of primitive recreation opportunity spectrum class opportunities available within the recommended wilderness area acreage. Recreation activities are only one of many activities within the wilderness study area that influence the area’s character and potential for inclusion in the National Wilderness Preservation System. Different recreation settings describe different levels of access, types of management facilities, and number of social encounters expected. Recreation opportunity spectrum classes vary across the alternatives. Decisions that pertain to provisions in ANILCA (fish hatcheries and set net sites, fish ladders and research sites, use cabins, harvest of fish and wildlife, communication sites, and subsistence access and activities) also influence the area’s character and potential for inclusion in the National Wilderness Preservation System, but these activities do not vary between the alternatives and therefore are only described within the Affected Environment section.

Assumptions for this analysis include the following:

- If Congress designates recommended wilderness areas, provisions similar to ANILCA would be applied to these areas
- The acreage figures for recommended wilderness area are based on estimates from GIS data used for this forest plan revision process. If wilderness area designation occurs, the acreage may be different because of shifting boundaries of lakes and rivers and the recession of tidewater glaciers

as well as changes in land ownership. Small islands of less than an acre are not included in the acreage amount but could be included in a wilderness area recommendation if they are located adjacent to larger landmasses that are recommended for wilderness area designation and otherwise could be managed as a wilderness area.

- Effects analysis is based on recommended wilderness area acres being designated by Congress.

Affected Environment

The Wilderness Act and National Roadless Area Review and Evaluations

The Wilderness Act of 1964 established the National Wilderness Preservation System. It mandates that wilderness areas be "…. administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness."

The Wilderness Act also directed a review of all primitive areas as to their suitability or non-suitability for preservation of wilderness. The draft Roadless Area Review and Evaluation (RARE) report was completed in 1972 and evaluated some 55.9 million acres of land across the nation and 1,449 roadless areas for possible inclusion into the National Wilderness Preservation System. The final report was published in 1973, with 274 of the roadless areas (12.3 million acres) selected for possible wilderness area designation by Congress. The decision became immediately embroiled in controversy. A lawsuit in California over a roadless area that had not been selected resulted in the Assistant Secretary of Agriculture and the Chief of the Forest Service ordering a new study of all roadless areas, called RARE II, in 1977. In 1978, the Forest Service completed an inventory of unroaded areas for the Chugach National Forest as part of this national process. At that time, the administration's proposal was to designate 669,500 acres of the Chugach National Forest as wilderness areas. These areas were in the Nellie Juan-Sargent Icefield and College Fiord portions of Prince William Sound. Three additional areas were recommended for wilderness in the RARE II process: the Two Indians drainage west of Resurrection Creek and the Tonki Cape and Devil Paw areas on Afognak Island. These areas are no longer part of the Chugach National Forest. Two areas were designated as non-wilderness roadless areas: the Resurrection Roadless Area and the southern portion of the Eastern Kenai Mountains Roadless Area around Snow River. All other areas within the national forest evaluated for roadless characteristics (3,301,800 acres) were put into a Further Planning Area category to be evaluated during the first planning cycle in the early 1980s.

ANILCA was passed by Congress in 1980, and it included three actions that had a major influence on the amount of acreage that was recommended for wilderness area designation within the national forest during the first forest planning effort in the early 1980s.

1. Section 501(a)(1) of ANILCA added 2,156,000 acres of roadless area to the national forest in the Nellie Juan, College Fiord, Copper/Rude River, and Controller Bay areas.
2. Section 704 of ANILCA designated the Nellie Juan-College Fiord area (2,116,000 acres) as a wilderness study area and required the Forest Service to study the area and make a report to the President and Congress on recommendations as to the suitability or non-suitability of all areas within the wilderness study area. ANILCA did not establish any designated wilderness areas within the Chugach National Forest.
3. Section 708(b) of ANILCA directed that for the NFS lands in Alaska, the RARE II FEIS was not subject to judicial review. The RARE II analysis was considered an adequate consideration of suitability of wilderness areas for inclusion within the National Wilderness Preservation System

(except for the wilderness study area, which is referenced in Section 704), and there would be no further requirement for the U.S. Department of Agriculture to review wilderness area options prior to the completion date of the initial forest planning cycle. Congress also determined that areas reviewed in the RARE II FEIS and not designated a wilderness area or a wilderness study area by ANILCA need not be managed to protect their suitability for wilderness area designation. In addition, Congress directed that the Department of Agriculture shall not conduct any further statewide roadless area review and evaluation of NFS lands in the State of Alaska for the purposes of determining their suitability for inclusion in the National Wilderness Preservation System.

These actions relate to current plan revision process in the following three ways:

1. The finding of adequate consideration does not prohibit additional evaluation of recommended wilderness areas.
2. The prohibition of a statewide roadless area review and evaluation does not prohibit such a review at a scale smaller than the State, such as for a forest plan revision
3. Areas included in RARE II are included in the Chugach National Forest inventory and evaluation using the same four-stage process used for other NFS lands as provided in FSH1909.12, Chapter 70.

Past and Present Activities Affecting Wilderness Characteristics

Past Activities

Human use within Prince William Sound over the past century has affected the natural condition and undeveloped quality of the landscape at varying scales and locations. Early development and use of resources included extraction of minerals at various lodes mines, such as Granite Mine, Mineral King Mine in Bettles Bay, and the Alaska Homestake Mine in Harriman Fiord; establishment of a Civil Aeronautics Administration communication site on North Dutch Island in the 1940s; building of private structures that helped facilitate set net fishing and hunting; fox farming with introduced populations of blue and silver fox on many islands; introduction of populations of Sitka black-tail deer onto Montague and Hawkins Islands in the early 1920s; and a fish cannery in Port Nellie Juan (destroyed by the 1964 earthquake). Later developments included fish hatcheries (Cannery Creek built in 1978 and Main Bay built in 1981), fisheries enhancement work (construction of eight operating fish ladders, various weirs, and fish structures), and a communications site on Naked Island.

Some of these activities have since ceased with very little evidence remaining on the landscape; other activities that have ceased have left remnant structures, debris, and trails. Some activities are ongoing with varying levels of development, human habitation, trails, roads, and use of motorized equipment and mechanical transport.

When ANILCA was passed by Congress in 1980, it included provisions that allowed activities, such as fisheries enhancement work, subsistence fishing and hunting, specified uses of motorized equipment and mechanical transport, continued use of existing private cabins that were connected to the taking of fish and wildlife, and the right to access State and private lands within the wilderness study area. Activities that result in infrastructure development, motorized noises, and changes to the natural condition affect the character of the wilderness study area wilderness study area. All Alaska residents may participate in subsistence activities under Title VIII of ANILCA. Under Federal subsistence, federally qualified rural residents may participate. These activities include use of snowmachines, motorboats, and other means of surface transport traditionally used to access areas and the use of motorized equipment authorized by permit. Residents and non-residents may use snowmobiles, motorboats, and airplanes and motorized equipment, such as chainsaws, for activities directly related to the taking of fish and wildlife (Section 1316 of ANILCA); however, such activities must be authorized with a permit. Section 1110 of ANILCA also allows use of snowmachines, motorboats, and airplanes by both resident and non-residents of Alaska for traditional activities. No permits are required for these uses.

One of the events that has had long lasting effects in the Prince William Sound area was the oil spill in 1989. At least 10,800,000 gallons of crude oil spilled from the *Exxon Valdez* tanker, resulting in the stranding of oil on an estimated 2,100 kilometers of shoreline in Prince William Sound, along the Kenai Peninsula and lower Cook Inlet, and on the western side of the Alaska Peninsula. The western part of Prince William Sound was one of the most impacted areas due to the direction of current and close proximity to where the *Exxon Valdez* tanker went aground. Injuries to natural resources led resource managers to limit access to hunting and fishing areas, and users, such as kayakers, were prevented from enjoying beaches that harbored visible oil. Extensive cleanup efforts occurred from 1989 through 1991. Surveys of affected shorelines in 1992 in Prince William Sound and along the Kenai Peninsula disclosed that surface oil remained on about one-third of the affected shorelines, and it was determined that the cost and potential environmental impact of further cleanup was greater than the problems caused by leaving the oil in place (EVOSTC 1994).

In 1994, the *Exxon Valdez* Oil Spill Restoration Plan was developed and it identified the wilderness study area in Prince William Sound along with six designated wilderness areas in the greater spill area as resources that were injured by the oil spill. Oil was stranded above mean high tide in many areas and during the intense cleanup periods, thousands of workers using hundreds of pieces of equipment were on beaches throughout the spill area creating an unprecedented intrusion of people, noise, and activity in primarily undeveloped areas (EVOSTC 1994). The cleanup intrusion ended in 1994 but injury to wilderness area and intrinsic values were still listed as a concern. In the 1994 restoration plan, there were no specific recovery objectives developed that benefited only wilderness areas without also addressing other injured resources. The restoration plan also emphasized habitat acquisition and protection as one of the principle tools for restoration. Habitat protection could take the form of changing an agency’s management practices or recommending injured areas for special designations by Alaska Legislature or Congress. In the intervening years, many of the injured resources that are intrinsic to the wilderness study area have been determined to be recovered and recreation use of the area has rebounded.

In 2014, the EVOS Trustee Council described the recovery status of various resources and included the wilderness study area in a category called passive use. This category includes natural resources, such as scenic shorelines, wilderness areas, and popular wildlife species, from which passive uses are derived. Until the public no longer perceives that lingering oil is adversely affecting the aesthetics and intrinsic value of these resources, the area as a whole cannot be considered recovered. Because recovery of a number of injured resources intrinsic to the wilderness study area is incomplete, the area has a still recovering status (EVOSTC 2014).

Another action that affected the character of the wilderness study area on a broad scale was the reconstruction of the Anton Anderson Memorial Tunnel (Whittier Tunnel) that connects the port city of Whittier in Prince William Sound to the Seward Highway and southcentral Alaska. The tunnel opened to vehicle traffic on June 7, 2000 after extensive conversion from a World War II railroad tunnel (AKDOT and PF 2017). The summer traffic increased from 127,554 vehicles in 2001 to 194,944 vehicles in 2007. This represents a 53 percent increase. Use has remained relatively static since 2007 at an average of 177,000 vehicles using the tunnel in May through September. This information suggests a corresponding initial increase in boat traffic in Prince William Sound that stayed relatively static since 2007. The corresponding higher level of human use for recreation, fishing, and hunting have affected some aspects of the area's character, such as opportunities for solitude and the natural condition of beaches and possibly black bear population numbers and dynamics.

Several studies have examined the distribution and levels of use throughout Prince William Sound in the past decade. In Poe et al. (2010), analysis of data from more than 40 different sources found that use levels are higher in the western half of Prince William Sound than the eastern half, and use in the summer is more widespread throughout Prince William Sound than use in the spring or fall, which tends to be more concentrated near access ports and public use cabins (Poe et al. 2010). This is most likely due to ease of access from Whittier, which is close to Anchorage, Alaska's major population center. Valdez is also a popular access port and is accessible from the Richardson Highway, which connects Prince William Sound to interior Alaska communities. The highest use levels were found at areas closest to Whittier (particularly Blackstone Bay) and Valdez (Columbia Glacier). Public use cabins within the wilderness study area are nodes of concentrated use, which can decrease opportunities for solitude along nearby shorelines and popular anchorage sites during the summer season. Designation and developments at State marine parks within the wilderness study area boundary also appear to attract people in higher concentrations (Poe et al. 2010).

Recreational impacts are present along shorelines, particularly in the bays closest to Whittier and Valdez, These impacts are generally limited to small areas of disturbance of vegetation (USDA 2015a). Twardock et al. (2010) studied beaches within the wilderness study area consistently for more than a decade and found that the number of campsites increased by 27 percent and total impacts at existing campsites expanded from 43 square meters to more than 73 square meters (Twardock et al. 2010). Some established campsites in Blackstone Bay and other popular areas were reinforced with native materials to prevent further expansion of vegetation impacts. Most of the wilderness study area shows little to no development or impacts related to recreation (USDA 2015a).

Current Activities

Fish Hatcheries

The Main Bay Hatchery is a state-owned hatchery built in 1981 by the Alaska Department of Fish and Game Fisheries Rehabilitation, Enhancement and Development Division as a chum salmon hatchery. It is located in Main Bay approximately 40 miles southeast of Whittier. Prince William Sound Aquaculture Corporation manages and operates the facility for the Alaska Department of Fish and Game under a special use permit authorized by the Forest Service. The permit authorizes use of 35.2 acres, including the fish hatchery, a diesel generator system, a short road, and several other associated buildings.

The Cannery Creek Hatchery is a state-owned hatchery built in 1978 by the Alaska Department of Fish and Game as a pink and chum salmon hatchery. It is in the Unakwik Inlet approximately 40 miles east of Whittier. This facility is also managed and operated by Prince William Sound Aquaculture Corporation for the Alaska Department of Fish and Game under a special use permit authorized by the Forest Service. The permit authorizes 40 acres and includes a fish hatchery, a dam, a diesel generator system, a short road, and several associated buildings.

Although allowed by provisions of ANILCA, the hatcheries and related infrastructure manipulate natural processes and affect natural condition, undeveloped character, and opportunities for solitude in the wilderness study area. Both hatcheries and related developments are managed according to ANILCA Section 1315(b), which states the site must be "constructed, managed, and operated in a manner that minimizes adverse impacts on the wilderness character of the area."

North Dutch Island Civil Aeronautics Administration Communications Site Removal

In 2016, an abandoned Civil Aeronautics Administration communication site was removed from North Dutch Island, which resulted in an improvement to the wilderness study area's natural conditions and undeveloped quality. Asbestos, lead paint, and petroleum contamination were present at the site. Remediation at the site included use of heavy equipment to remove buildings, oil tanks, and over 100 cubic yards of contaminated soils. The use of heavy equipment to accomplish the cleanup resulted in short term adverse impacts to the area's undeveloped quality. Contaminants included polynuclear aromatic hydrocarbons, lead, and diesel range organics, which were all brought to below Alaska Department of Environmental Conservation (ADEC) standards applicable to the area (Lydon 2016).

Non-indigenous Species

The first population of black slugs was discovered in the wilderness study area in 2012. Slugs have been confirmed at one other wilderness study area location (but not established), and reports indicate they may be at two additional locations within the wilderness study area. Since 2012, black slugs have become established in Whittier and Chenega Bay, both wilderness study area gateway communities, and have been established in Cordova for many years. Although surveys show that slugs affect a small and discrete area, presence of these slugs negatively affects the naturalness of the area (Lydon 2016).

Future Activities and Trends

Non-indigenous Species

The spread of *Elodea* spp. (waterweed), a highly invasive aquatic plant, is an emerging issue in Alaska and within the Chugach National Forest. *Elodea canadensis* has been found in a number of lakes and sloughs on the Copper River Delta. Recent surveys have found it spreading to new lakes and known populations are growing in size. The ecology and long term effects of *Elodea canadensis* on the Copper River Delta are not well understood and are being investigated. Outside its native range, this plant has often degraded water quality, impeded boat traffic, reduced dissolved oxygen, and impacted native fisheries. *Elodea* spp. has not been found within the wilderness study area at present, but with float plane and boat traffic being common within Prince William Sound, it is likely that it could occur and impact the natural condition of portions of the wilderness study area (Lydon 2016).

Land Status

Remaining parcels of land selected by CAC under the ANCSA may be conveyed to the Corporation in the future. The parcels are relatively small and are spread throughout the wilderness study area. Management of these parcels by CAC could affect the management of adjacent NFS lands, including the character of the wilderness study area. The State of Alaska also has three small parcels that are selected and remain to be conveyed in the northern half of the wilderness study area. The largest is on Glacier Island near Columbia Bay.

Trends

Several trends have affected the character of the wilderness study area. Technological advances in marine vessels and snowmachines, such as fuel efficiency, size, and power, combined with navigational tools, such as global positioning systems (GPS), have enabled visitors to go much farther into remote areas in much larger numbers in the past 15 years. Technological changes and resulting changes in use is affecting the character of the wilderness study area. The establishment of new uses and/or the expansion of uses into new areas within the wilderness study area in the future could eventually affect the potential for including the wilderness study area in the National Wilderness Preservation System. One emerging technology that could affect the character of the wilderness study area is unmanned aircraft (drones). Unmanned aircraft are useful for monitoring remote operating systems on communication sites, fish hatcheries, and fish weirs and have been used in connection with inspections on remote trail infrastructure on areas outside the wilderness study area. Unmanned aircraft are not allowed to land or take-off from designated wilderness areas in the lower 48 states. The use of unmanned aircraft could affect the character of the wilderness study area and are addressed in forest plan components that prohibit or limit their use.

Designated and Recommended Wilderness Areas within Other Public Lands

Within southcentral Alaska, there are two Federal agencies and one State agency that manage lands for wilderness area character or characteristics (see table 45). The State marine parks within Prince William Sound are the only units that are located directly adjacent to the wilderness study area. Out of the entire public land acreage (over 22 million acres), including the Chugach National Forest, approximately 62 percent (over 13 million acres) is being managed to maintain wilderness area character or characteristics.

Table 45. Designated and recommended wilderness areas on other public lands

Agency	Unit	Total Acres of Unit	Acres Managed for Wilderness Characteristics or as Designated Wilderness
U.S. Fish and Wildlife Service	Kenai National Wildlife Refuge	1,980,000	1,320,500
National Park Service	Kenai Fjords National Park	669,983	569,000
National Park Service	Wrangell-St. Elias National Park and Preserve	13,175,800	9,400,000
State of Alaska, Department of Natural Resources	Chugach State Park	495,000	235,000[a]
State of Alaska, Department of Natural Resources	Kachemak Bay State Park and State Wilderness Park	369,399	198,399
State of Alaska, Department of Natural Resources	Various Marine State Parks within western Prince William Sound	7,020	7,020[b]
Total acres		16697,202	11,729,919

a - Wilderness area designation within the State park system is a State park administrative designation and has no relationship to Federal lands designated wilderness areas under the Wilderness Act or ANILCA or any other type of Federal wildland designation.

b - The State Marine Parks are managed to maintain wilderness area settings and provide limited public facilities. The acres are estimated using GIS mapping.

Climate Change

Understanding of the potential consequences of climate change for natural resources in Alaska is increasing (Wolken et al. 2011). A focused assessment, Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula, by Hayward et al. (2017) evaluates the effects of climate change on a select set of ecological systems and ecosystem services in Alaska's Kenai Peninsula and Chugach National Forest regions (Hayward et al. 2017). Salient points from this climate change assessment that are pertinent to understanding the effects of climate change on the character of the wilderness study area over the next several decades. When considering how climate change could affect the wilderness study area, a review of potential climate change effects on physical and ecological characteristics of the wilderness study area and potential management responses to those changes provides insight into potential consequences of climate change.

Some key aspects of the climate in the future are warmer temperatures (5° F) in the next 50 years, increase in precipitation but with more variability, and an increase in storm frequency and intensity. Other aspects include more rain and less snow in lower elevations and earlier springs and later autumns, which signal a longer growing season, with less severe winters.

Changes in the natural condition of the wilderness study area could include continual glacial retreat and the profound effects on the coastal environment with Prince William Sound receiving up to 50 percent of its freshwater discharge from glacial runoff; changes in vegetation at various elevations and a potential increase in forest pathogen activity; changing hydrologic systems with increased storm intensity and snow dominant landscapes transitioning to rain dominant for lower elevations in winter months, which may in turn influence habitat availability for salmon and other fish species; and changes in coastal environment, including ocean acidification. Such changes would not reflect a negative change to the area's character, but rather a transition to different natural conditions.

Detrimental changes to the area's character would include the expanding range of introduced species (Sitka black-tail deer) and the establishment and expansion of invasive species populations (*Elodea* spp., European black slugs). Warmer, less severe winters would favor expansion of these species and potentially other invasive species of concern in southcentral Alaska.

Human uses in the wilderness study area that could be affected by climate change include winter recreation opportunities with more snow at higher elevations and less snow at lower elevations, reduced wildlife and glacier viewing from marine waters, and changes in subsistence and sport fishing and hunting opportunities as habitat changes.

The most probable effect to the area's character from climate change would be how humans react to these physical and biological changes. An example is a decision by the Forest Service in conjunction with the State of Alaska to physically change the character of a stream channel so that the salmon habitat won't be lost with a shifting hydrologic process. The State of Alaska is responsible for management of fish and wildlife populations within the wilderness study area and can pursue activities to actively manage these populations as provided for in ANILCA. Future State decisions might include activities that alter the natural progression of population dynamics so that wildlife and fish species remain available to people for harvesting. However, because the Forest Service has the responsibility for ensuring preservation of the wilderness study area's character and maintaining its potential for inclusion in the National Wilderness Preservation System, it is important the Forest Service work closely with the State on proposed fish and wildlife management projects to minimize impacts. Another example could include the Forest Service managing recreation use differently to either allow or restrict recreation activities temporally or spatially in response to changing snowpacks and season length. These potential future decisions by the State of Alaska and by the Forest Service are unknown, and therefore it is impossible to quantify the effects on the character of the wilderness study area or its potential for inclusion in the National Wilderness Preservation System. However, such actions would adversely impact the character of the wilderness study area. Continued monitoring would indicate trends in these types of effects over a longer period of time.

Environmental Consequences

Consequences Common to All Alternatives

Making the preliminary wilderness area recommendation for a forest plan revision does not create a wilderness area. Congress must pass legislation to designate a wilderness area. The current wilderness study area designation would stay intact until Congress makes a decision to remove the wilderness study area designation. All areas recommended for wilderness designation are within the wilderness study area. The forest plan management area plan direction for the wilderness study area would protect the values that make the area suitable for wilderness area designation for all alternatives.

Cumulative Effects Common to All Alternatives

Recreation use of the state tidelands is not currently regulated. An example of this use are helicopter flightseeing landings occurring near Columbia Glacier. The unregulated use is not widespread but does occur in more popular destinations where there are already higher levels of recreation use occurring on the uplands. This added level of motorized uses and higher densities of recreation use does affect the Forest Service’s ability to maintain the character of the wilderness study area. If areas recommended for wilderness designation become designated wilderness areas, this unregulated use would continue to incrementally affect the Forest Service’s ability to preserve the area’s character.

Cumulative Effects Common to Alternatives B, C, and D

The forest plan would have plan components that provide clearer direction to manage the wilderness study area similar to ANILCA designated wilderness per Forest Service regional policy. New plan components would prohibit certain uses, such as landings and taking off of helicopters and unmanned aircraft for public recreation purposes, require use of minimum requirements analyses prior to authorizing nonconforming uses described in the Wilderness Act, and restrict new land uses, except those allowed under ANILCA. This management direction would enhance preservation of the wilderness study area’s existing character and would provide beneficial cumulative effects for ensuring ecological integrity is maintained for the entire wilderness study area. It would also provide beneficial cumulative effects for ensuring that the wilderness study area continues to contribute to social and economic sustainability for the many activities that rely on qualities similar to wilderness. There could be adverse cumulative effects for social and economic purposes that rely on building new facilities and infrastructure and widespread use of motorized equipment or mechanical transport (except as those provided for by ANILCA).

If any of the recommended wilderness area in alternatives B, C, and D is designated by Congress, the cumulative effects would be similar. Designation and preservation of these areas would provide beneficial effects for social and economic sustainability of the tourism and other activities that rely on wilderness area qualities. Other beneficial effects would include sustaining ecological integrity and natural processes through the statutory protection wilderness designation provides. Management of the designated wilderness area would be directed by the Wilderness Act and any special provisions at the time of designation as well as national Forest Service policy for wilderness management. Designation of wilderness area could have an adverse cumulative effect in precluding other types of short term economic benefits, such as development of resources, and longer term recreation activities that require more development and infrastructure than would be allowed under the Wilderness Act.

Alternative A No Action

Two different scenarios are analyzed for alternative A. The first discloses the effects of continuing with current management: a designated wilderness study area and acres of a recommended wilderness area. This scenario represents no action. The second scenario discloses the effects of wilderness area designation of those recommended acres by Congress and being managed subject to the Wilderness Act and the Alaska National Interest Lands Conservation Act (ANILCA) provisions. It is assumed that Congress would also eliminate the wilderness study area designation.

Current Management Scenario

The Alaska Region 10 supplement to the Forest Service Manual, updated in 2008, provides general management direction for the wilderness study area (USDA 2008) and states the following:

> **Objective:** Manage designated wilderness and the wilderness study area to meet the spirit and intent of the 1964 Wilderness Act, while recognizing and allowing for specific exceptions authorized in ANILCA
>
> **Policy:** Subject to valid existing rights, the wilderness study area shall, until Congress determines otherwise, be administered to maintain presently existing character and potential for inclusion into the National Wilderness Preservation System. Management of the study area will follow the same direction provided for wildernesses established by ANILCA, to the extent consistent with law. The principle of non-degradation of conditions existing on the date the area was established will guide the management of designated wilderness and the Nellie Juan-College Fiord Wilderness Study Area, to the extent consistent with ANILCA.

The 2002 forest plan provides specific management direction for lands within the wilderness study area in management area 121 Wilderness Study Area. This management area direction applies to 1,936,544 acres in Prince William Sound, which is about 36 percent of the area of the national forest. There are several overlapping management directions (Wolverine Glacier Research Natural Area, and Wild, Scenic, and Recreational rivers) that would be consulted for portions of applicable areas within the wilderness study area. Marine waters and navigable waters are not under the jurisdiction of the Forest Service and are not included in this management direction.

The 2002 forest plan direction would continue to protect and maintain the area's character and potential for inclusion in the National Wilderness Preservation System across the entire wilderness study area. Natural ecological processes and disturbances would continue to be the primary forces affecting the composition, structure, and patterns of vegetation. Opportunities for solitude and primitive and unconfined recreation would be maintained. The wilderness study area would continue to be managed for low density, low disturbance, and widely distributed visitor use. In popular beach campsites, impacts associated with visitor use would continue to be monitored and new campsite development discouraged with passive controls. No new permanent developments or human occupancy would be authorized, except as provided for by ANILCA, by the national policies and guidelines framework for enhanced cooperation between State Fish and Wildlife agencies in the State's fish and wildlife agencies in the management of fish and game populations (2006), and by the *Exxon Valdez* Oil Spill Restoration Plan. The Forest Service will complete minimum requirements analyses to assess the effect of uses and activities in the wilderness study area on the area's character and potential for inclusion in the National Wilderness Preservation System.

Since none of the wilderness study area is withdrawn from mineral entry, plans of operations for locatable mineral development would be authorized with as minimal disturbance to surface resources as feasible while allowing for reasonable access to the mineral resources. On split estate lands acquired through the EVOS settlement and one additional split estate parcel on Knight Island at the head of Drier Bay, subsurface development by CAC could occur. The development of subsurface estates would adversely impact the character of the wilderness study area and could preclude the inclusion of surface estates and adjacent wilderness study area lands into the National Wilderness Preservation System. There are presently no known proposals for developing these lands.

Recreation Opportunity Spectrum

In alternative A, 63 percent of the area recommended for wilderness designation is in the primitive recreation class (see table 46). The primitive class areas are farther from the port towns of Whittier and Valdez where the Forest Service would manage for lower densities of recreation use and little to no recreation infrastructure development. These areas would better meet the management objective of maintaining the character of the wilderness study area and its potential for inclusion in the National Wilderness Preservation System. The areas closer to Whittier within the recommended wilderness area (Harrison Fiord and College Fiord) have a semi-primitive non-motorized recreation class. These areas would be managed for slightly higher densities of recreation use as described by the recreation opportunity spectrum class characteristics (number of parties encountered per day, number of parties within sight or sound of campsites, maximum party size). A wilderness study area stewardship plan would quantify levels of acceptable use and locations. Limited recreation development could occur as needed for resource protection. Current examples include a simple boardwalk along the Coghill Lake Trail, which traverses wetter muskeg meadows to access the Coghill Lake area and the Coghill Lake public use cabin. These areas would still be managed to maintain the area’s character but may need closer monitoring to determine if wilderness qualities or potential for inclusion in the National Wilderness Preservation System are changing due to higher use levels.

Table 46. Alternatives A and B recreation opportunity spectrum classes within the wilderness study area

Recreation Opportunity Spectrum Class	Entire Wilderness Study Area (acres)	Area Recommended for Wilderness Designation (acres)	Percent of the Recommended Wilderness Area
Primitive	1,068,940	879,336	63%
Semi-primitive Non-Motorized	785,755	508,174	37%
Semi-primitive Non-motorized (Winter Motorized Allowed)	85,312	zero	NA
Totals	1,940,007	1,387,509	NA

Designated Wilderness Scenario

The 2002 forest plan recommended 1,387,509 acres for wilderness area designation. In the intervening years, some of these lands have been conveyed to State and Regional and Village Native Corporation ownership. The remaining recommended lands total 1,391,104 acres. Once designated by Congress, these lands would be managed to preserve their wilderness character, which would meet the desired conditions stated in the 2002 forest plan. Natural ecological processes and disturbances would continue to be the primary forces affecting the composition, structure and patterns of vegetation. Outstanding opportunities for solitude and primitive and, unconfined recreation would be maintained. The designated wilderness area would be managed for low density recreation use and low ground disturbance at campsites. A wilderness area stewardship plan would quantify levels of acceptable use and locations. With the assumption that ANILCA provisions would apply, the existing and new development and uses of mechanical transport and motorized equipment connected with fisheries enhancement work, electronic sites, and subsistence use and the taking of fish and wildlife would potentially be allowed. Minimum requirements analyses would be performed prior to authorizing activities involving the non-conforming uses listed in the Section 4(c) of the Wilderness Act. The designated wilderness area would be withdrawn from mineral entry, which would preclude new mining claims from being located, but any existing mining claims, subject to valid existing rights, would be retained.

It is assumed that Congress would eliminate the wilderness study area designation for lands within the wilderness study area that are not included in a wilderness area designation. Management direction for newly designated wilderness areas and for former wilderness study area lands not designated as a wilderness area would have to be determined at that time, and the forest plan would have to be amended to include the new management direction. All of these lands would still be within IRAs (Nellie Juan, College Fiord, and Prince William Sound Islands). Areas such as Blackstone Bay, small bays along Port Wells, Culross Passage, and Cochrane Bay would not be within the designated wilderness area.

Split estate lands were not included in the area recommended for wilderness area designation. Any development of the subsurface by CAC would be governed by EVOS-acquired lands management direction and would not affect the wilderness character of the designated wilderness area except potentially along the boundary near Jackpot Bay. The area outside of the designated wilderness area would remain open for mineral entry.

Recreation Opportunity Spectrum

Similar to the current management scenario, the primitive recreation class would apply to 63 percent of the lands designated as a wilderness area. The areas closer to Whittier within the designated wilderness area (Harrison Fiord and College Fiord) have a semi-primitive non-motorized recreation class.

Cumulative Effects

The cumulative effects for alternative A are listed under those common to all alternatives.

Alternative B

The recommended area for wilderness area designation is 1,387,510 acres, the same as in alternative A. The effects of alternative B for the designated wilderness area are the same as for alternative A. For the remaining portions of the wilderness study area that would not be designated a wilderness area, management direction would be determined with a forest plan amendment. These lands would still be within IRAs (Nellie Juan, College Fiord, and Prince William Sound Islands).

Cumulative Effects

Cumulative effects for alternative B are listed in those common to all alternatives and those common to alternatives B, C, and D.

Alternative C

The recommended area for wilderness area designation for alternative C is 1,819,700 acres. Similar to alternative A, once designated by Congress, these lands would be managed to preserve their wilderness character and meet the desired conditions stated in the forest plan. Natural ecological processes and disturbances would continue to be the primary forces affecting the composition, structure, and patterns of vegetation. Opportunities for solitude and primitive, unconfined recreation would be maintained over a larger area than in alternatives A and B and would include popular destinations, such as Harriman Fiord, small bays along Port Wells, Esther Island and Passage, Cochrane Bay, and Culross Passage. The designated wilderness area would be managed for low density recreation use and low disturbance at campsites. A wilderness area stewardship plan would quantify levels of acceptable use and locations. With the assumption that ANILCA provisions would apply, existing and new development would potentially be allowed and uses of mechanical transport and motorized equipment would potentially be allowed for activities such as fisheries enhancement work, electronic sites, subsistence use, and taking of fish and wildlife. Minimum requirements analyses would be performed prior to authorizing activities involving the non-conforming uses listed in the Section 4(c) of the Wilderness Act. The designated wilderness area would be withdrawn from mineral entry, which would preclude new mining claims from being located, but any existing mining claims, subject to valid existing rights, would be retained.

It is assumed that Congress would eliminate the wilderness study area designation for lands within the wilderness study area that are not designated as a wilderness area. Management direction for the newly designated wilderness area and for former wilderness study area lands not designated as wilderness would have to be determined at that time, and the forest plan would have to be amended to include the new management direction. These lands would still be within IRAs (Nellie Juan, College Fiord, and Prince William Sound Islands).

Recreation Opportunity Spectrum

In alternative C, 98 percent of the area recommended for wilderness area designation is in the primitive recreation opportunity spectrum class (see table 47). The primitive class areas include most of the area near the port towns of Whittier and Valdez with exception of Blackstone Bay near Whittier. The Forest Service would manage the primitive class areas for lower densities of recreation use as described by the recreation opportunity spectrum class characteristics (number of parties encountered per day, number of parties within sight or sound of campsites, and maximum party size). A wilderness area stewardship plan would quantify levels of acceptable use and locations. The more popular bays and passages have a semi-primitive non-motorized recreation class as a fringe of area along the shoreline (generally from the shore to the 500-foot elevation line) where the Forest Service would manage for slightly higher densities of recreation use per recreation opportunity spectrum class characteristics and direction from a wilderness area stewardship plan. All areas farther from shore would be in the primitive class and would be managed for lower densities of recreation use. Wilderness character would be preserved in all of the areas designated as wilderness. The areas of semi-primitive non-motorized would need closer monitoring to verify wilderness character is being preserved.

Table 47. Alternative C recreation opportunity spectrum classes within the wilderness study area

Recreation Opportunity Spectrum Class	Entire Wilderness Study Area (acres)	Area Recommended for Wilderness Designation (acres)	Percent of the Recommended Wilderness Area
Primitive	1,896,761	1,786,525	98
Semi-primitive Non-Motorized	43,246	33,178	2
Totals	1,940,007	1,819,703	NA

Cumulative Effects

Cumulative effects for alternative C are listed in those common to all alternatives and those common to alternatives B, C, and D.

Alternative D

The recommended area for wilderness area designation for alternative D is 1,884,200 acres. The effects of this alternative are nearly identical to alternative C, except three areas would be included in the designated wilderness are that are not included for alternative C. These are Blackstone Bay, Erlington Island, and Glacier Island. These areas would be part of the designated wilderness area and would be managed to preserve wilderness character.

It is assumed that Congress would eliminate the wilderness study area designation for lands within the wilderness study area that are not designated as a wilderness area. Management direction for the newly designated wilderness area and for former wilderness study area lands not designated as wilderness would have to be determined at that time, and the forest plan would have to be amended to include the new management direction. These lands would still be within IRAs (Nellie Juan and Prince William Sound Islands).

Recreation Opportunity Spectrum

In alternative D, 100 percent of the area recommended for wilderness designation is in the primitive recreation class (see table 48). The Forest Service would manage the primitive areas for lower densities of recreation use as described by the recreation opportunity spectrum class characteristics (number of parties encountered per day, number of parties within sight or sound of campsites, maximum party size). A wilderness area stewardship plan would quantify levels of acceptable use and locations. This alternative would most closely align with managing for wilderness character once the area is designated as wilderness with the entire area being managed as primitive. Close monitoring of campsites in the popular bays would be needed to verify wilderness character is being preserved.

Table 48. Alternative D recreation opportunity spectrum classes within the wilderness study area

Recreation Opportunity Spectrum Class	Entire Wilderness Study Area (acres)	Area Recommended for Wilderness Designation (acres)	Percent of the Recommended Wilderness Area
Primitive	1,940,007	1,884,200	100
Semi-primitive Non-Motorized	zero	zero	zero
Totals	1,940,007	1,884,200	NA

Cumulative Effects

Cumulative effects for alternative D are listed in those common to all alternatives and those common to alternatives B, C, and D.

Analytical Conclusions

Current management direction for the wilderness study area is to maintain the area’s character and potential for inclusion in the National Wilderness Preservation System. This direction would remain in place for the entire wilderness study area until Congress acts on a wilderness area recommendation or terminates the wilderness study area designation.

Alternatives A and B have the least area recommended for wilderness designation at 1,387,510 acres (see table 49). If designated by Congress, 72 percent of the wilderness study area would be designated and would be managed to preserve wilderness character. These areas are located farther from the port towns of Whittier and Valdez and encompass some of the most remote areas within the Chugach National Forest. In areas not designated as wilderness, the wilderness study area designation would presumably be eliminated and management direction for these areas would need to be determined at that time. About 63 percent of the area recommended for wilderness designation would be managed under a primitive recreation opportunity spectrum class with most of these areas located farther away from Whittier and Valdez. Managing recreation use and development at the primitive class would align best with preserving wilderness character after designation.

Alternative C recommends more area for wilderness designation than alternatives A and B (1,819,700 acres), which, if designated by Congress, would include nearly 94 percent of the wilderness study area. This would include some of the popular recreation areas, such as bays along Port Wells, Esther Island, and Cochrane Bay and Culross Passage. The remaining areas not designated would include Blackstone Bay, EVOS-acquired lands, areas near private lands in the Nellie Juan Lake area, and two islands (Glacier Island and Erlington Island) near the Native villages of Tatitlek and Chenega Bay. About 98 percent of the area recommended for wilderness would be managed under a primitive recreation class. The popular areas for recreation use closest to Whittier would have areas of a semi-primitive non-motorized recreation class along the shoreline and a primitive recreation class farther from shore to reflect and accommodate current use patterns. This alternative best aligns managing for wilderness character after designation with consideration of current recreation use of shoreline areas.

Alternative D has the most area recommended for wilderness designation at 1,884,200 acres, which, if designated by Congress, would include nearly 97 percent of the wilderness study area. This alternative is based on public comment requesting all of the wilderness study area to be recommended as a wilderness area. The only lands not included are EVOS-acquired lands and the land around the Nellie Juan Lake area. The entire area recommended for wilderness would be managed in a Primitive recreation opportunity spectrum setting. This alternative would align best with the mandate to preserve wilderness character in designated wilderness, and it would require additional monitoring in more popular recreation use areas to determine if wilderness character is being preserved or degraded and recreation development and use is in alignment with a primitive setting.

Table 49. Summary of consequences by alternative

Measurement Indicator	Alternative A No Action	Alternative B	Alternative C	Alternative D
Acreage recommended for wilderness designation	1,387,510	1,387,510	1,819,700	1,884,200
Percentage of recommended wilderness area managed under primitive recreation opportunity spectrum class	63	63	98	100

Scenic Resources

Introduction

Regulations governing NFS land and resource management planning includes requirements for consideration, treatment, and protection of intangible resources, such as scenery and aesthetics. The Forest Service uses the Scenery Management System to fulfill these requirements. The scenery management system provides a systematic approach for determining the relative value of scenery on NFS lands and was used in this analysis to inventory and evaluate socially valued scenery. This system of analysis supports conservation of other ecosystem values, including recreation setting, sense of place, and quality of life.

Methodology

Spatial Scale

Indirect and cumulative effects: The spatial scale for indirect effects of scenery management includes the Chugach National Forest and areas outside of its boundary. The spatial scale for cumulative effects extends to some locations outside of the national forest because the land management decisions of neighboring land owners can influence the viewsheds of national forest landscapes. Cumulative impacts are discussed later.

Temporal Scale

Indirect and cumulative effects: The timeframe is the plan period (15 years). This timeframe was chosen because the forest plan would be revised after 15 years and different decisions about providing recreation opportunities could be made during the next forest plan revision process. The same 15-year timeframe was chosen with regard to cumulative effects. How the land management decisions of other agencies may change and may affect recreation opportunities within the Chugach National Forest becomes too speculative beyond 15 years.

Measurement Indicators

The measurement indicators used in this analysis are the Scenic Integrity Objectives, which describe the acceptable degree of deviation from the existing natural landscape. The ratings indicate the scenic value of landscape areas, regardless of existing scenic integrity.

Table 50. Range of scenic integrity objectives by management area

Management Area	Very High	High	Moderate	Low	Very Low
MA 1 Wilderness Study Area	yes	no	no	no	no
MA 2 Wild, Scenic, Recreation Rivers	yes	yes	no	no	no
MA 3 Designated Research Natural Areas	yes	yes	no	no	no
MA 4 Backcountry Area	yes	yes	yes	no	no
MA 5 ANILCA 501(b) Areas	yes	yes	yes	no	no
MA 6 EVOS Acquired Lands	yes	yes	yes	no	no
MA 7 Municipal Watershed	yes	yes	yes	no	no
MA 8 Front Country	yes	yes	yes	yes	no

Scenic integrity objectives identify the specific management direction for managing the scenery of Chugach National Forest. Each management area has an acceptable range of scenic integrity objectives based on allowed uses and authorized activities (see table 50). The scenic integrity objectives identify the degree of change from the natural character that will be allowed for any area.

Affected Environment

Changes created by management activities in the viewed landscape of the Chugach National Forest since the late 1990s have been few and have mostly been on the Kenai Peninsula. Some specific changes that have occurred and have affected scenery are:

- Wildlife habitat improvement projects
- Vegetation management projects due to fire, wind, and insects or disease
- Federal Energy Regulatory Commission
- Mineral extraction
- Small timber sales along the Seward Highway corridor
- Several site-specific changes from new recreation facilities and trails

While there have been numerous other management activities, none have had any effect on scenery. The viewing of scenery is a major recreation use in and of itself within the Chugach National Forest. The national visitor use monitoring data collected for the Chugach National Forest in 2013 identifies “viewing natural features/scenery” as one of the top three activities listed as the main activity for forest visitors. Of 885,000 visits, 13 percent of visitors listed viewing scenery as their main activity. Viewing scenery is also a major component in the overall satisfaction of visitors who list other activities, such as hiking, camping, tourism, and fishing, as their main activity.

At the time of the last forest plan revision in the late 1990s and early 2000s, a change had been occurring to the viewed landscape on the Kenai Peninsula due to the spruce bark beetle infestation. The change to the scenery was noticed more by regular users of the area but was almost invisible to first time visitors. The change was more noticeable in the foreground and near middleground distances than in background. To most people, the change appeared to be a natural occurrence and not a negative impact.

In the context of how the landscape is viewed, the forested portion makes up a small part of the overall view. The mountains, alpine, rock, and ice typically dominate the scenery with the forested parts of the view adding overall variety in line, form, color, and texture. To date, the changing scenery has not affected users or use patterns.

Changes in the scenery from the bark beetle have occurred both as spruce trees died and as management completed forest health mitigation projects. Throughout much of the Kenai Peninsula, there was a change in the line, form, color, and texture of the forest. The initial change turned the needles a rusty red; this was the most visible impact. After the needles fell (one season), the gray snags remained for five to 15 years if not treated. In pure forests of spruce, they took on a very gray color and the texture became very coarse. In mixed forests, which dominate the Chugach National Forest portion of the Kenai Peninsula, this change was not as apparent. This change in the scenery was most apparent in the foreground (within one-half mile). The dead spruce and fallen trees created a messy appearance. While considered natural appearing, it is less attractive than healthy forests, thus reducing the existing scenic integrity of the impacted areas.

Over time, the change resulted in a landscape that, while natural appearing, is different than it was in 2002. In forests with a lot of spruce, as dead trees fell, the landscape composition transitioned to a more open landscape with grass and shrub cover dominating. In areas that received forest health mitigation, new spruce trees were planted keeping the composition similar, but with much younger, smaller trees. This change in landscape over time due to the bark beetle does not change the overall landscape character. When impacted by the insect, the existing scenic integrity will decrease, but as time passes and/or mitigation is completed, the existing scenic integrity increases.

Since 2002, there have been multiple forest health mitigation projects to deal with the impacts of the beetle infestation. The results of these projects have improved the quality of the forest scenery.

Existing Scenery Inventory

Using the methodology described in Agriculture Handbook 701 for the scenery management system, the team took a snapshot of the existing scenic resources of Chugach National Forest.

Existing Landscape Character Descriptions

Landscape character defines a sense of place and describes the image or overall impression of a geographical area.

It is a description of the landscape that combines objective physical and biological elements with human elements valued for their aesthetic appeal. The attributes identified provide the frame of reference for defining the scenic attractiveness classes and existing scenic integrity of the landscape by showing what makes each landscape identifiable or unique.

There are eight landscape characters for the Chugach National Forest. Each of the landscape characters are unique, both visually and culturally, and they tend to correspond to ecosystem subsections for Alaska. Certain cultural attributes may result in deviations from subsections as cultural attributes do not necessarily follow physiographic boundaries. Each landscape will be described using physical, biological, and cultural attributes to describe the characteristic elements.

While each landscape character of the Chugach National Forest has unique characteristics that differentiate one from another, they all share one common characteristic: they all have large areas with a very high wow factor. The wow factor is an observed measure of people’s reactions or response when they view a landscape. It works for first-time viewers and repeat viewers equally well. It is the emotional reaction, easily observed in people, when they come around a bend in the road, enter a bay, or react as a view unfolds. While not scientifically based, decades of observing people viewing the landscapes of the Chugach National Forest shows this to be an accurate measure.

The eight landscape characters of the national forest (geographic area in parenthesis) follow and they establish the framework for all following steps in the scenery management system process:

1. Turnagain Arm (Kenai Peninsula)
2. Central Kenai Mountains (Kenai Peninsula)
3. Maritime Kenai (Kenai Peninsula)
4. Prince William Sound Fiords (Prince William Sound)
5. Prince William Sound Islands (Prince William Sound)
6. Copper Mountain (Prince William Sound)

7. Copper/Bering Rivers (Copper River Delta)
8. Tasnuna/Wernicke Rivers (Copper River Delta)

The landscape characters are predominately physical and biological with little influence from human cultural attributes. Only the landscape characters on the Kenai Peninsula have any significant cultural influence from human activities.

Existing Scenic Integrity

The valued attributes of the landscape character description are used as a frame of reference for determining the existing scenic integrity level. Scenic integrity level indicates the degree of intactness and wholeness of the landscape character, and helps locate and rank areas in need of scenic rehabilitation. It serves as a benchmark for monitoring landscapes to assess changes associated with planned management activities. Conversely, scenic integrity level is a measure of the degree of visible disruption of landscape character. A landscape with very minimal visual disruption is considered to have high scenic integrity level. Landscapes with increasingly incompatible relationships among scenic attributes are viewed as having diminished scenic integrity level. Five terms are used to describe the levels of existing scenic integrity in this forest plan:

Very high: the valued landscape character is intact with only minute deviations if any. The existing landscape character and sense of place is expressed at the highest possible level.

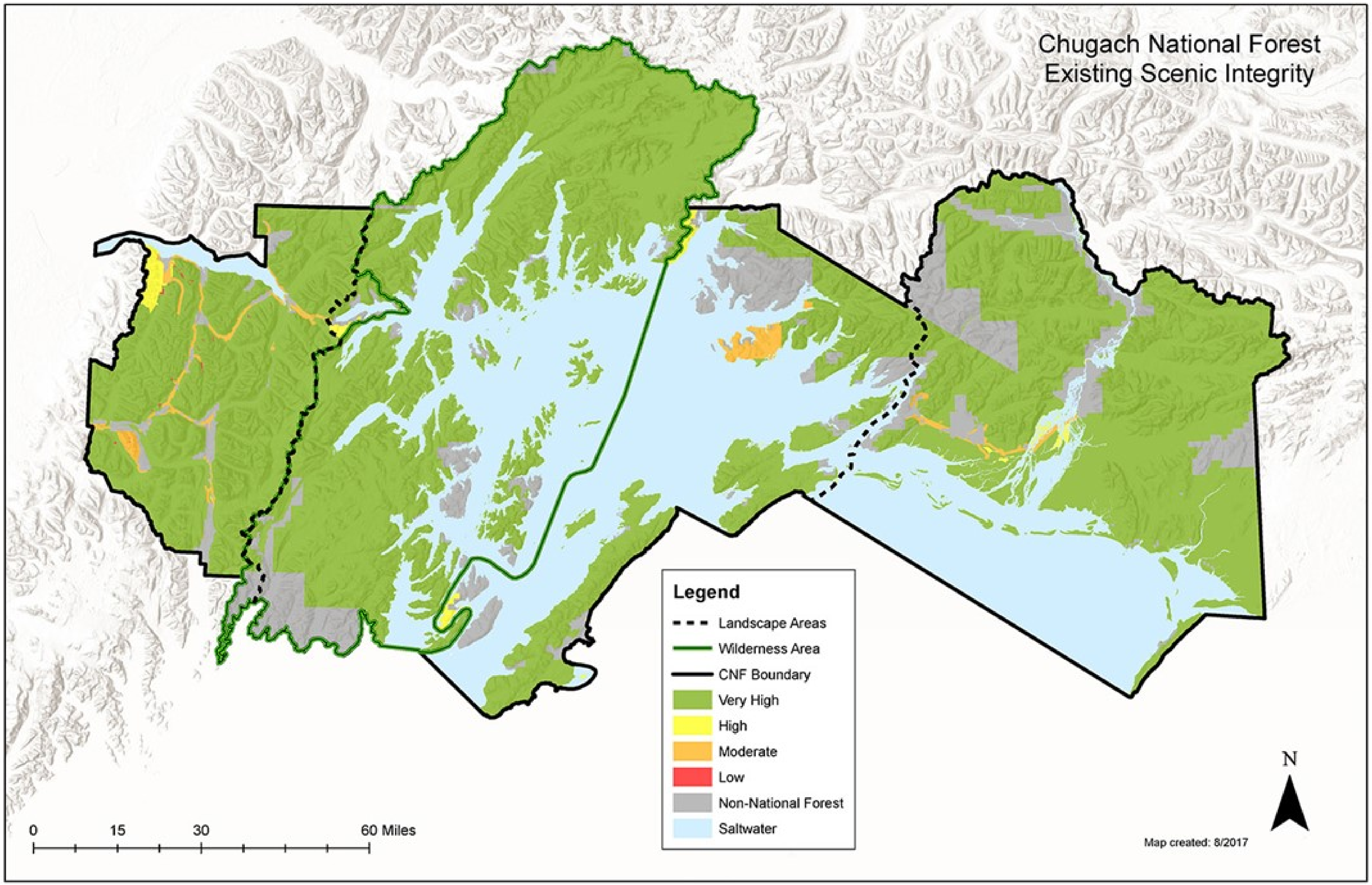
High: the valued landscape character appears intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so that they are not evident.

Moderate: the valued landscape character appears slightly altered. Noticeable deviations must remain visually subordinate to the landscape character being viewed.

Low: the valued landscape character appears moderately altered. Deviations begin to dominate the valued landscape character being viewed, but they borrow valued attributes, such as size, shape, edge effect, and pattern of natural openings, changes in vegetation types, or architectural styles outside the landscape being viewed. They should not only appear as valued character outside the landscape being viewed, but compatible or complementary to the character within.

Very low: the valued landscape character appears heavily altered. Deviations may strongly dominate the valued landscape character. They may not borrow from valued attributes such, as size, shape, edge effect, pattern of natural openings, changes in vegetation type, or architectural styles within or outside the landscape being viewed. However, deviations must be shaped by and blend with the natural terrain so that elements that include unnatural edges, roads, landings, and structures do not dominate the composition.

The Chugach National Forest mostly includes landscapes with a very high level of scenic integrity. Noticeable deviations in the landscape character are concentrated along the existing travelways of the Kenai Peninsula and are associated with years of road construction and reconstruction. Additionally, the high voltage transmission line paralleling the Seward Highway reduces the scenic integrity in certain locations when viewed from the Seward Highway. In Prince William Sound and the Copper River Delta, the landscape has few signs of human intervention and is predominantly of very high scenic integrity. The exception is lands recently acquired from the Native village corporations of Tatitlek and Eyak. These lands have been noticeably altered through significant timber harvest activities and have very low scenic integrity. Table 51 and map 10 display the existing scenic integrity levels of the Chugach National Forest.



Map 10. Existing scenic integrity levels for the Chugach National Forest

Table 51. Scenic Integrity on NFS lands by geographic area

Geographic Area	Very High (acres)	High (acres)	Moderate (acres)	Low (acres)
Kenai Peninsula	1,086,795	21,621	43,839	1,755
Prince William Sound	2,542,186	21,506	29,960	
Copper River	1,647,046	5,517	14,923	

A description of how scenery has changed since 2002 follows.

Kenai Peninsula Geographic Area

Much of the Kenai Peninsula Geographic Area scenery remains the same as it was prior to the 2002 forest plan revision. Noticeable deviations in the landscape character are concentrated along the existing travelways of the Kenai Peninsula and are associated with road construction and reconstruction. Additionally, the high voltage transmission line paralleling the Seward Highway reduces the scenic integrity in certain locations when viewed from the Seward Highway. Privately owned parcels along the road are gradually being developed. This development is a foreground to national forest views. Spruce beetle killed trees altered scenery in the 1990s and was a major issue during development of the 2002 forest plan. Since then, however, vegetation management projects have removed much of the spruce beetle killed trees and encouraged other plants to grow. This diversified canopy increases the scenic quality of the area by making a texturally varying plant pallet.

Table 52. Comparison of scenic integrity levels from 2002 to 2017 on the Kenai Peninsula

Scenic Integrity Level	Existing Scenic Integrity 2002 (acres)	Existing Scenic Integrity 2017 (acres)
Very high	1,118,130	1,086,795
High	35,490	21,621
Moderate	18,060	43,839
Low	950	1,755
Very low	120	0

Prince William Sound Geographic Area

Scenery in the Prince William Sound Geographic Area for the most part looks undisturbed, much like it did when Captain Cook sailed these waters and recorded what he saw. Steep-walled canyons or fiords carved by glaciation, islands teaming with birds, and the rugged tree-covered coast all offer great viewing opportunities. The exceptions to this are areas where timber harvest occurred on lands previously in private ownership.

Table 53. Comparison of scenic integrity levels from 2002 to 2017 in Prince William Sound

Scenic Integrity Level	Existing Scenic Integrity 2002 (acres)	Existing Scenic Integrity 2017 (acres)
Very high	2,546,180	2,542,186
High	1,520	21,506
Moderate	21,050	29,960
Low	8,500	0
Very low	47,890	0

Copper River Delta Geographic Area

Scenic integrity within the Copper River Delta Geographic Area remains unchanged with the exception of private lands that have been logged, the Copper River Highway, and a cell phone tower at the junction of the Copper River Highway and the Copper River.

Table 54. Comparison of scenic integrity levels from 2002 to 2017 on the Copper River Delta

Scenic Integrity Level	Existing Scenic Integrity 2002 (acres)	Existing Scenic Integrity 2017 (acres)
Very high	1,691,950	1,647,046
High	0	5,517
Moderate	1,330	14,923
Low	90	0
Very low	320	0

Climate Change

During the past twenty years, researchers have studied and modeled the effects of climate change on ecosystems within Alaska. The Climate Change Vulnerability Assessment for the Chugach National Forest and the Kenai Peninsula, by Hayward et al. (2016) evaluates the effects of future climate change in Alaska's Kenai Peninsula and Chugach National Forest regions (Hayward et al. 2017). During the next several decades, climate change will have effects on scenic resources.

Glaciers are a primary tourist attraction and all national forest visitors experience their grandeur and beauty. During the past decade, all glaciers in the region have lost mass, with one exception. As visitors travel to view the very high scenic quality of glaciers, their continued retreat over the next few decades could have economic impacts.

Non-tidewater glaciers are thinning at a rate of three meters per year, equal to the height of one school bus. Tidewater glaciers are more complex; not all are retreating but most are thinning. Viewing tidewater glaciers in Prince William Sound has been very popular with visitors and changes to these glaciers are uncertain, but any glaciers retreating to where they become non-tidewater glaciers may eventually diminish visitors' ability to view and experience their grandeur.

Another result of a warming climate will be changes to vegetation patterns. Overall this effect may or may not impact the scenic integrity levels experienced in the national forest; however, the eight landscape character types will likely change over time. Sub-alpine and alpine terrain is converting to shrubs or forest. In certain parts of the Chugach National Forest, the coastal rainforest will remain and expand westward, while on the Kenai Peninsula, deforestation is occurring as evergreen forests convert to grassland.

Fires on the western Kenai Peninsula will likely increase, lowering scenic integrity levels for five to 10 years after the fires.

As has been visible in recent decades, there will be an increase in the frequency and extent of insect and other diseases on vegetation, adding to vegetation pattern changes and decreasing the scenic integrity of the landscape.

Environmental Consequences

Consequences Common to All Alternatives

The Chugach National Forest landscape is highly intact. It is natural or natural appearing except for isolated alterations to the landscape character, primarily on the Kenai Peninsula. The most obvious and significant effects on scenic resources are from vegetation and landform alterations typically associated with resource management activities, such as road construction, vegetation management, powerline clearing, recreation facility development, and mineral exploration and development.

All projects proposed for the national forest will require a site-specific assessment of their potential impacts on scenic resources. The scenic integrity objectives, along with the standards and guidelines specific to scenery, will serve as direction for design and implementation of management activities.

Mineral Extraction

There are areas throughout the national forest where another entity owns the rights to subsurface minerals. In these areas, mineral exploration and extraction is allowed following authorized procedures, and the mapped scenic integrity objective of the surface land management varies. There are standards and guidelines for reclamation and remediation to restore scenic resources within a timeframe that is consistent with the mapped scenic integrity objective.

Chugach Alaska Corporation (CAC) has proposed development of their subsurface estate in Port Gravina in the Prince William Sound Geographic Area. The surface estate is part of the national forest and was purchased from the Tatitlek Corporation via EVOS settlement funding. CAC’s development of the subsurface estate would affect scenic resources.

The Hope Mining Company proposes a mining plan of operations near Resurrection Creek in Hope to conduct placer mining activities on 264 acres of Federal mining claims. This activity will affect scenic resources and the area has been assigned a low scenic integrity objective for all action alternatives.

Wildfire

Wildland fires have the potential to change the appearance of the landscape. Fire is a part of the natural process of the Kenai Peninsula but very rare in both Prince William Sound and the Copper River Delta. Visual changes may be noticed after a burn but would become less noticeable, typically within five years, as new grasses, shrubs, and trees become established.

Alternative A No Action

Under the no-action alternative, management of scenic resources would continue to adhere to the forestwide and management area-specific goals, objectives, standards, and guidelines in the 2002 forest plan.

Existing scenic integrity has improved since the 2002 forest plan was approved using this management strategy (see table 52, table 53 and table 54); however, looking to the future, more projects could be implemented that deviate from a landscape character that is unaltered or that appears unaltered. Under this alternative there is more leeway for deviation from natural landscape character.

Under this alternative, scenic quality would not be managed in ways that improve visitor satisfaction or protect scenic resources.

Action Alternatives

Scenic integrity objectives identify the direction for managing the scenery of Chugach National Forest in relation to the landscape character. In this plan, each management area has a defined and acceptable range of scenic integrity objectives based on allowed uses and authorized activities. The scenic integrity objectives are tailored to the management objectives of the prescription. Each alternative will then have a varying and specific set of mapped scenic integrity objectives based on the management areas of the alternative. The scenic integrity objectives identify the degree of change from the natural character that will be allowed for any area. Specific project analysis will address the actual design requirements necessary to maintain the scenic quality within the scenic integrity objective using standards and guidelines. The standards and guidelines will provide guidance for non-conformance allowances based on management area direction.

Alternative B

Alternative B is more similar to existing scenery management than alternatives C and D. This alternative converts more than 2,000,000 acres of NFS lands to a very high scenic integrity objective, mostly within the Prince William Sound and Copper River geographic areas. The existing scenic integrity of these lands is currently very high, and this alternative establishes a very high scenic integrity objective whereby the landscape character is intact with no deviations. The existing landscape character and sense of place is expressed at the highest possible level.

This alternative retains 2.9 million acres as high scenic integrity objective. Of the three action alternatives, this alternative would allow the most acres to deviate from natural landscape character. However, to the user, the valued landscape character would still appear intact. Deviations may be present but must repeat the form, line, color, texture, and pattern common to the landscape character so that they are not evident.

Road corridors would be managed with a moderate scenic integrity objective. These areas of the national forest experience the most active management and recreation development due to the ease of accessibility. Resource management activities along the roads and trails of the Kenai Peninsula, portions of Prince William Sound and road accessible areas of the Copper River Delta would have lower scenic integrity objectives, allowing for a more noticeable change in the landscape character. Some of these activities may be noticed by visitors along roads and trails, but should not detract from the overall enjoyment of viewing the scenery. This is consistent with the landscape character goals for this alternative.

It might seem counterintuitive that the Seward Highway corridor, a national scenic byway, be managed as moderate scenic integrity objective. The viewer, when passing through the landscape either by car, or at scenic vistas, would for the most part be focused on the middleground and background viewshed. Therefore, the foreground will be managed as Moderate and the middleground and background vistas containing the mountains, valleys, and glaciers are managed to a scenic integrity objective of high.

Managing the background of roadways at a high scenic integrity objective would provide guidance for scenery management that would allow more leeway for projects to deviate from a landscape character that is unaltered or that appears unaltered. Under alternative B, more deviation is allowed from natural landscape character in places that are viewed from the Seward Highway corridor, a national scenic byway. Alternatives C and D establish more vistas from the Seward Highway as a high scenic integrity objective. Vehicular traffic currently experiences some of the most extraordinary vistas within the national forest.

Alternative C

Alternative C manages the greatest number of acres with a very high scenic integrity objective, whereby the landscape character of these areas is to remain intact with only minute deviations, if any. The existing landscape character and sense of place is expressed at the highest possible level. Simultaneously, this alternative assigns a range of low, moderate, and high scenic integrity objective levels, consistent with the allowed range of scenic integrity objectives for each geographic area, in areas of the national forest with active land and resource management activities, developed recreation sites, and other authorized activities (e.g., Hope Mining Company, Cooper Dam Access Road, whistle stops, highway corridors, gravel acquisition sites, and campgrounds).

Road corridors will be managed with a moderate scenic integrity objective as in alternative B. The difference from alternative B is that the middleground and background viewsheds will be managed at a very high scenic integrity objective instead of high.

The suitable and recommended wild and scenic rivers segments with scenery as an outstandingly remarkable value would be managed at either a high or very high scenic integrity objective. These include Twentymile River Portage Creek, Sixmile Creek, East Fork Sixmile Creek, Lower Snow River, Upper Snow River, Nellie Juan River and Childs Glacier.

Of the action alternatives, alternative C manages the greatest number of acres with a low scenic integrity objective. These locations include the Hope Mining Company claim, the road to the Cooper Lake Dam and developed recreation sites, including the Trail River and Ptarmigan campgrounds. In these locations scenery appears moderately altered and the deviations to landscape forms dominate the viewed landscape.

Overall, this alternative provides guidance for scenery management that would result in a future condition that maintains or enhances the existing scenic quality of the national forest, while allowing for authorized land and resource management activities.

Alternative D

Effects of this alternative would be the same as alternative C.

Cumulative Effects

A hydroelectric facility is being analyzed for Grant Lake within the Kenai Peninsula Geographic Area. Kenai Hydro, Limited Liability Corporation submitted their final license application to the Federal Energy Regulatory Commission in April 2016. All the proposed facilities (road, powerline, and power generation facilities) would be would be built on State of Alaska land but is anticipated to impact a short section of proposed route for the INHT. If the trail is built in the current planned location directly adjacent to the planned power facilities, visitors would experience a heavily altered landscape character resulting in decreased scenic quality on adjacent lands. This is anticipated to affect about a mile of the INHT and surrounding areas.

Chugach Alaska Corporation owns lands adjacent to the Chugach National Forest in the Nellie Juan Lake and Nellie Juan River areas within the Prince William Sound Geographic Area. During the planning period, CAC could develop a road system on NFS lands to access their lands. Reasonable access across Federal lands is guaranteed to private land owners owning land within the wilderness study area by Section 1110(b) of ANILCA. If road access is developed, the scenic integrity level of this corridor would decrease from very high to moderate. This potential development would affect scenic resources for all alternatives.

The State of Alaska Department of Transportation and Public Facilities and Federal Highway Administration has proposed changing the location of the Sterling Highway through the community of Cooper Landing. The final environmental impact statement and record of decision has not been released yet. The draft environmental impact statement released in 2015 documented the analysis of the effects of no action and four action alternatives. Each alternative would affect different amounts of acreage within Chugach National Forest thus having different cumulative effects on scenery.

Analytical Conclusions

Alternative C manages the greatest number of acres with a very high scenic integrity objective, whereby the landscape character is to remain intact with only minute deviations, if any. The existing landscape character and sense of place is expressed at the highest possible level. Simultaneously, this alternative assigns a range of low, moderate and high scenic integrity objective levels in areas of the national forest with the most active land and resource management activities, developed recreation sites and other authorized activities. Alternative C provides guidance for scenery management that would result in a future condition that maintains or enhances the existing scenic quality of the national forest, while allowing for authorized land and resource management activities. Alternative D is the same as alternative C.

Alternative A, the no-action alternative, would continue to manage scenery as defined in the 2002 forest plan (see table 56). Management area direction would continue as is; however, the guidance for scenery management would result in a future condition that is lower than the existing scenic integrity of the national forest.

Of the three action alternatives, alternative B allows the most acres to deviate from natural landscape character. However, to the user, the valued landscape character still appears intact. The major difference between alternative B and alternatives C and D is the scenic integrity objective of the middleground and background viewsheds from major highway corridors (Seward and Sterling). Alternative B maps these areas at a high scenic integrity objective and alternatives C and D map these areas at a very high scenic integrity objective.

Table 55. Summary of consequences for all NFS lands by alternative

Scenic Integrity Objective	Alternative A No Action	Alternative B	Alternative C	Alternative D
Very low	0	0	0	0
Low	8,272	457	4,913	4,913
Moderate	172,647	114,357	111,910	111,910
High	5,193,325	2,889,197	149,432	149,432
Very high	40,904	2,411,137	5,148,893	5,148,893

Table 56. Scenic integrity objectives for alternative A (no action) by geographic area

Geographic Area	Very High (acres)	High (acres)	Moderate (acres)	Low (acres)	Very Low (acres)
Kenai Peninsula	6,002	1,020,004	119,736	8,269	0
Prince William Sound	16,132	2,542,326	35,194		0
Copper River	18,770	1,630,996	17,717	3	0

Table 57. Scenic integrity objectives for alternative B by geographic area

Geographic Area	Very High acres (percent change from no action)	High acres (percent change from no action)	Moderate acres (percent change from no action)	Low acres (percent change from no action)
Kenai Peninsula	6,002 (0%)	1,041,778 (2%)	105,773 (-1%)	457 (-1%)
Prince William Sound	1,075,249 (41%)	1,517,812 (39%)	591 (-1%)	0 (0%)
Copper River	1,329,887 (79%)	329,607 (79%)	7,992 (-1%)	0 (0%)

Table 58. Scenic integrity objectives for alternative C by geographic area

Geographic Area	Very High acres (percent change from no action)	High acres (percent change from no action)	Moderate acres (percent change from no action)	Low acres (percent change from no action)
Kenai Peninsula	1,012,222 (87%)	44,082 (-85%)	92,792 (-2%)	4,913 (0.028%)
Prince William Sound	2,501,483 (96%)	91,281 (-94%)	888 (-1%)	0 (0%)
Copper River	1,635,188 (97%)	14,069 (-97%)	18,230 (<1%)	0 (0%)

Table 59. Scenic integrity objectives for alternative D by geographic area

Geographic Area	Very High acres (percent change from no action)	High acres (percent change from no action)	Moderate acres (percent change from no action)	Low acres (percent change from no action)
Kenai Peninsula	1,012,222 (87%)	44,082 (-85%)	92,792 (-2%)	4,913 (0.028%)
Prince William Sound	2,501,483 (96%)	91,281 (-94%)	888 (-1%)	0 (0%)
Copper River	1,635,188 (97%)	14,069 (-97%)	18,230 (<1%)	0 (0%)

Minerals

This section analyzes the effects of the revised forest plan and the alternatives on mineral resources and the potential for acquiring minerals from Federal lands.

Methodology

Spatial Scale

The geographic boundary of the minerals analysis area is all lands managed by the Chugach National Forest whether public domain, acquired, or acquired with a split estate where the minerals are managed by the United States (36 CFR 228; 43 CFR 3501.15) or for where surface management oversight is provided to the Forest Service under manual direction (FSM 2830) for those split estate lands with privately owned minerals (see map 11). For cumulative effects, the geographic boundary is all lands within the proclaimed national forest boundary, regardless of ownership.

Temporal Scale

The temporal scale for the minerals analysis in this document is 15 years to provide consistency with the current planning effort. Projects with significant mineral development are generally expected to have a project lifespan far exceeding 15 years, but those longer spanning projects with a 50 or 100 year lifespan should be considered on case-by-case project basis.

Past, Present, and Future Activities used in the Analysis

- Locatable minerals withdrawals already existing on NFS lands and newly proposed withdrawals of lands from mineral entry
- Development on State or private lands adjacent to NFS lands: in some limited cases, withdrawal of adjacent NFS lands could change the market conditions for economically feasible development of the overall deposit for some locatable mineral commodities because the deposit may extend across ownership boundaries and may not be economically viable in parts

Measurement Indicators

Number of acres open to location and mineral entry: indicates amount of the national forest available to locatable minerals under the 1872 Mining Law, as amended.

Analysis Methods and Assumptions

Minerals administration will be consistent with various mining, leasing, and property laws and is consistent with Forest Service policy at FSM 2800.

Additional assumptions common to all resource areas are stated in chapters 2 and 3. These include the assumption that all recommended wilderness areas would be designated by Congress, and that this wilderness area would be managed subject to the provisions of ANILCA, similar to other designated wilderness areas in Alaska. It is important to understand that this is an assumption used only for the purposes of analysis.

Affected Environment

Locatable Minerals

Locatable minerals are those minerals that may be located and removed from Federal lands under the authority of the General Mining Act of 1872, as amended. In general, locatable minerals are those hard rock minerals that are mined and processed for the recovery of metals but may also include certain nonmetallic minerals and uncommon varieties of materials that possess valuable and distinctive properties. Lands open to mineral entry are in the public domain and have not been appropriated, withdrawn, or segregated from location and entry. There are currently 4,372,657 acres open to mineral entry within the national forest, which includes 1,940,007 acres in the wilderness study area wilderness study area (see map 11). The Nellie-Juan and College Fiord additions are fully within the designated wilderness study area (ANILCA 1980, Section 704) and until Congress acts to designate part or all of the wilderness study area or eliminate the wilderness study area entirely, all of these Federal lands are currently open to mineral entry.

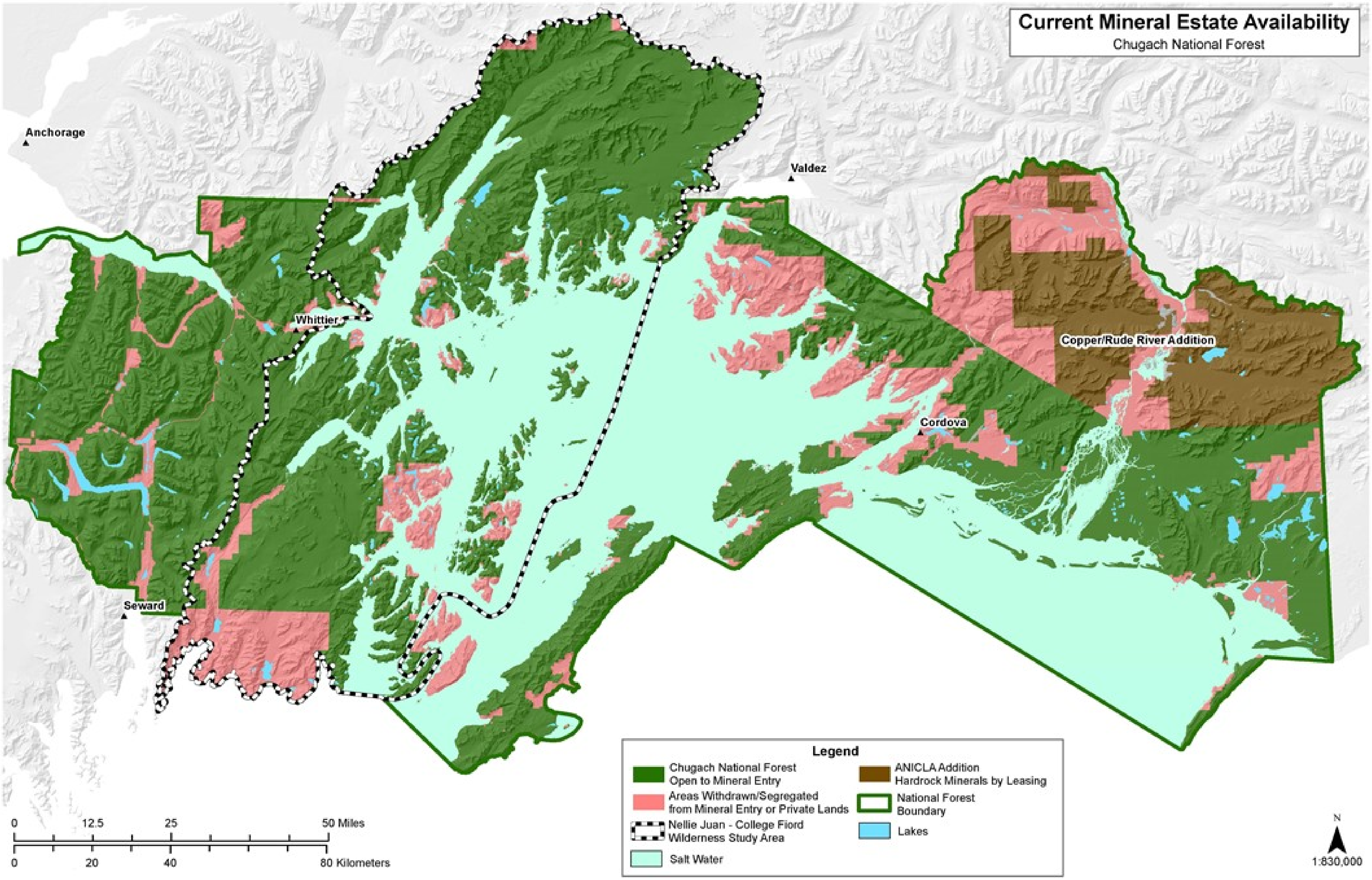
Placer Gold Deposits/Operations

Placer gold deposits are where the locatable minerals are weathered from the bedrock and hosted in unconsolidated deposits. In the late 1840s when Alaska was still owned by Russia, placer gold was first discovered in Kenai Peninsula drainages which would later become part of the Chugach National Forest. Thousands of ounces of placer gold were mined during the past hundred years from many of the creeks, primarily on the roaded portions of the Kenai Peninsula. Mid-sized mechanical placer operations have occurred seasonally, including many years during implementation of the 2002 forest plan.

Lode Deposits and Operations

Lode deposits are where the locatable minerals are hosted in bedrock. The rigorous permitting requirement to establish a lode mine, the limited size of lode deposits in the area, and the predominance of small-scale miners all serve to limit development of lode mines within the national forest. Several lode operations exist within the national forest, but production is very limited. Operators work seasonally and tend to use rudimentary hand tools.

Larger gold lode deposits exist in northern Prince William Sound. Both the Cliff and Granite mines have had significant historic gold production. Historically, base metals, primarily copper, have also been produced from lode mines in Prince William Sound; however, the more significant identified deposits have been selected and conveyed to CAC, under the ANCSA.



Map 11. Acres open to mineral entry versus withdrawn/segregated from mineral entry

Mineral Potential for Locatable (hardrock) Minerals

A newly released report from the U.S. Geological Survey (Karl et al. 2016, 2017) indicates that considerably more lands within the national forest have high mineral potential than were previously indicated (Nelson and Miller 2000). Approximately 73 percent of the national forest is now considered to have high mineral potential (3,924,599 acres) (see map 12) compared to 298,174 acres (approximately 6 percent) previously considered as having high mineral potential (Nelson and Miller 2000). This suggests that the likelihood of discovery of an undeveloped locatable mineral deposit is greater than previously considered.

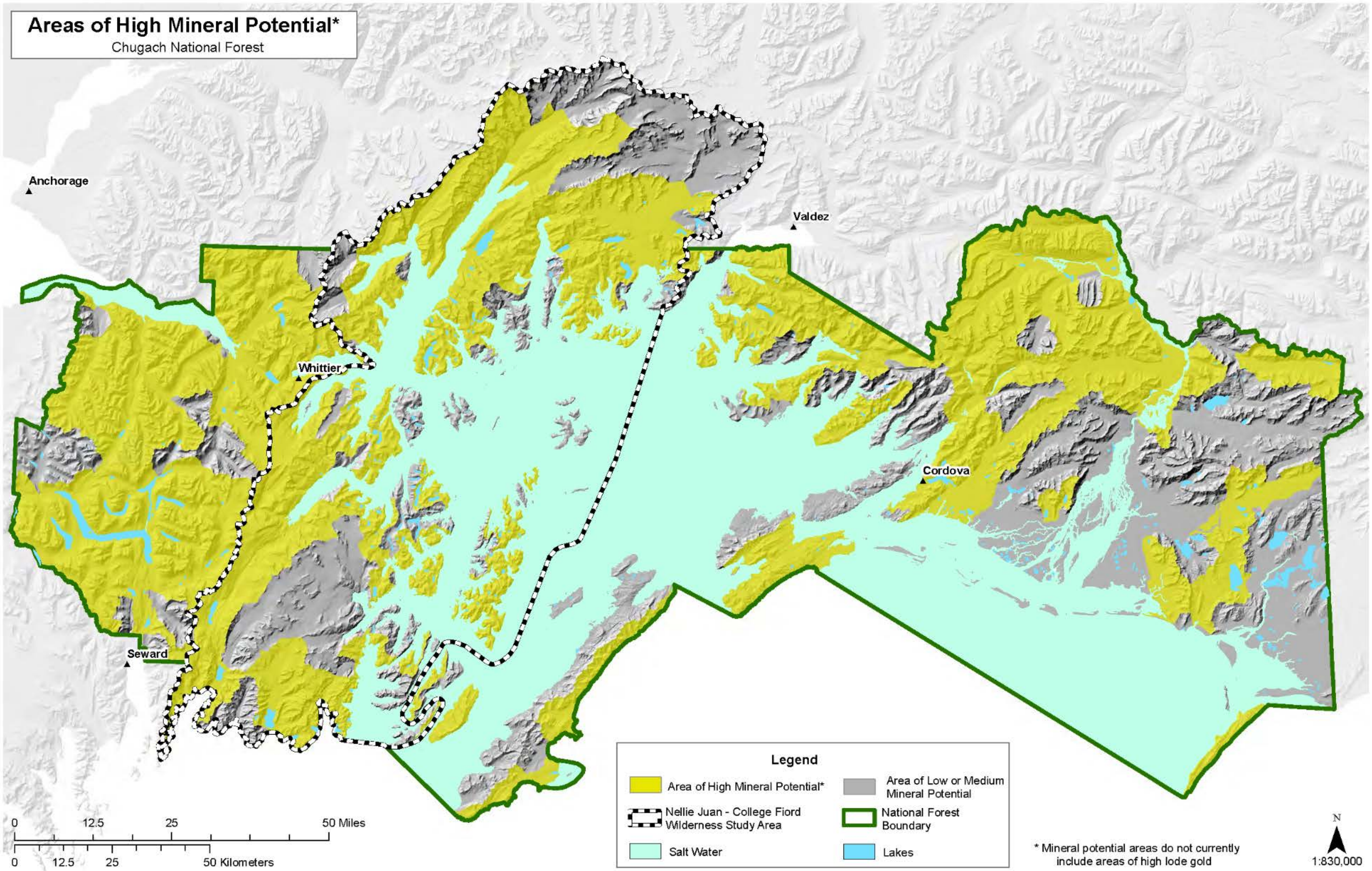
Even though millions of acres of the national forest have high potential to host mineral deposits, economically developable deposits may never be identified within these lands. Conversely, numerous deposits may be discovered and developed into economically viable deposits of importance to the Nation’s welfare by providing jobs, revenues, and strategic and critical minerals as encouraged by the Mining and Minerals Policy Act of 1970.

High mineral resource potential was assigned to areas where geological, mineralogical, geochemical, mineral occurrence, and geophysical characteristics indicate a geologic environment that is favorable for resource occurrence; where interpretations of data indicate a high degree of likelihood for resource accumulation; where data indicating presence of resources support mineral deposit models; and where evidence indicates that mineral concentration has taken place. Resources or deposits were not necessarily identified for an area to be assigned high resource potential.

Six groups of mineral deposit types that may each contain one or more critical mineral that is used in products vital to national security (National Research Council 2008) or mineral commodities for which the United States imports more than half of its total supply and which are largely derived from nations that cannot be considered reliable trading partners (U.S. Department of Energy 2010) were considered in this study:

1. Rare earth element (REE) deposits with or without thorium (Th), yttrium (Y), niobium (Nb), uranium (U), and zirconium (Zr), associated with peralkaline to carbonatitic intrusive rocks
2. Placer and paleoplacer gold (Au) deposits that in some places might also produce platinum group elements (PGE), chromium (Cr), tin (Sn), tungsten (W), silver (Ag), or titanium (Ti)
3. Platinum group element (PGE) deposits with or without cobalt (Co), chromium (Cr), nickel (Ni), titanium (Ti), and vanadium (V), associated with mafic to ultramafic intrusive rocks
4. Carbonate-hosted copper (Cu) deposits with silver (Ag), and possibly cobalt (Co), germanium (Ge), and gallium (Ga)
5. Sandstone-hosted uranium (U) deposits that in some deposits might also produce V or Cu
6. Tin (Sn)-tungsten (W)-molybdenum (Mo) deposits, possibly with indium (In), and (or) fluorspar associated with specialized granites

The relative certainty of deposit presence is displayed in the maps in the original report by shading for each level of potential as 1) dark shading is high certainty, 2) medium shading is medium certainty, and 3) light shading is low certainty. Lighter shaded areas have the same permissive geology as darker shaded areas in their respective level of mineral potential but may actually offer a higher likelihood of containing an undiscovered deposit as they haven’t received as much scrutiny in the way of exploration (Karl pers. comm. 2017). All six deposit types and all three shades were lumped into one color and shade (see map 12) to avoid publishing excessive maps.



Map 12. Areas of high mineral potential

The U.S. Geological Survey (Karl et al. 2016) is currently in the process of analyzing lode gold-type deposits (gold found in rock) under the same process as the 2016 publication and has presented preliminary results (Karl et al. 2017). The analyses address undivided lode gold and orogenic, intrusion-related, and epithermal gold deposit types. Key features, including host rock composition, mineralogy reported from heavy mineral concentrates and site descriptions, pathfinder element geochemistry, alteration, and other factors that characterize these deposit types, were integrated into the analyses to evaluate whether or not the deposit types could be distinguished in Alaska. Preliminary data (Karl et al. 2017) indicates that high potential areas for lode gold that weren't already designated as having high potential for one of the six deposit types already published (Karl et al. 2016) include western Culross Island recommended for wilderness designation in alternatives C and D and an additional area in the Sargent Icefield that is proposed for wilderness designation in all alternatives.

The maps of "Areas of High Mineral Potential" (see map 13, map 14 and map 15) display the locations of high potential areas that are recommended for wilderness designation for each alternative. Table 60 and table 61 display the number of acres of high potential in each area and total acres that would be withdrawn from mineral entry if wilderness designation occurs, by alternative. A composite map of all areas of high mineral potential as described in Karl et al. (2016), regardless of relative certainty shading as presented in that publication, is provided in map 12 to avoid publishing excessive maps.

Leasable Minerals

Leasable mineral authority is under the Secretary of the Interior. Various acts provide authority for nonrenewable energy and solid leasable minerals, which include oil and gas, coal, and hardrock leasable minerals.

Oil and Gas

Oil was first discovered in 1901 at Katalla and by 1902 Alaska had its first producing oilfield. More than 150,000 barrels were produced. Production ceased when the onsite refinery burned in 1933.

A leasing availability analysis was conducted as part of the 2002 forest plan FEIS. Four geographic zones for oil and gas were analyzed and a synopsis of their history of availability and current status follows:

- Geographic Zone 1: The Katalla areas defined in the Chugach Natives, Inc. Settlement Agreement (1982), gave Chugach Alaska Corporation (CAC) rights to drill from a private portion of the mineral estate beneath the Chugach National Forest with the rights to be extinguished if a producing well was not established by December 31, 2004 (page 23). A producing well was not established and the rights have expired. The 2002 forest plan FEIS specified (page 3-501; table 3-97, page 3-502) that "upon expiration of CAC's oil and gas rights, the area would be managed according to the underlying prescription, and would be…unavailable in the Preferred alternative," which was the selected alternative. Chugach Alaska Corporation's right to the oil and gas estate at Katalla under the 1982 Chugach Natives, Inc. Settlement Agreement were extinguished on December 31, 2004 (page 24).

Geographic Zone 1 is not currently available for oil and gas leasing.

- Geographic Zone 2: The Katalla Exchange Preference Area as defined in the 1982 Chugach Natives, Inc. Settlement Agreement (page 39), gave CAC first opportunity to acquire, through exchange, the rights to explore, develop and produce oil and gas in the area in the event that the

Secretary of Agriculture elected to make all or any part of the area available for oil and gas leasing (see Section B on page 41). The 1982 Chugach Natives, Inc. Settlement Agreement further stated that the United States "shall not be obligated to make a management decision on opening all or part of the Katalla Exchange Preference Area." The exchange rights terminated 25 years from the date of the Chugach Natives, Inc. Settlement Agreement on January 2, 2008 (page 44).

Geographic Zone 2 is not currently available for oil and gas leasing.

- Geographic Zone 3: Zone 3 is an area identified as having low potential for oil and gas production and is located outside of Geographic Zones 1 and 2 and was not available under the preferred (selected) alternative in the 2002 forest plan FEIS (page 3-501; table 3-97, page 3-502; ROD page 12).

Geographic Zone 3 is not currently available for oil and gas leasing.

- Geographic Zone 4: Zone 4 is the remainder of the Chugach National Forest outside of Geographic Zones 1, 2, and3, and is not believed to have any oil and gas potential.

Geographic Zone 4 is not currently available for oil and gas leasing (2002 ROD page 12). Oil and gas leasing are excluded from the wilderness study area (per 36 CFR 228.102(b)(3)). This exclusion extends to lands recommend for wilderness (36 CFR 228.102(b)(2)).

Coal

The 2002 forest plan EIS included a discussion on the Bering River Coal Field deposit. Coal occurs in the Kushtaka Formation and only outcrops on CAC lands so development of coal on the national forest is not foreseeable and no further discussion is warranted. Since the Bering River Coal deposit is on privately held lands, Federal surface management regulations do not apply and the Forest Service has no authority. There is a road right-of-way to this deposit through NFS lands and held by CAC that would be administered under a Forest Service special use permit if CAC pursues development.

Hardrock Leasable Minerals

Hardrock minerals, such as gold and other metals, are generally conveyed by discovery and location. However, when mineral lands are acquired by the Federal government, those minerals are only available under the laws and regulations for leasable minerals. The Copper River Addition was appended to the Chugach National Forest under provisions of ANILCA in 1980. Hardrock minerals within this addition are not available for mineral entry because the lands were withdrawn from mineral entry, but may be made available under leasing laws as described in Sec. 502 of ANILCA (1980). There are currently 695,582 acres available in the Copper River Addition that may be made available to hardrock leasable minerals.

Seven additional small acquired parcels that include the subsurface estates and total less than 500 acres are scattered across the national forest; any hardrock minerals within these acquired estates would also be disposed under hardrock leasing laws.

Salable Minerals (mineral materials)

Salable minerals are common variety minerals disposed under sales contract or free use permit as authorized under the Materials Act of 1947 and the Surface Resources Act of 1955. They include the following categories: agricultural supplies, building materials, abrasive materials, construction materials, and landscape materials. The regulations for salable minerals may be found at 36 CFR 228C.

Sand and Gravel

Extensive deposits of sand and gravel occur as alluvial, bench, and glacial deposits and are ubiquitous to nearly every valley within the national forest. Suitability of sand and gravel deposits for construction purposes varies based on factors that include particle hardness, durability, and silt content. Road, rail, or marine accessibility is necessary for development.

Quarry Rock: shot rock, rip-rap, and armor stone

Quarry rock suitable for construction purposes is in short supply within the Chugach National Forest, especially near roaded areas where the demand exists for road construction and other construction projects. Extensive portions of the Valdez Group are rocks along the roaded corridor and are commonly low grade slates and other non-competent or highly fractured rock that is unsuitable for construction use. Rock that fractures into large blocks either naturally or by controlled blasting is even less common and is in demand for many infrastructure projects.

Decorative Stone

A small tonnage of stone is produced from the national forest each year for use as decorative stone.

Salable Agricultural Minerals

Travertine deposits occur infrequently within the Chugach National Forest and potentially may be suitable for use as an agricultural soil conditioner or amendment and may be disposed under salable mineral materials regulations at 36 CFR 228C.

Abandoned and Inactive Mine Lands

Abandoned mine sites were inventoried in the mid-1990s and rated on criteria that includes physical and chemical hazards (site reports are on file in the Chugach National Forest minerals library). Known explosives and immediate chemical hazards have been addressed at abandoned mines. Mitigation of physical hazards at abandoned mines continues to be addressed on a case-by-case basis and often includes sealing mine adits, shafts, and other workings from entry by humans. Some sites were designated as superfund sites under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 and pose longer term chemical risks due to contamination of soil and/or ground water.

Recreational Gold Panning

Recreationists may remove mineral specimens from NFS lands, including withdrawn lands, using small hand tools and four inch or less suction dredges (measured at the nozzle). Recreational users are afforded no rights under U.S. mining laws and the activity is not covered under 36 CFR 228A. The activity is not considered an economically gainful endeavor. Only one area within the national forest (Resurrection Creek restoration area) has a closure order as of 2012 to preclude the use of gold pans and other hand tools for recreational gold panning.

Private Minerals

Certain acquired NFS lands, including lands purchased by the United States following the *Exxon Valdez* oil spill, have a split estate: the surface ownership is held by the Federal government but the subsurface estate is privately owned. The Forest Service objective is to administer mineral reservations and outstanding mineral rights consistent with the rights reserved or outstanding and the acquired rights of the United States in a manner that minimizes damage to national forest resources (FSM 2830). The specific terms of the deeds by which the surface and subsurface owners acquired their interests also provide the basis for Forest Service authority to administer mineral reservations and outstanding mineral rights. As a general rule, the Forest Service does not have authority to deny the exercise of a mineral reservation or outstanding mineral right. The exercise of all reserved and outstanding mineral rights is subject to applicable Federal and State laws and regulations pertaining to mining, real property, and environmental protection.

Mineral Reservations

Mineral reservations are mineral rights retained by a grantor in a deed conveying land to the United States. The authority for the administration of mineral reservations is 36 CFR 251.15 or previously issued Secretary of Agriculture's rules and regulations that govern the exercise of mineral rights reserved in conveyances to the United States. The appropriate rules and regulations in effect at the time of the mineral reservation were incorporated as part of the deed by which the United States acquired the surface. There are two parcels (12,161 acres) within the national forest with split estates where the Forest Service manages the surface estate and a private party holds a mineral reservation to the subsurface estate.

Outstanding Mineral Rights

Outstanding mineral rights are those rights owned by a party other than the surface owner at the time the surface was conveyed to the United States. There is usually no contractual or other legal relationship between the United States and the owner of outstanding mineral rights. The Secretary's rules and regulations do not apply to the administration of outstanding mineral rights. There are 10 parcels (120,167 acres) within the national forest with split estates where the Forest Service manages the surface estate and a private party holds outstanding mineral rights to the subsurface estate.

Effects of Climate Trends

Weather patterns during the past number of years have varied widely. Longer shoulder seasons have occurred in some years where gravel has not frozen as quickly late in the year, offering additional opportunity to excavate unfrozen sand and gravel for construction projects and for placer mining.

An increase in average seasonal temperatures could foreseeably cause additional freeze-thaw cycles which would more quickly degrade infrastructure, such as roads, and would thus require additional material resources to restore the infrastructure to a maintained condition.

Environmental Consequences

Effects Common to All Alternatives

Leasable Minerals (hardrock leasable minerals)

The Copper/Rude River Addition was appended to the Chugach National Forest under provisions of ANILCA (1980) and is part of the 501b management area. Hardrock minerals within this addition are not available for mineral entry because the lands were withdrawn but may be made available under leasing laws as described in Sec. 502 of ANILCA (1980). There are 687,168 acres of NFS lands currently remaining in the Copper River/Rude River Addition after adjusting for ANCSA and ANILCA selections and conveyances. None of the alternatives would affect minerals in the Copper River/Rude River Addition.

Salable Minerals (mineral materials, common variety minerals)

Mineral materials are found in great quantities across the national forest. In order for a common variety mineral to have commercial value and be able to be extracted and transported to a market, which is commonly a large infrastructure project location, an economically viable form of transportation must be readily available. Mineral materials deposits must be adjacent to a readily accessible transportation system to be considered commercially viable. Mineral material disposals (free use or sale contract) are at the discretion of the authorized Forest Service line officer.

None of the alternatives propose changes to areas along transportation corridors where any foreseeable salable mineral material development would occur. None of the alternatives would adversely affect salable mineral materials or their availability.

Private Minerals

Access, exploration, and development of private minerals would not be affected by any of the alternatives. Per regional policy and FSM 2323.73, operating plans would need to include reasonable requirements to protect the wilderness study area’s resources and values and maintain its existing character and potential for inclusion in the National Wilderness Preservation System.

Discovery and development of locatable minerals would be adversely affected by mineral withdrawals resulting from Wilderness designation. Currently all NFS lands within the wilderness study area are open to mineral entry. Wilderness area designation would result in the withdrawal of these lands from mineral entry, subject to valid existing rights.

The maps of areas of high mineral potential (see map 13, map 14, and map 15) display the locations of high mineral potential areas that are recommended for wilderness area designation for each alternative.

Table 60. Acres that would potentially be withdrawn from mineral entry if wilderness area is designated

Measurement Indicator	Existing Condition	Alternative A No Action	Alternative B	Alternative C	Alternative D
Acres open to mineral entry within Chugach National Forest	4,372,657	2,985,147	2,985,147	2,552,957	2,488,457
Acres that could potentially be withdrawn from mineral entry	zero	1,387,510	1,387,510	1,819,700	1,884,200
Acres with high mineral potential that could potentially be withdrawn from mineral entry	zero	910,382	910,382	1,091,797	1,147,998

Withdrawing lands from mineral entry adjacent to lands that host known deposits can gravely affect the economics of developing the mineral deposit and its economic viability as those adjacent lands often host undiscovered mineral deposits or extensions of the originally known deposit. If a deposit on private lands extends onto NFS lands, and the NFS lands are withdrawn, mining the private lands may not be economically viable, whereas, if mining could continue within the same deposit onto NFS lands, economic viability could be more certain. This situation is possible in many parts of the Chugach National Forest. The Port Wells area is especially noteworthy, as two large claims blocks have been held for a considerable number of years, with historic mineral production from the area, especially the Granite Mine, and reoccurring interest in the Granite Mine property. One lode claim is currently (April 2017) located at the historic Rough and Tough prospect directly west of Mount Cameron. Dozens of historically producing mines, prospects, and mineral occurrences are known from areas scattered across the wilderness study area. The list would be far too extensive if all sites were listed.

Table 61. Areas with high mineral potential that would be withdrawn from mineral entry if wilderness area is designated (in acres)

Area within Recommended Wilderness	Existing Condition	Alternative A No Action	Alternative B	Alternative C	Alternative D
Greater College Fiord Area	zero	585,819	585,819	586,432	586,432
South Harriman Fiord	zero	23,047	23,047	23,047	23,047
Western Port Wells	zero	zero	zero	38,005	38,005
Southeast Port Wells	zero	zero	zero	31,550	31,550
Decision Point	zero	zero	zero	1,083	1,083
Blackstone Bay	zero	zero	zero	zero	44,634
Cochrane Bay	zero	243	243	44,220	44,220
NE Port Nellie Juan	zero	12,859	12,859	12,859	12,859
North Nellie Juan	zero	185,989	185,989	186,609	186,609
South Nellie Juan	zero	91,364	91,364	91,364	91,364
North Bainbridge Island	zero	7,362	7,362	7,362	7,362
East Erlington Island	zero	zero	zero	2,093	2,093
North Knight Island	zero	zero	zero	14,342	14,342
Central Knight Island	zero	zero	zero	2,628	2,628
South Knight Island	zero	zero	zero	22,404	22,404
Eleanor Island	zero	3,350	3,350	14,592	14,592
Foul Bay	zero	350	350	14,592	14,592
Columbia Glacier	zero	zero	zero	11,951	11,591
Glacier Island	zero	zero	zero	zero	9,474
Totals	zero	910,382	910,382	1,091,797	1,147,998

Alternative A No Action

Locatable Minerals

There are 4,372,657 acres currently open to mineral entry under alternative A (no action) if the wilderness area recommendation is not acted upon and the current condition remains unchanged. There would be 2,985,147 acres open to mineral entry under alternative A in the event that recommended wilderness becomes designated: under alternative A, 1,387,510 additional acres would be withdrawn from mineral entry, subject to valid existing rights, in the event that the area becomes designated. Withdrawing lands from mineral entry would have an adverse effect to people that pursue the discovery and development of locatable minerals.

Areas with high mineral potential in the wilderness study area have a higher likelihood of adversely impacting discovery and development of locatable minerals than the no-action alternative, due to inclusion of additional areas analyzed and mapped that have high potential for one or more of the nine described deposit types (see map 12) (Karl et al. 2016; 2017), in the event that those lands become a designated wilderness area and thus are withdrawn from mineral entry.

The map of areas of high mineral potential (see map 13) displays the locations of 910,382 acres of high potential areas that are included in the recommended wilderness area for alternative A. Table 61 displays the number of acres of high potential in various areas and the total acres that would be withdrawn from mineral entry if alternative A is selected and the recommended wilderness area is designated.

Alternative B

Locatable Minerals

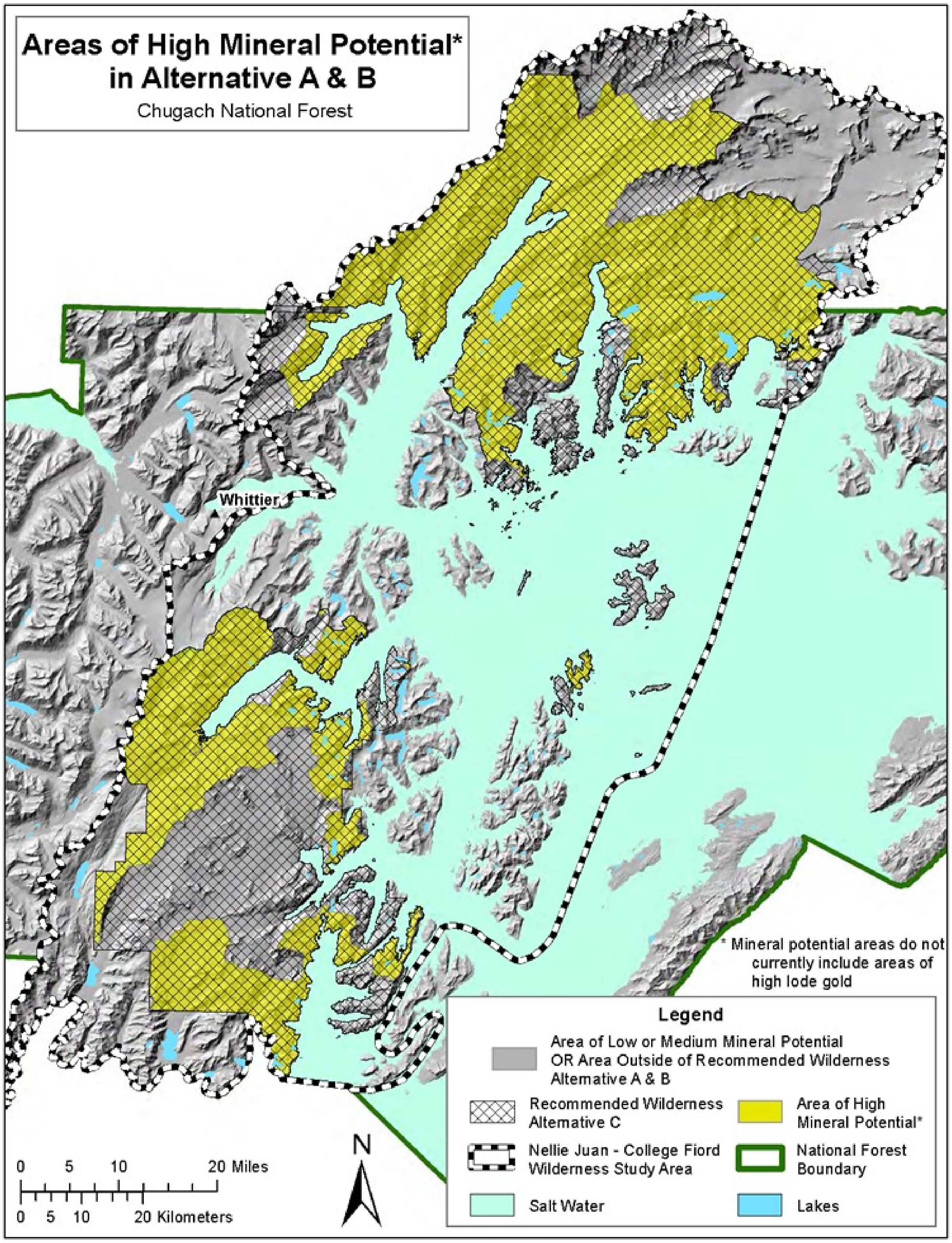
There are 2,985,147 acres open to mineral entry under alternative B. There are 1,387,510 acres of recommended wilderness area under alternative B.

Under alternative B, 1,387,510 additional acres would be withdrawn from mineral entry, subject to valid existing rights, in the event that the area became a designated wilderness area. Withdrawing lands from mineral entry, especially in areas of high mineral potential, would have an adverse effect to people that pursue the discovery and development of locatable minerals.

Alternates B would represent a neutral effect to locatable minerals compared to the no-action alternative; the same number of acres would be withdrawn from mineral entry (1,387,510 acres).

Areas with high mineral potential in the wilderness study area are considered to have a higher likelihood of adversely impacting discovery and development of locatable minerals due to inclusion of areas analyzed and mapped as having high potential for one or more of the nine described deposit types (see map 12) (Karl et al. 2016; 2017), in the event that those lands become a designated wilderness area and thus are withdrawn from mineral entry.

The map of areas of high mineral potential (see map 13) displays the locations of 910,382 acres of high potential areas that are included in the recommended wilderness area for alternative B. Table 61 displays the number of acres of high potential in various areas and the total acres that would be withdrawn from mineral entry if alternative B is selected and the recommended wilderness area is designated.



Map 13. Areas of high mineral potential for alternatives A and B

Alternative C

Locatable Minerals

There are 1,819,700 acres open to mineral entry under alternative C. There are 2,552,957 acres of recommended wilderness area under alternative C. Under alternative C, 1,819,700 additional acres would be withdrawn from mineral entry, subject to valid existing rights, in the event that the area becomes a designated wilderness area. Alternative C would have an adverse impact to the discovery and development of locatable minerals compared to the no-action alternative (alternative A) by increasing the acres that would be withdrawn from mineral entry from 1,387,510 acres to 1,819,700 acres (432,190 acres or 10 percent increase).

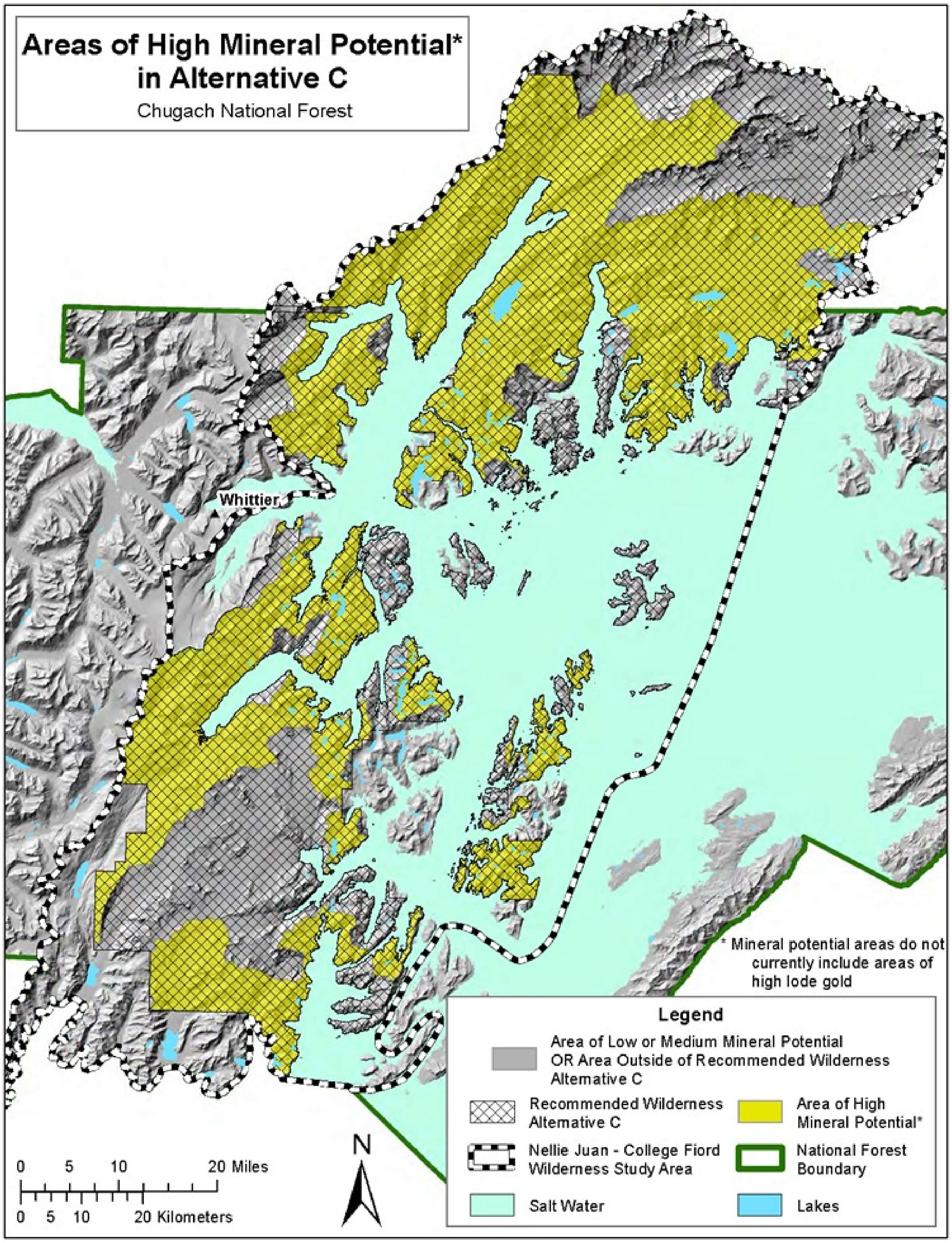
Areas with high mineral potential in the wilderness study area are considered to have a higher likelihood of adversely impacting discovery and development of locatable minerals due to inclusion of areas analyzed and mapped as having high potential for one or more of the nine described deposit types (see map 12) (Karl et al. 2016; 2017), in the event that those lands become a designated wilderness area and are withdrawn from mineral entry.

Sixteen (16) general areas (181,415 acres) are shown in Table 61, have high mineral potential, and are included as a recommended wilderness area in alternative C in addition to the number of acres of recommended wilderness area under alternatives A and B (910,382 acres) for a total of 1,091,797 acres see map 14). The designation of the recommended wilderness area would adversely impact the discovery and development of locatable minerals.

The map of areas of high mineral potential (see map 14) displays the locations of high potential areas that are included in the recommended wilderness area for alternative C. Table 61 displays the number of acres of high potential in various areas and the total acres that would be withdrawn from mineral entry if alternative C is selected and the recommended wilderness area is designated.

Withdrawing lands from mineral entry adjacent to lands that host known deposits can gravely affect the economics of developing the mineral deposit and its economic viability as those adjacent lands often host undiscovered mineral deposits or extensions of the originally known deposit. The Port Wells area is especially noteworthy as two large claims blocks have been held for a considerable number of years, historic mineral production from the area especially the Granite Mine, and reoccurring interest in the Granite Mine property. One lode claim is currently (April 2017) located at the historic Rough and Tough prospect directly west of Mount Cameron. Dozens of historically producing mines, prospects, and mineral occurrences are known from areas scattered across the wilderness study area.

Inclusion of designated wilderness areas in areas considered to have high potential for mineral resources would adversely impact the discovery and development of locatable minerals (see map 14).



Map 14. Areas of high mineral potential for alternative C

Alternative D

Locatable Minerals

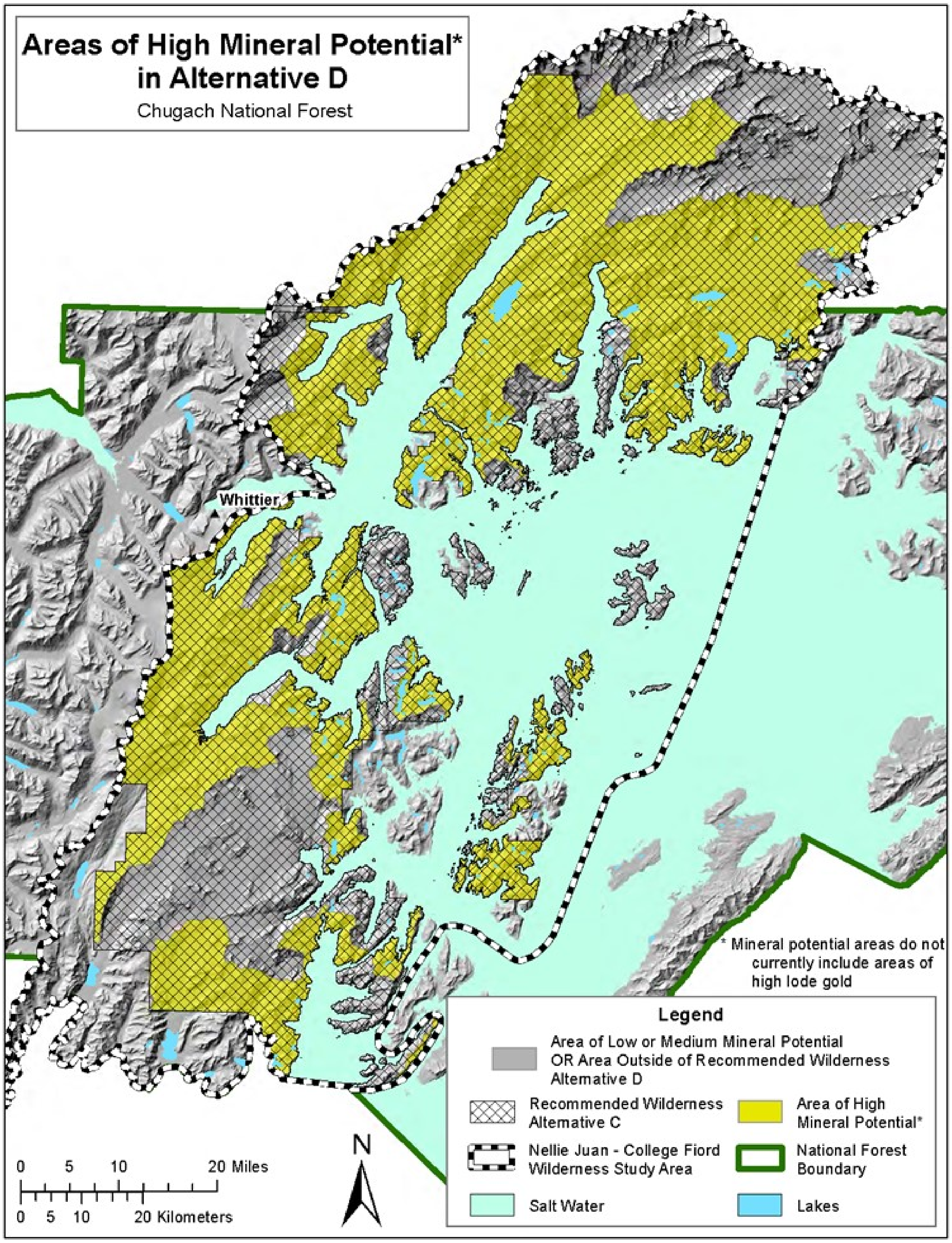
There are 2,488,457 acres open to mineral entry under alternative D. There are 1,884,200 acres of recommended wilderness under alternative D. Under alternative D, 1,884,200 additional acres would be withdrawn from mineral entry, subject to valid existing rights, in the event that the area becomes a designated wilderness area. Alternative D represents an adverse impact to the discovery and development of locatable minerals, compared to the no-action alternative (alternative A), by increasing the number of acres that would be withdrawn from mineral entry from 1,387,510 acres to 1,884,200 acres (496,690 acres or 11 percent increase).

Areas with high mineral potential in the wilderness study area are considered to have a higher likelihood of adversely impacting the discovery and development of locatable minerals due to inclusion of areas analyzed and mapped as having high potential for one or more of the nine described deposit types (see map 12) (Karl et al. 2016; 2017), in the event that those lands become a designated wilderness area and are withdrawn from mineral entry.

Nineteen (19) general areas (556,201 acres) shown in Table 61 have high mineral potential, and are included as a recommended wilderness area in alternative D in addition to the number of acres under alternatives A and B (1,091,797 acres) for a total of 1,147,998 acres (see map 15). The designation of the recommended wilderness area would adversely impact the discovery and development of locatable minerals.

The map of Areas of high mineral potential (see map 15) displays the locations of high potential areas that are included in the recommended wilderness area for alternative D. Table 61 displays the number of acres of high potential in various areas and the total acres that would be withdrawn from mineral entry if alternative C is selected and the recommended wilderness area is designated.

Withdrawing lands from mineral entry adjacent to lands that host known deposits can gravely affect the economics of developing the mineral deposit and its economic viability as those adjacent lands often host undiscovered mineral deposits or extensions of the originally known deposit. The Port Wells area is especially noteworthy as two large claims blocks have been held for a considerable number of years, historic mineral production from the area especially the Granite Mine, and reoccurring interest in the Granite Mine property. One lode claim is currently (April 2017) located at the historic Rough and Tough prospect directly west of Mount Cameron. Dozens of historically producing mines, prospects, and mineral occurrences are known from areas scattered across the wilderness study area. The list would be far too extensive if all sites were listed.



Map 15. Areas of high mineral potential for alternative D

Cumulative Effects

For cumulative effects, the geographic boundary is all lands within the proclaimed national forest boundary, regardless of ownership. Withdrawing lands from mineral entry adjacent to lands that host mineral deposits can adversely affect the economics of developing the overall deposit as those adjacent lands can host extensions of the originally known deposit or undiscovered mineral deposits.

Analytical Conclusions

The only consequences to mineral resources would result from designation of the recommended wilderness area. Currently all NFS lands within the wilderness study area are open to mineral entry. If recommended Wilderness were to be designated by Congress, the greatest amount of land would be withdrawn under alternative D, and the least amount would be withdrawn under alternative A. This pattern would be the same for areas of high mineral potential (see table 60 and table 61).

Discovery and development of locatable minerals would be adversely affected by mineral withdrawals resulting from wilderness area designation, but withdrawals would be subject to valid existing rights. The amount of lands recommended for wilderness area designation varies by alternative and is displayed in table 1.

Special Uses

Introduction

This report analyzes the effects of the alternatives on lands special use authorizations within the Chugach National Forest plan area. Special use authorizations provide use of NFS lands for a wide variety of activities. Authorizations are issued to commercial and noncommercial operations, which provide use of and access to these lands. As of 2017, the Forest Service administers approximately 130 lands special use authorizations.

Methodology

Definitions Specific to this Analysis

Commercial use or activity: any use or activity on NFS lands (a) where an entry or participation fee is charged, or (b) where the primary purpose is the sale of a good or service, and in either case, regardless of whether the use or activity is intended to produce a profit.

Permit: a special use authorization that provides permission, without conveying an interest in land, to occupy and use NFS lands or facilities for specified purposes, which is both revocable and terminable.

Revocation: the cessation, in whole or in part, of a special use authorization by action of an authorized officer before the end of the specified period of use or occupancy for reasons set forth in § 251.60(a)(1)(i), (a)(2)(i), (g), and (h) of 36 CFR 251 Subpart B–Special Uses.

Special use authorization: a written permit, term permit, lease, or easement that authorizes use or occupancy of NFS lands and specifies the terms and conditions under which the use or occupancy may occur.

Suspension: a temporary revocation of a special use authorization.

Termination: the cessation of a special use authorization by operation of law or by operation of a fixed or agreed upon condition, event, or time as specified in the authorization, which does not require a decision by an authorized officer to take effect, such as expiration of the authorized term; change in ownership or control of the authorized improvements; or change in ownership or control of the holder of the authorization.

Spatial Scale

All NFS lands within the plan area.

Temporal Scale

The planning timeframe is 15 years.

Affected Environment

As of February 2017 the Forest Service administers approximately 130 lands special use authorizations for the Chugach National Forest. These include: 2 fish hatcheries, 5 power lines, 2 Federal Energy Regulatory Commission-related activities, 7 telephone lines, 4 fiber optic cables, 31 electronic sites, 14 roads, and 65 other various land use authorizations issued.

Additionally the Forest Service administers an average of 15 temporary permits issued for filming or other short-term uses; therefore an exact number of authorizations issued at any one point in time can vary depending on the number of temporary authorizations issued.

There is a United States Geological Survey research site located within the Wolverine Glacier Research Natural Area, 24 miles northeast of Seward. It was authorized under a memorandum of understanding, which has expired, and will be authorized under special use permit in the future. This operation is not included in the total number of special use authorizations administered.

Utility Corridors and Facilities

Five power line special use authorizations are currently issued. Two are issued to Chugach Electric Association, and one each is issued to Homer Electric, Cordova Electric Cooperative, and the City of Seward. There are two permits for Federal Energy Regulatory Commission-related hydropower activities: a hydropower dam on Cooper Lake, and one investigative study permit for hydropower feasibility on Grant Lake.

There are seven special use authorizations for telephone lines issued. There are two special use authorizations each issued to TelAlaska, and Alaska Communication Systems, and one each issued to GCI Communication Corporation, Yukon Telephone Company, and Cordova Telephone Cooperative.

There are four special use authorizations for fiber optic cable, one each issued to Cordova Telephone Cooperative, Inc.; GCI Communication Corp.; TelAlaska, Inc.; and ACS Internet.

Fish Hatcheries

There are two fish hatcheries under special use authorizations to the Alaska Department of Fish and Game. Both the Main Bay Hatchery and the Cannery Creek Hatchery are within the Glacier Ranger District within Prince William Sound.

The Main Bay Hatchery is a state-owned hatchery built in 1981 by the Alaska Department of Fish and Game and operates as a sockeye salmon facility. It is in Main Bay in Prince William Sound approximately 40 miles southeast of Whittier. Prince William Sound Aquaculture Corporation manages and operates the facility for the Alaska Department of Fish and Game.

The Cannery Creek Hatchery is a state-owned hatchery built in 1978 and operates as a pink salmon hatchery. It is in the Unakwik Inlet in Prince William Sound, approximately 40 miles east of Whittier. This facility is also managed and operated by Prince William Sound Aquaculture Corporation for the Alaska Department of Fish and Game.

Communication Sites

There are 31 electronic site special use authorizations administered. Some communication sites have more than one authorization holder. The 19 communication sites under special use authorization (SUA) (by geographic area) include:

Copper River Delta Geographic Area

1. 22 Mile (1 SUA), Cordova Ranger District
2. Heney Ridge (3 SUA), Cordova Ranger District

Kenai Peninsula Geographic Area

1. Begich, Boggs Visitor Center roof top (2 SUAs), Glacier Ranger District
2. Portage Passage (behind RR depot) (1 SUA), Glacier Ranger District
3. Windy Point (mountain side) (2 SUAs), Seward Ranger District
4. Windy Point (water side) (1 SUA), Seward Ranger District
5. Tern Lake (2 SUAs), Seward Ranger District
6. Tern Peak (1 SUA), Seward Ranger District
7. Cecil Rhode Mt. (1 SUA), Seward Ranger District
8. Cooper Mountain (4 SUA), Seward Ranger District
9. Hope Mountain (1 SUA), Seward Ranger District
10. Sheep (Wilcott) Mountain (1 SUA), Seward Ranger District

Prince William Sound Geographic Area

1. Naked Island (5 SUAs), Glacier Ranger District
2. Point Pigot (2 SUAs), Glacier Ranger District
3. Mount Thomas (1 SUA), Cordova Ranger District
4. Potato Point (1 SUA), Cordova Ranger District
5. Hinchinbrook Island (1 SUA), Cordova Ranger District
6. Johnstone Point (1 SUA and 1 MOU: 1964 Memorandum of Understanding between FAA and USFS for 4 facilities located at Johnstone Point; not included in total number of special use authorizations), Cordova Ranger District
7. Jack Peak (2 SUAs), Cordova Ranger District

There are communication site management plans for Naked Island, Point Pigot, Potato Point, Mount Thomas, Hinchinbrook Island, Johnstone Point, Jack Peak, 22 Mile, Windy Point (mountain side), Windy Point (water side) Tern Lake, Cooper Mountain, Hope Mountain, and Sheep (Wilcott) Mountain.

Trends in Land Use

There is a continued interest in conducting various forms of research within the Copper River Delta, Prince William Sound, and the Kenai Peninsula. Interest in filming for various television programs, travel guides, and other ski/adventure related videos within the national forest has increased. The number of structures authorized within the national forest has remained constant; however, some of the existing infrastructure has been authorized for more than 30 years, and there is an increase in significant maintenance projects to address at the aging facilities. The transmission line on the Kenai Peninsula is currently undergoing a rebuild to replace existing line and structures that are 45-plus years old. Both Main Bay and Cannery Creek hatcheries have been in place for 30-plus years and are undergoing reconstruction of their aging facilities. Interest in establishing new communication sites has increased. Highway realignment projects for the Sterling Highway and the Seward Highway are resulting in the need to amend existing special use authorizations to move utility infrastructure further away from the highway right-of-way.

Environmental Consequences

Most of the direction for authorizing and administering special uses comes from the Forest Service Manual and Handbook. The existing laws, regulations, and policies governing special uses within the national forest can be found in Forest Service Manual 2300 (Recreation Wilderness Management), FSM 2700 (Special Uses Management) and Forest Service Handbook 2709.11, FSH 2709.12, FSH 2709.14, and 2709.15, and under Title 36 CFR part 251, subparts A and B, which are independent from direction in the forest plan.

Special uses would be managed to be consistent with the plan components for other resource areas (e.g., recreation, heritage, wildlife, and the wilderness study area). The relevant plan components do not vary by alternative in ways that would affect special use authorizations.

The demand for additional special use authorizations will be driven by the need to use NFS lands by local and state governments, companies, and private citizens for additional utilities, communication sites, and other uses requiring authorization. This will not change or be affected by any of the alternatives

Cumulative Effects

Under all alternatives, there would be no cumulative effects from the proposed management changes.

Analytical Conclusions

Proposed changes to the forest plan would not result in any measurable changes to lands special uses authorizations or administration.

Infrastructure

Introduction

This section analyzes the effects of the alternatives on the road system and facilities of the Chugach National Forest.

Methodology

Spatial Scale (indirect and cumulative effects analysis areas)

The boundary for indirect effects is the Chugach National Forest boundary. This area was chosen because the indirect effects of providing varying levels of recreation opportunities and classes is determined at a forestwide level.

The boundary for cumulative effects is the Chugach National Forest boundary.

Temporal Scale

The timeframe is the plan period (15 years).

Past, Present, and Future Activities used in the Analysis

Past activities:

- Forest Realignment and Enhancement Act Sales of Seward Administrative facilities

Present activities:

- Current and ongoing infrastructure annual maintenance

Future activities:

- Trail River Campground Bridge Replacement (2020)
- Eyak River Boating Site Rehabilitation
- Palmer Creek Road Bridge Replacement
- Russian River Campground Road Reconstruction Phases 1 and 2

Affected Environment

Administrative Facilities

The Facilities Master Plan for the Chugach National Forest provides current inventory information, analysis, and a detailed plan of action for Forest Service managers. At the close of fiscal year 2016, the Chugach National Forest administrative facilities portfolio was approximately 70 buildings with a total footprint of approximately 120,000 square feet and a replacement value of slightly over $44 million. The associated deferred maintenance for those facilities was estimated at approximately $2.5 million.

Since 2002, the Forest Service has constructed a new office, two new housing complexes, installed a new modular office, and replaced three paint/fuel storage buildings with four new hazardous materials buildings. The Forest Service has also removed two facilities at the Whittier site, transferred the triplex located on Kodiak Island to the U.S. Fish and Wildlife Service, decommissioned four storage buildings, conveyed two residences in Seward via the Forest Service Facilities Realignment and Enhancement Act of 2005, and removed 11 administrative cabins. At the time of this writing, the Forest Service is also in the process of conveying the Seward Ranger District Office through the Forest Service Facilities Realignment and Enhancement Act. With the budget for operations and maintenance of the administrative facilities portfolio projected to remain static at approximately $500,000 per year, management will continue to prioritize completing deferred maintenance while also right-sizing the footprint to meet current and future needs.

Based on current budgets and national program direction, the Forest Service will manage the administrative facility portfolio to most efficiently meet mission requirements while addressing critical health and safety items and deferred maintenance and implementing sustainable building retrofits in order to reduce the environmental footprint.

Roads

The Forest Service classifies maintenance of NFS roads by five maintenance levels (MLs): numbered maintenance level 1 through 5. Maintenance level 1 roads are closed to motor vehicle use. Maintenance level 2 roads are maintained for high-clearance motor vehicles. Maintenance levels 3 through 5 roads are maintained for standard passenger cars during the normal season of use. Maintenance levels increase with increasing degrees of user comfort and convenience. Table 62 displays a summary of miles for each road maintenance level (1 through 5). Maintenance levels 1, 2, and 3 roads are typically single lane roads with turn-outs. Maintenance level 1 and 2 roads are usually native surface or gravel and maintenance level 3 roads are typically gravel surfaced. Maintenance level 4 and 5 roads are typically double lane roads with a well maintained gravel surface or pavement.

Annual grading is performed on maintenance levels 3 through 5 roads that get the most use. Brushing of roads occurs on a 5-year or longer rotating basis as needed on maintenance levels 2 through 5 roads. Other maintenance activities include drainage system repairs (culverts and ditches) and pavement repairs (crack sealing, etc.) on maintenance level 5 roads that are paved.

The national forest road system also includes roads under different jurisdictions (state, county, municipality, special use permit holders, and others). There are a total 94.2 miles of NFS roads, and another 210 miles of state highways and major state roads throughout the Chugach National Forest, including state highways and other local government and private roads. The state highways and other local government roads form the backbone of the road system, providing access to the NFS roads and most of the developed recreation sites. These include roads that provide only summer access and roads that provide both summer and winter access to NFS lands. The motor vehicle use map (MVUM) shows where and when NFS roads are open to the public. Approximately 75 percent of these roads are on the Kenai Peninsula, and the remaining 25 percent are on the Copper River Delta. There are no NFS roads in Prince William Sound, and access to NFS lands is by state or local roads, boat, or plane. Almost all NFS roads are categorized as very low volume roads where the average daily traffic is 400 vehicles per day or less. Only seasonal use at Russian River Campground has been shown to exceed the very low volume classification.

The Chugach National Forest road system has been reduced by approximately three miles since 2002. The 2002 forest plan appendix B shows a total of 97 miles of inventoried road. In 2012, the Forest Service conducted a roads validation in an effort to obtain consistency between the 2002 forest plan, Infra data, and the MVUM. The total number of NFS roads miles was subsequently reduced even with the addition of some small trailhead and day use roads. Data displayed for roads in table 62 is from the Infra roads database.

Table 62. Chugach National Forest road miles by maintenance level

Geographic Area	Maintenance Level 1	Maintenance Level 2	Maintenance Level 3	Maintenance Level 4	Maintenance Level 5	Totals
Kenai Peninsula	6.7	19.0	34.8	10.5	0.2	71.2 miles
Copper River Delta	5.5	4.9	12.6	zero	zero	23.1 miles
Prince William Sound	zero	zero	zero	zero	zero	Zero miles
Totals	12.2 miles	23.9 miles	47.4 miles	10.5 miles	0.2 miles	94.2 miles

The road system includes six road bridges (see table 63). Two of these bridges (Sheridan Road and Tern Lake) were constructed to replace culverts through the Aquatic Organism Passage program. Palmer Creek Bridge 2 was closed in 2012 due to log stringer failure and discussion regarding replacement of this bridge is in progress. Replacement of the Trail River Bridge is programmed for construction in 2020 through the Federal Lands Transportation Program (FLTP). Bridges are inspected biannually in conformance with the Federal Highway Administration’s National Bridge Inspection Standards.

Table 63. Chugach National Forest road system bridges

Bridge	Location	Type	Length (feet)	Year Built
Sheridan Road Bridge	Copper River Delta	Glulam Slab	46	2006
Tern Lake Bridge	Kenai Peninsula	Glulam Slab	41	2009
Trail River Bridge	Kenai Peninsula	Glulam Girder	142	1965
Milk Creek Bridge	Kenai Peninsula	Glulam Girder and Floorbeam	42	1980
Palmer Creek Bridge 1	Kenai Peninsula	Timber Frame	32	1957
Palmer Creek Bridge 2	Kenai Peninsula	Log Stringer	17	2000

Source: Chugach National Forest Infra Database (2017)

From 2012 through 2016, the Forest Service invested an average of 181,000 dollars per year into annual road and bridge maintenance (mainly road brushing and grading).

Travel Management

As part of revision for the 2002 forest plan, a roads analysis was performed to fulfill requirements of the 2001 Roads Rule. The Forest Service made a decision on a minimum road system. The 2001 Roads Rule is now included in the 2005 Travel Management Rule (36 CFR, Part 212, Subpart A)(36 CFR 212.5(b)). As required by the 2005 Travel Management Rule, the Forest Service completed a travel analysis report for the Chugach National Forest in 2015. This report identified the most ecologically, economically, and socially sustainable road system in terms of access for recreation, research, and other land management activities and included a financial analysis of the minimum road system. Results of the travel analysis report will be used to inform future NEPA decisions concerning management of the national forest’s transportation infrastructure.

Environmental Consequences

Alternatives B and D

Most management area designations do not affect the present or future management of administrative facilities or the road system. The exception to this is the inclusion of the Palmer Creek drainage in the Backcountry management area under alternatives B and D. This change reflects a desire from the public to keep recreation development within the Palmer Creek valley at the current level. The Palmer Creek valley changed from the Fish and Wildlife Conservation management prescription to the Backcountry management area. The recreation opportunity spectrum class for the area along the Palmer Creek road is roaded natural, which is a slightly more developed recreation setting than what is described for management intent for the backcountry management area, but still consistent at the lowest level of recreation development. The Palmer Creek drainage includes Palmer Creek Road and Coeur d' Alene Campground. Palmer Creek Road occupies the majority of the length of the drainage and is open seasonally as snow conditions permit. The Palmer Creek Road is valued highly for its scenic alpine beauty, being the only road within the national forest that accesses the alpine ecosystem. The access route through the Palmer Creek drainage includes three large live stream crossings. Currently these crossings are comprised of two road bridges and a large double culvert structure. All of these structures are currently planned for replacement. These plans are consistent with current management of the infrastructure in the drainage; however, each would be evaluated for replacement with trail structures rather than road structures.

Alternative C

Under alternative C, the Palmer Creek drainage would be included in the front country management area. Under this alternative, planned maintenance and replacements of the infrastructure would not change and would remain consistent with current road management objectives.

There are no other areas within the national forest where management area designations proposed under alternative C are anticipated to affect the current management intent of administrative facilities or the road system.

Changes to Infrastructure from Recreation Opportunity Spectrum Settings

Signage and trail classes will be changing to better conform to the new recreation opportunity spectrum settings.

Changes to the Recreation Opportunity Spectrum that Require Travel Management Decisions

Two changes to recreation opportunity spectrum classes would require travel management decisions (table 9).

Cumulative Effects

The primary link to and through the Chugach National Forest is via the state highway system. These routes, managed by the Alaska Department of Transportation and Public Facilities, include portions of the Seward Highway, Sterling Highway, Alyeska Highway, Portage Glacier Road, Exit Glacier Road, and Copper River Highway. The other unique aspect of transport through the Chugach National Forest is the Alaska Marine Highway System. The system provides service through Prince William Sound to the communities of Whittier, Valdez, and Cordova.

The Alaska Department of Transportation and Public Facilities four-year program for transportation system preservation and development is published as the Statewide Transportation Improvement Program. It includes interstate, state, and some local highways; bridges; ferries; and public transportation, but it does not include airports or non-ferry-related ports and harbors. It covers all system improvements for which partial or full Federal funding is approved and that are expected to take place during the four-year duration of the Statewide Transportation Improvement Program. Specific Roadway projects impacting the Chugach National Forest on the Statewide Transportation Improvement Program at the time of this publishing include Seward Highway mileposts 17 to 22.5, mileposts 25 to 36, and mileposts 75 to 90; Sterling Hwy mileposts 45 to 60; Shotgun Cove Road Construction; and Shepard Point Road Construction.

Under all alternatives, management of the national forest road system would not add to the cumulative effects from these projects because NFS roads are generally located off the major roadways. NFS road management is generally focused on maintenance of the current system and resource protection.

Analytical Conclusions

Alternatives B and D would allow a higher level of recreation infrastructure development along road systems in the Palmer Creek drainage, which includes Palmer Creek Road and Coeur d' Alene Campground. Alternative C would maintain infrastructure at the current level.

Overall, management of the NFS roads would not differ significantly by alternative. 2002 forest plan direction now covered by the Travel Management Rule would be removed from the forest plan in alternatives B, C, and D, but this change would not affect management of the road system. The designation of roads, trails, and areas available for motorized use would remain the same in all alternatives.

Ecological Sustainability

Air Quality and Carbon

Introduction

The air quality and carbon section addresses Federal Clean Air Act and Alaska State requirements concerning national ambient air quality standards, prevention of significant deterioration, regional haze, and wilderness air quality values. In addition, this section examines greenhouse gases (GHG) and carbon sequestration as outlined in the 2012 Planning Rule.

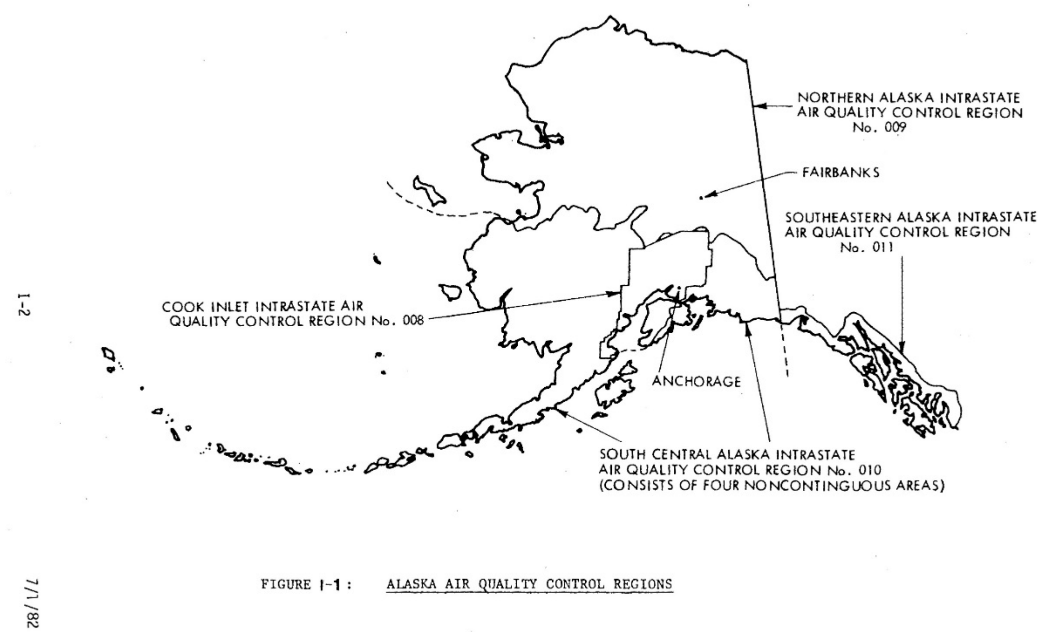
Methodology

Spatial Scale

Airsheds

An airshed is defined as a geographic area that, because of topography, meteorology, and/or climate, is frequently affected by the same air mass. It is difficult to define the boundaries of individual airsheds in the plan area. Many of the local airsheds are constrained by topography, especially in some of the fjord and mountainous areas. The mountains channel flow, create winds, cause upslope and downslope flow, initiate drainage winds, produce wind shear and extreme mechanical turbulence. Some areas are also characterized by local inversions and stagnant air flow during parts of the year.

Alaska's Department of Environmental Conservation (ADEC) has divided the state into four Intrastate Air Quality Control Regions (ADEC 1972). The Chugach National Forest is within two of these regions: Cook Inlet and southcentral Alaska. The Cook Inlet Intrastate Air Quality Control Region comprises all watersheds flowing into Cook Inlet (for the Chugach National Forest, this means anything flowing into the Kenai River or Turnagain and Knik Arms). The rest of the national forest lies within the Southcentral Intrastate Air Quality Control Region (see map 16).



Map 16. Alaska air quality control regions

Class I and Sensitive Air Quality Areas

The Clean Air Act provides the Forest Service with specific responsibilities for protection of air quality in Class I areas. Only wilderness areas designated before August 7, 1977, are classified as Class 1 areas by the Clean Air Act. There are no Class 1 areas within the Chugach National Forest. The Chugach National Forest has one wilderness study area. Per 2002 forest plan direction, and regional policy, the Nellie Juan-College Fiord Wilderness Study Area is to be managed to maintain its presently existing character, including wilderness air quality related values, and the potential for inclusion in the National Wilderness Preservation System.

National Ambient Air Quality Standards and Greenhouse Gases (GHG)

The U.S. National Ambient Air Quality Standards criteria pollutants and GHG emissions data is available at the borough level. National Ambient Air Quality Standards are standards established by the United States Environmental Protection Agency (EPA) under authority of the Clean Air Act (42 U.S.C. 7401 et seq.; 40 CFR part 50) that apply for outdoor air throughout the country for pollutants considered harmful to public health and the environment. Primary standards are designed to protect human health. Secondary standards are designed to protect public welfare (including effects on soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, and climate), damage to property, transportation hazards, economic values, and personal comfort (EPA 2016). A district that meets a given standard is known as an attainment area for that standard and otherwise is known as a non-attainment area. The spatial scale for analysis of National Ambient Air Quality Standards and GHG emissions is within Kenai Peninsula and Valdez-Cordova boroughs.

Carbon Sequestration

Carbon sequestration data is available for NFS lands within the national forest boundary. The spatial scale for analysis of carbon sequestration is the plan area.

Temporal Scale

Future effects can be considered short term as this planning timeframe is 15 years.

Measurement Indicators

The indicators used in this analysis are summarized in table 64 and are described in the following text.

National Ambient Air Quality Standards

Hazardous air pollutants, also known as toxic air pollutants or air toxics, are those pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. Most air toxics originate from human-made sources, including mobile sources (e.g., cars, trucks, and buses) and stationary sources (e.g., factories, refineries, and power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Some air toxics are also released from natural sources, such as volcanic eruptions and forest fires. Hazardous Air Pollutants emissions inventories can be retrieved from U.S. EPA Toxics Release Inventory Program. The original list included 189 pollutants. Since 1990, EPA has modified the list through rulemaking to include 187 hazardous air pollutants.

Regional Haze

In addition to setting the National Ambient Air Quality Standards, the Clean Air Act specifically addresses visibility under Section 169A. The law requires states to develop long-term strategies to improve visibility in Class I areas over the next 60 years. Visibility improvement in these areas will have a complementary effect of improved air quality throughout the nation.

Table 64. Resource indicators for assessing effects

Resource Element	Resource Indicator	Measure	Used to address:	Source
National Ambient Air Quality Standards	Criteria Pollutants: Ozone Nitrous Oxide Sulfur Dioxide PM-2.5 PM-10 Lead 187 Hazardous Air Pollutants	Quantify project implementation emissions from equipment use and prescribed burning in tons per acre and annually	Law	Clean Air Act of 1990
Regional Haze	Visibility	Decrease/Increase in Deci Views (A measurement of visibility. One deci view represents the minimal perceptible change in visibility to the human eye)	Law	Clean Air Act of 1990
Wilderness Air Quality Related Values	Sensitive Receptors: Water Fauna Flora Lichens Soils Scenic Vistas Critical Loads: Atmospheric Deposition of Nitrogen, Sulfur and Mercury	Units of Measure vary among Sensitive Receptors and Critical Loads.	Law	Clean Air Act of 1990
GHG	CO2 Equivalents: Carbon Dioxide (C02), Methane (CH4) and Nitrous Oxide (N2O)	Quantify Project Implementation Emissions from Equipment Use and Prescribed Burning in tons per acre and annually	Policy	CEQ; USD
Carbon Sequestration	Above and Below Ground Terrestrial Carbon Sequestration	Metric units, i.e., hectares (ha), kilograms (kg), metric tons (1,000 kg, denoted t), millions of metric tons (denoted Mt), and t/ha.	Policy	CEQ

Wilderness Air Quality Values

Under the Clean Air Act, wilderness air quality values incudes sensitive receptors. Sensitive receptors are specific types of features or properties within a wilderness area that can be negatively impacted by air pollutants, e.g., high-altitude lakes, lichens, and scenic vistas. In other words, sensitive receptors are the specific components of an ecosystem through which change in an air quality related value or wilderness air quality value is quantified. Sensitive receptors are selected for 1) known or suspected sensitivity to pollutants, 2) availability for manageable, cost-effective monitoring, sampling, and analysis methods, and 3) relevance for modeling capabilities. Examples of indicators for sensitive receptors might be a population survey for a particular amphibian, a plankton count and water quality analysis in a sensitive lake, or an assessment of the vista from a particular viewpoint. Sensitive receptors include water, fauna, flora, lichens, soils, and scenic vistas.

Nationally, critical loads are measured for two primary resources. First, the acid-neutralizing capacity values of high-altitude lakes and the effects of acidification to macroinvertebrates and other organisms. Second, the effects of ozone to flora, such as conifers and other ozone sensitive species, such as quaking aspen (*Populus tremuloides*) and lichen. Critical loads include atmospheric deposition of nitrogen, sulfur, and mercury.

Greenhouse Gases (GHG)

Three of the most important GHGs resulting from human activity are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) (Cushman and Jones 2002). They are produced by both natural processes and human activity. While they make up less than one percent of the earth's atmosphere, they exert a powerful influence over global temperatures.

Greenhouse gases play a role in the natural environment by absorbing the sun's heat. As the sun's energy radiates back from the earth's surface toward space, these gases trap the heat in the atmosphere keeping the planet's surface warmer than it would otherwise be. Increases of atmospheric GHG result in additional warming of the earth's atmosphere. Carbon dioxide equivalent (CO_2e) is a metric used to compare the emissions from various GHG based upon their global warming potential. For instance, over a 100-year period, the global warming potential of methane (CH_4) is estimated to be about 28 to 36 times greater than carbon dioxide (CO_2), so its carbon dioxide equivalent (CO_2e) is 28 to 36. The carbon dioxide equivalent (CO_2e) of nitrous oxide (N_2O) is 298 (EPA 2015a).

Carbon Sequestration

Carbon sequestration is defined as the rate of accumulation of carbon in a carbon pool. The analysis of carbon sequestration examines a limited number of carbon pools based on the availability of information. Aboveground live trees is the most straightforward carbon pool to estimate. Long-term monitoring of forest plots and widespread sampling of different species lends itself to estimates of above ground tree carbon. Belowground carbon, including dead wood, is not nearly as comprehensively sampled. Soils are notorious for not having many sampling points, and depth sampling is often not extensive. Carbon stocks and changes in carbon (sequestration) are reported based on available information, which is largely summarized in the forest plan assessment (USDA 2014a).

Analysis Methods and Assumptions

This section addresses Federal Clean Air Act requirements concerning National Ambient Air Quality Standards, prevention of significant deterioration, regional haze and wilderness air quality values. The analysis uses information and data from existing research, assessments, Federal and State laws, regulations, and plans.

Affected Environment

National Ambient Air Quality Standards

No communities within or directly adjacent to the national forest are classified by the EPA as non-attainment areas or maintenance areas. However, there are multiple rural communities within or adjacent to the Chugach National Forest that have been identified as reporting problems with PM10 (dust) and/or PM2.5 (woodsmoke). Pollution levels in the communities have not triggered violations of health standards that would lead to a change from attainment to non-attainment. Anchorage is identified as being a maintenance area for carbon monoxide (CO), and Eagle River is classified as a non-attainment area and is currently working to apply for re-designation to a limited-maintenance area for PM10 (dust) (ADEC 2011).

Cook Inlet and Southcentral Alaska Air Quality Control Regions include the national forest area and both regions are classified as in attainment. To identify an area by its air quality, all geographic areas in the State are designated by the Federal administrator as attainment, non-attainment, or unclassifiable. An area is designated attainment for a particular air pollutant if its air quality meets the ambient air quality standard for that air pollutant. If air quality does not meet the ambient standard for a particular air pollutant, that area is designated non-attainment for that air pollutant. If there is insufficient information to classify an area as attainment or nonattainment for a particular air pollutant, the area is designated unclassifiable for that air pollutant (ADEC 2016).

To establish standards for the prevention of significant deterioration of air quality, the state is divided into four air quality control regions as follows:

(A) Cook Inlet Intrastate Air Quality Control Region

(B) Northern Alaska Intrastate Air Quality Control Region

(C) Southcentral Alaska Intrastate Air Quality Control Region

(D) Southeast Alaska Intrastate Air Quality Control Region

The Southcentral Alaska region contains 60 to 70 percent of the state’s population with Anchorage, the State’s largest city, home to 279,240 people in 2012. Bounded by active volcanoes on the southwest and glacial river plains to the northeast, this sector of the state has experienced 24-hour dust levels in excess of 1,000 ug/m^3 (micrograms per cubic meter). The EPA requires states to submit ambient air quality network assessments to the EPA every five years. The 2010 assessment is the latest available (Alaska 2010). According to the assessment, at present, all major anthropogenic sources in the Cook Inlet Basin are in compliance with the air quality standards and their emissions do not travel towards other populated areas with significant pollution sources. While the impact from anthropogenic sources is believed to be minimal (not exceeding the National Ambient Air Quality Standards), Alaska does have major sources of air pollution: wildland fires, windblown dust from natural sources of crustal materials, and particle emissions from volcanic eruptions, all of which are uncontrollable (Alaska 2010).

Nearby major industrial sites include two Chevron facilities at Trading Bay and Swanson River: Agrium and Alaska LNG at Nikiski. The state of Alaska conducts ambient air pollution concentration monitoring at various industrial monitoring sites and in the southcentral Alaska region. These four oil and gas installations in the Cook Inlet area have been monitored from 2008 to 2015. All of the sites were found to be in compliance with National Ambient Air Quality Standards during when the monitoring occurred (Alaska 2017).

The Chugach National Forest has relatively good air quality overall, but there are some concerns (good air quality is defined as satisfactory and air pollution poses little or no risk). Chugach National Forest air quality related issues are mainly due to dust, woodsmoke, and vehicle and marine vessel emissions. No communities within or directly adjacent to the national forest are classified by the EPA as non-attainment areas or maintenance areas. However, there are multiple rural communities within or adjacent to the Chugach National Forest that have reported problems with PM10 (dust) and/or PM2.5 (woodsmoke).

Most of the human activity within the national forest occurs along railroads; powerlines; developed and decommissioned roads and trails; and areas open to snowmachines, skiing, heli-skiing, and OHVs. Outside of NFS lands, ship and boat traffic is another source of air pollutants. Human activity and use varies greatly by season, extent, and duration. Because many of these activities do not require permits from the Forest Service, it is difficult to estimate the amount or extent of use.

Owing to the generally cool, moist climate and low incidence of lightning, natural fires are infrequent within and immediately adjacent to the national forest. When fire does occur, it is usually during drought or dry periods resulting in intense fires. Smoke from natural fires are infrequent in the Prince William Sound and Copper River Delta geographic areas. See the Wildfire and Fuels section of this EIS for more information.

Annual emissions from wildfires in the Kenai Peninsula borough causes significant amounts of particulates (PM10 and PM2.5) and GHG (methane and carbon dioxide) (see table 65). Emissions from prescribed burning contribute about 0.04 percent PM10 compared to wildfires (see table 66). Valdez-Cordova wildfire emissions are lower compared to the Kenai Peninsula and prescribed burning emissions estimates were not available for the borough (see table 67). 2014 is the latest year of available data from the EPA (EPA 2014).

There is limited air resource data for the Chugach National Forest. Some recent deposition and haze monitoring has been completed for the national forest. There are also quite a few state air quality monitors in the vicinity, as well as IMPROVE sites for the Tuxedni Wilderness Area and Denali National Park. A review of the latest data available at the IMPROVE sites shows that levels, relative to National Ambient Air Quality Standards, were well below the applicable thresholds in 2014.

The 2002 forest plan includes a monitoring question concerning the impact of snowmachine use on air quality where winter motor vehicle use is greatest. An air quality monitoring pilot study was conducted for the national forest during the winter of 2006-07 to quantify the levels of air pollutants in areas with high levels of winter motor vehicle use. The carbon monoxide and fine particulate data collected on the eight sample days indicated no violations of the EPA 24 hour standards, though there were some issues identified with the carbon monoxide sampling tool.

Table 65. 2014 Estimated wildfire emissions for Kenai Peninsula Borough in tons (EPA 2014)

National Ambient Air Quality Standard or GHG Abbreviation	National Ambient Air Quality Standard or GHG	Tons
CH_4	Methane	40,373.54
CO	Carbon Monoxide	837,383.5
CO_2	Carbon Dioxide	8,294,465
EC	Elemental Carbon portion of PM2.5-PRI	6,644.346
NH_3	Ammonia	13,687.74
NO_3	Nitrate portion of PM2.5-PRI	92.41861
NOX	Nitrogen Oxides	8,548.69
OC	Organic Carbon portion of PM2.5-PRI	32,332.52
PM10	PM10 Primary	82,616.7
PM25	PM2.5 Primary	70,014.12
PMFINE	Remaining PMFINE portion of PM2.5-PRI	30,062.66
SO_2	Sulfur Dioxide	5,413.107
SO_4	Sulfate Portion of PM2.5-PRI	882.1774
VOC	Volatile Organic Compounds	19,6761.4

Table 66. 2014 Estimated prescribed fire emissions for Kenai Peninsula Borough in tons (EPA 2014)

National Ambient Air Quality Standard or GHG Abbreviation	National Ambient Air Quality Standard or GHG	Tons
CH_4	Methane	20.79764
CO	Carbon Monoxide	437.291
CO_2	Carbon Dioxide	3,582.516
EC	Elemental Carbon portion of PM2.5-PRI	3.88489
NH_3	Ammonia	7.121743
NO_3	Nitrate portion of PM2.5-PRI	0.380313
NOX	Nitrogen Oxides	3.117966
OC	Organic Carbon portion of PM2.5-PRI	17.83919
PM10	PM10 Primary	41.94113
PM25	PM2.5 Primary	35.54332
PMFINE	Remaining PMFINE portion of PM2.5-PRI	13.32164
SO_2	Sulfur Dioxide	2.41512
SO_4	Sulfate Portion of PM2.5-PRI	0.117293
VOC	Volatile Organic Compounds	102.3751

Table 67. 2014 Estimated wildfire emissions for Valdez-Cordova Borough in tons (EPA 2014)

National Ambient Air Quality Standard or GHG Abbreviation	National Ambient Air Quality Standard or GHG	Tons
CH_4	Methane	1.228757
CO	Carbon Monoxide	25.36492
CO_2	Carbon Dioxide	266.5265
EC	Elemental Carbon portion of PM2.5-PRI	0.203233
NH_3	Ammonia	0.415114
NO_3	Nitrate portion of PM2.5-PRI	0.002827
NOX	Nitrogen Oxides	0.286281
OC	Organic Carbon portion of PM2.5-PRI	0.988966
PM10	PM10 Primary	2.527066
PM25	PM2.5 Primary	2.141545
PMFINE	Remaining PMFINE portion of PM2.5-PRI	0.919536
SO_2	Sulfur Dioxide	0.172331
SO_4	Sulfate Portion of PM2.5-PRI	0.026983
VOC	Volatile Organic Compounds	5.967711

Air quality monitoring was conducted during the winters of 2011-12 and 2015-16, using a different carbon monoxide detector rated for extreme cold. Monitoring based on two years provides an indication of trend but the limitation of a short time-series should be recognized. Results from monitoring indicate motor vehicle use at Turnagain Pass resulted in increased levels of carbon monoxide and fine particulates at sites measured near the parking lot. However, the carbon monoxide and fine particulate data collected on the sample days indicated no violations of the EPA state air quality standards (USDA 2014a). This monitoring shows carbon monoxide levels remained below health standard thresholds and the data suggests that exceeding the standard in the future is unlikely based on motor vehicle use trends at Turnagain Pass.

Regional Haze

Haze is caused by particulate matter suspended in the air or atmosphere. Haze can be both naturally occurring and manmade. Some natural sources of particulate matter include windblown dust, wildland fires, bioorganic emissions from trees (i.e., pollen), and emissions from the ocean such as salt spray. Manmade sources include emissions from gas and diesel engines, electric utility and industrial fuel burning, manufacturing operations, prescribed burns, and dust from unpaved roads and paved roads treated with gravel, construction, and agriculture. Particulate matter can remain suspended in the air for a long period of time and can travel to areas hundreds or even thousands of miles away from the pollution sources.

The Regional Haze Rule, adopted by the EPA in 1999, calls for State and Federal agencies to work together to improve visibility in 156 national parks and wilderness areas. The rule requires the States, in coordination with the EPA, National Park Service, U.S. Fish and Wildlife Service, Forest Service, and other interested parties, to develop and implement air quality protection plans to reduce the pollution that causes visibility impairment. The Regional Haze Rule establishes specific state implementation plan requirements and strategies to adopt when implementing a plan. States must develop long-term plans for reducing pollutant emissions that contribute to visibility degradation and within the plans establish goals aimed at improving visibility in Class 1 areas. The state implementation plan must address haze caused by all sources of pollutants that impair visibility, including haze caused from smoke, vehicles, electric utility and industrial fuel burning, and other activities that generate pollution. Alaska has four Class 1 areas:

- Denali National Park
- Tuxedni Wilderness Area
- Simeonof Wilderness Area
- Bering Sea Wilderness Area

Denali National Park and the Tuxedni Wilderness Area are the two closest to the Chugach National Forest and could possibly be affected by emissions generated within the national forest. It is not known to what extent the Forest Service emission estimates have been included in the Regional Haze state implementation plan requirements, though emissions and the risk of emissions from the Chugach National Forest are probably low.

Air quality concerns in the Nellie Juan-College Fiord Wilderness Study Area, related largely to commercial cruise ship emissions, point towards diminished visibility and possible ecological impacts from air pollution. Understanding and protecting wilderness study area air quality is a key approach to monitoring and maintaining wilderness character and is used as an indicator in the Chugach National Forest Wilderness Study Area Character Monitoring Protocol.

In 2012, the Forest Service began a pilot project to monitor cruise ship visual emissions in College Fiord. The work responded to a history of questions and complaints from visitors, outfitters, guides, and other tour operators about the impact of cruise ship visual emissions on the area's wilderness character. The public feedback was substantiated by recent research showing that ship emissions reduce visibility in Prince William Sound by up to 30 percent and may have associated ecological impacts on local marine and terrestrial environments (Molders et al. 2010). In spring 2012, the Forest Service partnered with the ADEC to become certified in EPA Method Nine Visual Emissions Monitoring Protocol.

Between May and September, Forest Service employees used EPA Method Nine to successfully monitor visual emissions from 10 percent of cruise ships visiting College Fiord. Preliminary reports suggest cruise ship visual emissions may have exceeded allowable state standards in College Fiord.

Wilderness Air Quality Values

A critical load is defined as "a quantitative estimate of the exposure to one or more pollutants below which significant harmful effects on specific sensitive elements of the environment do not occur according to present knowledge." A target load is set based on policy and management direction and, depending on whether or not current critical loads values have been exceeded, can be above or below the critical load. In general, the critical load is based on modeled or measured dose-response data, while a target load can be based on political, economic, spatial, or temporal considerations in addition to scientific information. Defining the critical and target loads for areas within the national forest helps resource managers communicate the effects of air pollution on resources to Forest Service decision makers as well as to air regulators. At this time there are no known target loads set for this area.

There has been limited air quality data collected for the Chugach National Forest. However, lichen community data from the Tongass National Forest collected by the regional air program and Forest Inventory and Analysis (FIA) program shows that species overlap with western Oregon and

Washington (Region 6) is probably sufficient to apply those nutrient N critical loads to Region 10 until region-specific critical loads can be established (Pardo et al. 2011). Based on existing literature (Geiser et al. 2010) and a recent study to calibrate dry weight lichen nitrogen concentrations with nitrogen deposition in Alaska, Oregon, Washington, and California (Root et al. 2013), a conservative nutrient N critical load for the Chugach National Forest would be between 2.7 and 4 kg per hectare per year.

In 2012, Forest Service ecology and wilderness specialists revisited lichen biomonitoring plots established in 1993 and 1994 in the Nellie Juan-College Fiord Wilderness Study Area. The work was part of a planned two-year effort to re-survey lichen communities and collect lichens for elemental analysis at 21 existing plots and create up to eight new plots in the wilderness study area. Re-visiting existing plots enables the Forest Service to: (1) determine if baseline air quality conditions have changed; (2) establish thresholds for 27 contaminants in lichens for the Chugach National Forest (Dillman et al. 2007); and (3) track changes in air quality over time indicated by shifts in lichen community composition or contaminant levels. Establishing new plots in specific areas helps the Forest Service address air quality concerns that have arisen since establishing the 1993 and 1994 plots. The community identification element of the work is also a cost-effective way to monitor forest vegetation community changes related to air quality and climate change. Results of this monitoring are included in a multi-regional (Alaska, Oregon, and Washington) lichen monitoring database. These data have been used to suggest critical loads for nutrient nitrogen (N) and to develop better understanding of lichen and forest community dynamics in response to acidifying and fertilizing nitrogen and sulfur-based air pollutants.

A recent study by Shirokauer et al. (2013) suggests that acidic deposition from local sources of nitrogen and sulfur oxides is likely to be more important than local or long distance transport of nutrient nitrogen as ammonium nitrates and sulfates. This is especially true in areas with frequent inversions and docking ports where ships are continuously running their generators.

Greenhouse Gases (GHG)

The principal source of Alaska's anthropogenic GHG emissions is residential, commercial, and industrial fuel use, accounting for 49 percent of total State gross GHG emissions in 2005. Nearly 85 percent of the residential, commercial, and industrial fuel use sector emissions are contributed by the industrial fuel use subsector. The next largest contributor to total gross GHG emissions is the transportation sector, which accounted for 37 percent of the total State gross GHG emissions (Alaska Greenhouse Gas Inventory and Reference Case Projections, 1990-2020 Center for Climate Strategies July 2007). According to the EPA's National Emissions Inventory, annually, wildfires in Kenai Peninsula and Valdez-Cordova boroughs emit about 40,375 tons of methane and 8,294,732 tons of carbon dioxide, (tables 66, 67, 68) , and wildfires are the largest source of GHG in the counties.

Carbon Sequestration

Live trees in the forests of the Chugach National Forest are currently a carbon sink (store more carbon than they release), sequestering an estimated 150 thousand metric tons aboveground per year. The magnitude of carbon release from the decomposition of dead trees is presently unknown forestwide (USDA 2014a).

Compared to the 1999 to 2003 time period, overall aboveground live tree carbon within the national forest increased 4.6 percent during the 2004 to 2010 time period (Barrett 2014).

The total carbon pool within the boundary of the Chugach National Forest (excluding carbon in the ocean) is estimated at about 493 million metric tons (Mt) (USDA 2014a). There is about 6.5 times more carbon estimated to be belowground (428 million metric tons) than aboveground (66 million metric tons) (USDA 2014a).

Aboveground Carbon

Estimates of aboveground carbon in forest trees (Barrett 2014), forest vegetation, shrubland vegetation, and herbaceous vegetation are summarized here. Belowground carbon estimates are at the end of this section.

Forest Tree Carbon

Barrett (2014) provides information on the storage and change of aboveground carbon in live and dead trees within forest vegetation of the Chugach National Forest. The estimates are derived from remeasured inventory plots installed by the Forest Inventory and Analysis program. These data primarily represent unmanaged forest conditions as less than three percent of the plots had a record of past silvicultural activity. Excluding the wilderness study area, the carbon stores reported by Barrett (2014) is 98.9 tons per hectare of forest vegetation. Tree carbon is split as 84 percent live trees, 6 percent snags, and 10 percent downed logs. By geographic area, carbon densities are estimated at 75.2, 103.4, and 118.8 tons per hectare for the Kenai Peninsula, Prince William Sound, and Copper River Delta, respectively. Barrett (2014) also provides carbon mass information broken down by species and forest type.

In addition, to assess change, Barrett (2014) compared live and dead tree carbon for inventories from two time periods: 1999 to 2003 and 2004 to 2010. There was an overall increase in live tree carbon of 4.6 percent between the two time periods. These figures are equivalent to an annual increase of 0.8 percent, 150 thousand metric tons per year for forest vegetation, and 619 kilograms per forest hectare per year.

Also, in white spruce stands on the Kenai Peninsula, about 47 percent of the above-ground carbon in trees is stored in snags primarily killed by the spruce bark beetles in the 1990s (Andersen 2011).

When carbon is removed from forests through harvest, a portion of the harvested carbon is stored in wood products, often for many decades. Data on carbon pools associated with harvested wood is only available for the Chugach and Tongass National Forests combined. This carbon pool currently is contributing to atmospheric carbon. In other words, the carbon pool associated with harvested wood is declining because decay of products harvested between 1909 and 2011 exceeds additions of carbon to the pool. Total forest carbon, on the other hand, is a function of both harvested wood products and ecosystem carbon, which may have increased in the study area during the study period (Loeffler et al. 2012).

Forest, Shrubland, and Herbaceous Vegetation Carbon

Estimated carbon stores for forest, shrubland, and herbaceous vegetation in the three geographic areas are displayed in table 68. The forest, shrubland, and herbaceous vegetation groupings are aggregates of national land cover database (NLCD) classes (see table 69). Estimates of carbon stores for forest vegetation by geographic area are totals for trees reported by Barrett (2014) plus weighted average totals for other plants (non-trees) in closed and open needleleaf forests in southeast Alaska reported by Mead (1998).

Table 68. Estimates of carbon stores (tons per hectare) rounded to the nearest whole number by forest, shrubland, and herbaceous vegetation in the geographic areas

Vegetation	Copper River Delta	Kenai Peninsula	Prince William Sound
Forest	121	77	105
Shrubland	7	4	6
Herbaceous	1	1	1

Table 69. Aggregation of national land cover database classes into the forest, shrubland, and herbaceous vegetation groupings used in the estimation of carbon stocks

Vegetation	National Land Cover Database Classes
Forest	Evergreen forest
	Deciduous forest
	Mixed forest
Shrubland	Shrub/scrub
	Dwarf shrub
	Woody wetlands
Herbaceous	Grassland/herbaceous
	Sedge/herbaceous
	Emergent herbaceous wetlands

The total amount of carbon held in aboveground vegetation within the boundary of the Chugach National Forest is estimated to be about 66 million metric tons. Nearly 60 percent of this pool resides in forest vegetation in the Prince William Sound Geographic Area (see table 70). As a caveat, it is likely that the national land cover database is classifying more shrubland to forest than the Forest Inventory and Analysis (FIA) database. Therefore the carbon mass values are probably lower for national land cover database forestland than for FIA database forestland (Barrett pers. comm. 2013).

Table 70. Land area and estimated carbon pool (millions of metric tons) by forest, shrubland, and herbaceous vegetation in the Kenai Peninsula, Prince William Sound, and Copper River Delta geographic areas aggregated across national land cover database types

Vegetation	Copper River Delta	Kenai Peninsula	Prince William Sound	National Forest Totals
Land Area* (hectares)				
Forest	122,934	92,783	372,798	588,515
Shrubland	249,599	230,728	291,988	772,315
Herbaceous	33,993	4,180	5,226	43,400
Totals	406,526	327,691	670,012	1,404,230
Carbon Pool (millions of metric tons)				
Forest	14.88	7.14	39.14	61.16
Shrubland	1.75	0.92	1.75	4.42
Herbaceous	0.03	0.004	0.01	0.04
Totals	16.66	8.07	40.90	65.63

*Values represent total land area within the outer boundaries of the Chugach National Forest; land in other ownership within the outer boundary are included in the estimates.

Carbon Sink or Carbon Source

Processes that release CO_2 into the atmosphere are called carbon sources, while processes that absorb it are called carbon sinks. A sink absorbs more carbon that it gives off, while a source emits more than it absorbs. Live trees are the only pool of carbon within the national forest for which carbon sequestration rates have been estimated. Barrett (2014) indicates that live trees in the forests of the Chugach National Forest are currently a carbon sink, sequestering an estimated 150 thousand metric tons per year. The magnitude of carbon release from the decomposition of dead trees is presently unknown forestwide. The decomposition rate of dead spruce trees (snags and logs) on the Kenai Peninsula is estimated at less than two percent per year (Harmon et al. 2005).

Future Trend in Sequestering and Storing Carbon

The magnitude of potential effects of climate change on carbon pools across the Chugach National Forest is not currently well known. Current understanding, however, suggests that the temperate coastal rainforest, which dominates carbon storage for the Chugach National Forest, is unlikely to experience significant change in structure or composition during the next 20 to 50 years. Temperate coastal rainforests rarely experience fire. The trends described previously for carbon sequestration represent a reasonable scenario for trends in carbon sequestration during the plan period within the national forest.

Opportunity to Influence Trends

The spruce bark beetle infestation previously referred to resulted in extensive hazardous fuels accumulation and altered potential for large wildfires (potential source of carbon to the atmosphere). In response to altered forest conditions on the Kenai Peninsula, an interagency committee of Federal, state, local, and Alaska Native land managers developed an action plan for fire prevention and protection, hazardous fuels reduction, ecosystem restoration, and community assistance (Kenai Peninsula Borough 2004). As part of this action plan, mechanical and prescribed fire fuel reduction is occurring on about 100,000 acres (40,468 hectares) of the Kenai Peninsula with much of the effort occurring outside the national forest.

Influences on Carbon Stocks

Biomass and carbon accumulation, or net ecosystem carbon balance, is a function of the interaction of vegetation growth with environmental drivers, especially moisture, nutrient, temperature, radiation, and disturbance, such as fires, avalanches, landslides, wind throw, floods, and insect or disease outbreaks (Chapin et al. 2006). Assessing system drivers and stressors on vegetation was considered previously. Forest Service management has limited capability to affect most of these variables across broad areas. As referred to previously, hazardous fuel reduction is ongoing in response to the spruce bark beetle infestation on the Kenai Peninsula. Much of that fuel reduction involves burning of mechanically piled wood. Such burning is an immediate source of carbon to the atmosphere. Beyond the plan period, changes in vegetation, such as alpine afforestation and development of vegetation on formerly glaciated lands, are expected to influence carbon stocks.

Belowground (soil) Carbon

Current concerns regarding carbon cycling have focused attention on the role of forests and soils in the storage and cycling of carbon in many key biomes. Carbon accrues in forest ecosystems through photosynthesis and cycles within the system until it is lost through respiration, decomposition, or as dissolved organic carbon or becomes captured by the system as long-term, relatively immobile carbon (Schimel et al. 2015). Large quantities of carbon are stored in the soil and forest floor, and soil usually represents a larger carbon pool than above-ground biomass on forest and woodland sites, particularly in northern climes where cooler temperatures result in lower decomposition rates. Soil carbon accumulates in cooler temperate, boreal, and arctic environments. This makes soil carbon assessment more important in those systems. Estimates prepared by the U.S. Geological Survey for the conterminous United States indicate that total soil organic carbon storage is 73 billion metric tons (PgC), and total forest biomass carbon is 17 billion metric tons (Sundquist et al. 2009).

Soil organic carbon includes carbon compounds in the forest floor litter layer and the mineral soil to a depth of one meter (or depth to bedrock if the soil is shallower than one meter). In the case of organic soils, the entire depth of the soil to a meter or more may be composed entirely of partially decomposed plant materials (D'Amore et al. 2015).

Soil organic carbon was estimated for the Chugach National Forest using data from the Natural Resource Conservation Service Revised Alaska State Soil Survey Geographic Database (STATSGO) (see table 71) (D'Amore et al. unpublished). Total belowground carbon in the Chugach National Forest, excluding carbon in the ocean is estimated to be 427.6 million metric tons. By geographic area, the estimated soil organic carbon is 103.04 million metric tons on the Kenai Peninsula, 217.6 million metric tons in Prince William Sound, and 121.37 million metric tons on the Copper River Delta (see table 72).

Table 71. Estimated soil organic carbon stored in the upper 39 inches (100 centimeters) of soil by landtype associations in the Chugach National Forest

Landtype Association Alphanumeric Code and Name		Min	Max	LTA Total	
	Acres	Pounds per acre	Pounds per acre	millions of metric tons	percent
00 Glaciers and Icefields	2,257,583	0.28	87.51	22.54	5.1
10 Mountain Summits	1,210,656	0.43	166.40	74.44	16.8
30 Mountain sideslopes	1,129,667	0.40	166.40	111.94	25.3
40 Depositional slopes	172,757	0.40	166.40	14.72	3.3
60 Glacial Moraines	61,659	1.60	87.51	4.84	1.1
70 Coastal Landscapes	345,300	0.40	161.41	12.55	2.8
80 Fluvial valley bottom	407,920	0.40	166.40	36.10	8.2
90 Hills and Plateaus	843,993	0.40	166.40	141.40	32
CW Clear water	46,280	0.55	166.40	3.58	0.8
GW Glacial water	119,830	1.60	166.40	5.49	1.2
SW Ocean salt water	2,989,184	0.40	166.40	14.84	3.4
Totals	9,584,830	NA	NA	442.44	100

Note: Acreage figures are derived from the LTA GIS layer and may be different than other acreage values displayed for other resources. All total carbon values are based on present acreage figures.

Table 72. Summary of estimated total organic carbon stored in soils of the Kenai Peninsula, Prince William Sound, and Copper River Delta geographic areas of the Chugach National Forest

Landtype Association Alphanumeric Code and Name	Copper River Delta		Kenai Peninsula		Prince William Sound	
	acres	millions of metric tons	acres	millions of metric tons	acres	millions of metric tons
00 Glaciers and Icefields	866,462	8.64	147,933	1.48	1,243,188	12.4
10 Mountain Summits	196,933	12.1	407,011	25.02	606,713	37.29
30 Mountain sideslopes	242,541	24.01	367,319	36.36	519,807	51.46
40 Depositional slopes	33,586	2.86	124,141	10.57	15,030	1.28
60 Glacial Moraines	47,929	3.77	5,237	0.41	8,493	0.67
70 Coastal Landscapes	334,296	12.14	1,513	0.05	9,491	0.34
80 Fluvial valley bottom outwash	328,240	29	45,839	4.05	33,840	2.99
90 Hills and Plateaus	116,451	19.48	137,127	22.94	590,415	98.77
CW Clear water	5,974	0.46	23,773	1.84	16,534	1.28
GW Glacial water	118,987	5.44	844	0.04	zero	zero
SW Ocean salt water	695,622	3.45	55,863	0.28	2,237,699	11.11
Totals	2,987,021	121.37	1,316,599	103.04	5,281,210	217.6

Three landtype associations make up 75 percent of the total soil organic carbon storage in the national forest (see table 71). The mountain summit, mountain sideslopes, and hills and plateaus landtype associations dominate the carbon storage for the Chugach National Forest. The lowest storage is in clear water landtype associations, which have soil carbon storage similar to moraines and glacial water. The soil organic carbon in the water landtype associations is derived from map units that contain scrub vegetation, flood plains, and subaqueous vegetation soils. These areas, while not extensive, do contain fairly dense carbon stocks in some cases.

Forest soil carbon storage is a significant component of the global carbon cycle. Soil carbon is important for sustaining forest productivity. Carbon or soil organic matter has numerous interactions with other soil properties and supports essential ecosystem functions (Grigal and Vance 2000; Jurgensen et al. 1997; Nave et al. 2010; Powers et al. 2005), including:

- Nutrient cycling, by providing sustenance for populations of soil fauna and fungi active in decomposition; nearly all nitrogen and phosphorous in forms available to plants comes from organic matter
- Contributing much of the soil's cation exchange capacity, and binding harmful metals
- Maintaining soil structure, which influences aggregate stability, gas exchange, water infiltration, and storage, buffers fluctuations in soil temperature; aggregate stability and macropore structure help limit compaction and erosion
- Providing specialized microsites with accumulations of soil organic matter required by certain plant species for germination and root development

Carbon compounds are inherently unstable and owe their abundance in soil to biological and physical environmental influences that protect carbon and limit the rate of decomposition (Schmidt et al. 2011). Large quantities of soil organic matter accumulate in environments, such as wetlands, where the rate of decomposition is limited by a lack of oxygen, and high-altitude and high latitude sites where temperatures are limiting. Globally, about 98.5 percent of the carbon in peatlands is in peat versus about 1.5 percent in vegetation (Gorham 1991). Peatlands are common within the Chugach National Forest. Forest Service management practices have the potential to alter the amount and types of soil organic matter, but because inherent soil or site characteristics sometimes compensate for or mitigate the effects of soil organic matter change, the direct impacts on productivity may be unclear (USDA 2014a).

Environmental Consequences

Effects Common to all Alternatives

Implementation of any of the alternatives considered in detail would not substantially change the existing air quality of the national forest. The alternatives have no significant differences that would affect air quality. Air quality is temporarily lowered on roads and at developed recreation sites by vehicle emissions, dust, and smoke from campfires. Air quality is also temporarily lowered during burning, both by wildland and prescribed fires.

Management of the Chugach National Forest under the 2002 forest plan would continue to result in continued carbon sequestration unless there is an increase in large-scale disturbance. The 2002 forest plan does not have an allowable sale quantity for commercial timber sales, and there is little harvesting of trees for personal use fuelwood, lumber/house logs, commercial fuelwood, wildlife habitat improvement, and special forest products.

The largest pool of aboveground carbon within the Chugach National Forest is in the forests of Prince William Sound (see table 70) and a large portion of this geographic area is in the wilderness study area. The wilderness study area is managed to maintain the presently existing character of the area. Continuing such management of the wilderness study area would likely contribute towards maintaining the large carbon pool in Prince William Sound. Similarly, since 2002 forest plan direction limits vegetation management to management area prescription categories 3, 4, and 5 (percent of the national forest), continuing such management would marginally reduce carbon pools locally but not significantly reduce the substantial carbon sequestration occurring forestwide.

National Ambient Air Quality Standards

In all alternatives, anthropogenic emissions from Forest Service administrative functions, recreation, transportation (including cruise ships), special uses, mining, and vegetation management would vary little and there would be no significant differences between the alternatives. Dust impacts from roads under all alternatives would not substantially change existing air quality within the national forest except very locally and on a very intermittent basis. Hazardous fuels reduction by mechanical means would continue at a small scale. Smoke from unplanned wildfires would continue to be managed as it is. Prescribed burning and managed wildfire would continue to be required to conform to or comply with agency policy and state air quality control regulations.

Regional Haze

For all alternatives the risk of emissions from the Chugach National Forest decreasing visibility in nearby Class I airsheds are estimated as low. Cruise ships in the College Fiord and Prince William Sound are expected to continue to reduce visibility in the areas and the Nellie Juan-College Fiord wilderness study area and may impede successful implementation of the state regional haze plan (USDA 2014a).

Wilderness Air Quality Values

All alternatives are expected to result in no significant impacts to wilderness area air quality related values from forest activities and uses. A conservative nutrient N critical load for the Chugach National Forest is between 2.7 and 4 kg per hectare per year and would remain within acceptable levels and produce no significant impact to aquatic, vegetation, and soil resources.

Greenhouse Gases (GHG)

Anthropogenic GHG emissions from Forest Service administrative functions, recreation, transportation (including cruise ships), special uses, mining, oil and gas, and vegetation management are expected to vary little among alternatives and there would be no significant differences between the alternatives. Smoke from unplanned wildfires would continue to be managed as it is; planned wildfire would not be emphasized and/or promoted beyond what has already been achieved and planned for. Prescribed burning and managed wildfire would continue to be required to conform to or comply with agency policy and state air quality control regulations. Climate change will cause deforestation (as forest pathogens kill trees) and afforestation (as trees occupy current alpine environments and areas recently occupied by glaciers) that will affect greenhouse gas emissions, see carbon sequestration section (Hollingsworth et al. 2017).

Cumulative Effects

Cumulative effects to air quality include (1) air contaminations from urban communities, (2) dust and vehicles emission from people traveling along Federal, State, and national forest highways and roads, and (3) burning from both wildfires and prescribed fires within the national forest and on adjacent Federal, State, and private lands, especially on the Kenai Peninsula. All areas within the national forest are currently in compliance with National Ambient Air Quality Standards. Any cumulative effect most likely would be temporary and would not be expected to substantially degrade long-term air quality of the national forest. Air quality could be affected in the event of future mineral exploration and development and increases in cruise ship emissions.

Analytical Conclusions

Table 73. Summary of consequences by alternative

Measurement Indicator	Alternative A No Action	Alternative B	Alternative C	Alternative D
National Ambient Air Quality Standards	No change from 2002 forest plan	Same as A	Same as A	Same as A
Regional Haze	No change from 2002 forest plan except for recently documented reduction in visibility caused by cruise ships	Same as A	Same as A	Same as A
Wilderness Air Quality Value	No change from 2002 forest plan	Same as A	Same as A	Same as A
GHG	No change from 2002 forest plan except for possible increase/ decrease in emissions due to climate change	Same as A	Same as A	Same as A
Carbon Sequestration	No change from 2002 forest plan except for possible increase/ decrease in sequestration due to climate change	Same as A	Same as A	Same as A

Geology

Introduction

The purpose of the geology discussion in this draft environmental impact statement is to describe the natural geologic setting of the national forest and to highlight various geologic features, landscapes, and processes that affect management decisions.

Methodology

Spatial Scale

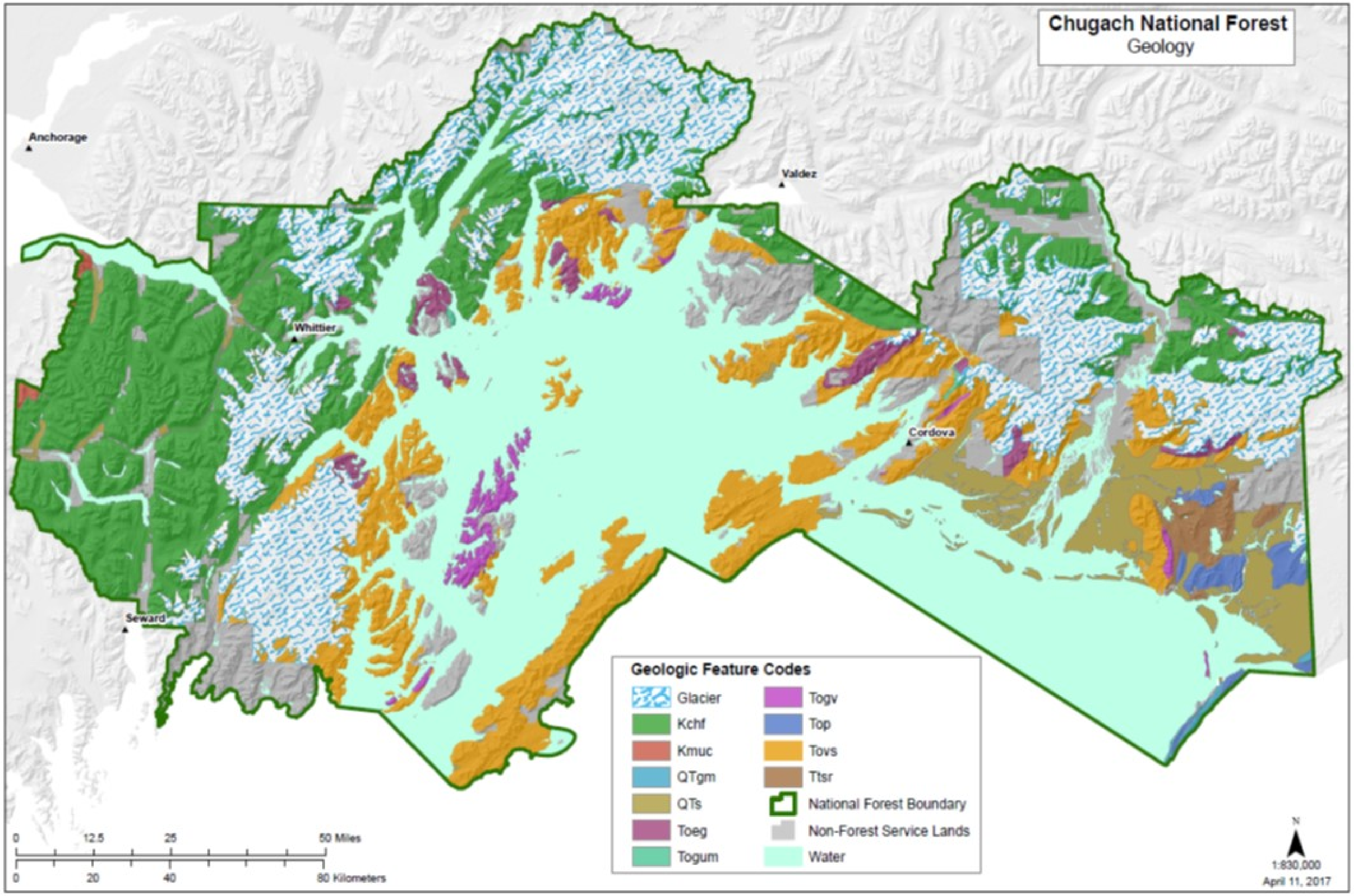
The geographic boundary considered in this geology report is all areas within the greater national forest boundary regardless of land ownership because geology and geologic processes do not recognize political, survey, or other boundaries. The Forest Service's geology GIS layer has been updated with the data from a compilation geologic map for the entire state of Alaska (Wilson et al. 2015) (see map 17).

Temporal Scale

The temporal scale for all but the most catastrophic of the geologic processes (i.e., earthquakes) is measured in millions of years and is thus not a practical consideration for a 15-year plan period. No management decision will affect the outcome of geology or geologic processes so no attempt is made to provide a temporal scale for this analysis.

Table 74. Legend for map 17

Geologic Code	Description
Kchf	Chugach accretionary complex (Cretaceous)
Kmuc	McHugh and Uyak Complexes and similar rocks (Late Cretaceous)
QTgm	Yakataga and Tugidak Formations (Quaternary and uppermost Tertiary)
QTs	Unconsolidated and poorly consolidated surficial deposits (Quaternary or late Tertiary)
Toeg	Granitic rocks in southern Alaska (Tertiary, Oligocene and Eocene)
Togum	Mafic and ultramafic rocks of the Valdez and Orca Groups (Tertiary, Eocene to Paleocene)
Togv	Volcanic rocks of the Orca Group and Ghost Rocks Formation (Tertiary, Eocene to Paleocene)
Top	Redwood and Poul Creek Formations (Tertiary, Miocene to Eocene)
Tovs	Sedimentary and volcanic rocks of the Orca Group, undivided (Tertiary, Eocene to Paleocene)
Ttsr	Sedimentary rocks of eastern Prince William Sound (Tertiary, Eocene)



Map 17. Geologic map of the Chugach National Forest (Wilson et al. 2015)

Analysis Methods and Assumptions

The geology is preexisting and geologic processes will continue to occur regardless of management considerations within this analysis or decisions made as a result of this analysis, therefore no specific methods will be applied for this resource. The assumption is that geologic processes will continue at a rate consistent with geologic history with episodes of catastrophic events (i.e., earthquakes, volcanism, massive landslides, etc.) and that any management decisions that will alter or otherwise affect the erosional processes will apply BMPs and that those implemented BMPs will be effective at mitigating rates of erosion.

Affected Environment

The Chugach National Forest is part of southcentral Alaska, one of the more tectonically active areas on the earth. The national forest is contained almost entirely within the Kenai-Chugach mountain system, which is a topographically continuous mountain chain extending from Kodiak Island up the Kenai Peninsula and around Prince William Sound and connecting to the Saint Elias Range to the east. The principle fault systems in the area follow the same curved trend as the Kenai-Chugach Range. The Border Ranges fault (originally a subduction-zone thrust, subsequently reactivated) lies in the lowlands along the mountain front and nearly parallels the western border of the Chugach National Forest (Karl et al. 1997).

The Kenai-Chugach Mountains consist of ocean-floor rocks of the Chugach Terrane. These rocks originated in the paleo-Pacific, and were accreted to the continental margin during Jurassic and Cretaceous geologic time. The range is composed primarily of, or underlain by, folded and faulted, weakly metamorphosed shales, greywackes, and volcanic rocks of Mesozoic age (Valdez Formation). In the eastern half of the national forest, younger, Tertiary sandstones, siltstones, shales and submarine volcanic rocks are the predominant rock types. These weakly metamorphosed sediments of both Mesozoic and Tertiary age are intruded in several locations by Tertiary granitic rocks (Tysdal and Case 1979).

The tectonic setting of the area has been an interplay of compressional and translational tectonic processes for more than 150 million years. Rapid uplift of southcentral Alaska has resulted from modern subduction of the Pacific Plate beneath the North American Plate: the seismic belt, which rings the Pacific Ocean basin (Blanchet 1983). Earthquakes are common. Larger earthquakes, such as the March 27, 1964 earthquake, had substantial effects not only on the topography, but the ecosystems as well. Rock type and geologic processes work together to affect the surficial geology of the Chugach National Forest. Topography, which results from both of the above factors, in turn affects environmental elements, such as slope, soil types, weather, drainage patterns, and vegetation types.

Approximately 2 million years ago, summer temperatures became slightly cooler than they are today. Great glaciers filled the valleys of high latitudes and joined into huge ice caps that spread over much of southern Alaska, Prince William Sound, and the Chugach-Kenai mountains. The Pleistocene ice age ice caps waxed and waned and glaciers advanced and retreated. The ice sheets and glaciers reworked the topography of the land by rounding mountains, scouring bedrock, depositing glacial sediments, and carving U-shaped valleys and submarine trenches. Unconsolidated sediments remain in some areas and include glacial till (ice-contact deposits), glacial outwash, and glacial marine sediments. During the last glacial maximum, ice flowed all the way to the continental shelf. As glaciers retreated worldwide, the ice sheet receded first at coastal margins, then north and eastward along major channels and valleys into the mountains. Deglaciation was rapid and largely complete by around 12,000 years ago.

Since deglaciation, coastlines have shifted dramatically due to tectonic events, worldwide sea level changes, and land rebound in the absence of the glaciers’ massive weight. Elevated marine beaches and deltas along the coastline indicate an uplift of the land relative to the sea since the last glacial maximum.

In the upper portions of the Copper River Delta, extensive glaciofluvial sediments were deposited. These stratified, unconsolidated sediments are formed from silts, sands, gravels, and cobbles, which have been worked by glacial melt water streams. Glaciofluvial deposits are found in most valley bottoms on the national forest and are recent in age. The most extensive deposits include the upper Copper River Delta, the base of the Scott and Sheridan glaciers near Cordova, the Resurrection River valley near Seward, the Nellie Juan River near Kings Bay, the Lowe River near Valdez, and the Twentymile River near Portage (Blanchet 1983).

On the lower Copper River Delta and extending eastward along the Gulf of Alaska Coast are recent (Quaternary) coastal deposits formed by a combination of actions by glacial, riverine, and oceanic processes. The deposits were formed by interlayering of alluvial sediments, marine sediments, and glacial drift. Topographically the deposit takes on landforms, such as deltas, beaches, spits, and bars (Blanchet 1983).

Paleontological resources are scarce within the Chugach National Forest; most original sedimentary rocks have been metamorphosed to some degree and sedimentary features and fossils have been obliterated. A few poorly preserved fossils and trace fossils have been documented from scattered locations around Girdwood, across the Kenai Peninsula, and western Prince William Sound. Better preserved fossils are known from younger, unaltered sedimentary rocks from the eastern portion of the national forest, most notably from rocks of Tertiary age from onshore Gulf locations and Middleton, Wingham, and Kayak islands (Nelson et al. 1985). Microfossils are known from numerous locations within the national forest and help to provide age dates to many geologic rock units.

Recently, one known fossil location near the community of Hope has produced additional specimens that have greatly increased the known faunal assemblage from that location, including *terrebelid* trace fossils, two species of *Inoceramya*, a starfish, a sea biscuit, a heteromorphic ammonite (cephalopod), and an extremely large clam specimen. This late Cretaceous faunal assemblage is currently undergoing a detailed review.

Paleontological resources are managed and protected on Federal lands per Subtitle D of the Omnibus Public Land Management Act of 2009 (Public Law 111-11). The Forest Service recently issued new rules for paleontological resource preservation that became effective on May 18, 2015 (80 [74] Federal Register 21587-21638). The new rule addresses the management, collection, and curation of paleontological resources from NFS lands, including management using scientific principles and expertise, collecting of resources with and without a permit, curation, confidentiality of specific locality data, and penalties for illegal activities.

Landslides are categorized as geologic hazards by the Forest Service and are extremely common within the national forest and most commonly occur on slopes that exceed the angle of repose (approximately 35 to 40 percent). Landslides are gravity induced features that are often triggered when loose or unconsolidated materials that have accumulated, slide or flow downslope, generally accumulating at the toe of the slope in a fan, as colluvium. Liquefaction of soils can cause landslides in areas with gentler slopes especially when a bedding plain or rock cleavage is parallel to the slope. Avalanches effectively act as landslides, carrying soil and rock to the colluvial fan at the toe of the slope when snow and ice gravity flow down the slope. The effect on the landscape by landslides and avalanches is a vertical path along the slope where vegetation is disrupted and soil does not have the opportunity to accumulate.

The geology and the effects of geologic processes on the system as a whole contribute substantially to the grandiose scenic pleasantries of the national forest; however, there are no geologic features that are specific and unique. The entire breadth of scenery is dominated by the geologically imposed landscape.

Environmental Consequences

None of the alternatives would result in any consequences to geologic resources or processes.

Cumulative Effects

None of the alternatives would result in any cumulative effects to geologic resources or processes.

Analytical Conclusions

None of the alternatives would result in any consequences to geologic resources or processes.

Soils

Introduction

This section analyzes the potential impacts (indirect and cumulative effects) of the alternatives on the soil resource. Information about the soil resource provides planning teams with an understanding of the inherent capability of different portions of the landscape to meet a variety of land management objectives.

Methodology

Spatial Scale (indirect and cumulative effects analysis areas)

The characterization of soil resources is the area defined by the Chugach National Forest boundary and more specifically by the landtype associations within the Chugach National Forest. This is because management activities rarely affect soil condition on adjacent land and because the landtype associations are mapped consistently across the entire national forest. Soil productivity is a site specific attribute of the land and soil productivity of one area is not dependent on the productivity of an adjacent area.

Temporal Scale

The analysis focuses on activities that could have measurable impacts to soils during the next plan period of approximately 15 years.

Past, Present, and Future Activities used in the Analysis

Past management activities and disturbance within the Chugach National Forest, including timber harvest, silvicultural activities, grazing, road building, and wildland fire, can have cumulative effects on the soil resource. Mining and special uses have also occurred within the Chugach National Forest. Impacts to soils from past management include changes in soil productivity and soil stability as discussed in the following text.

There are no foreseeable activities that would vary from present activities other than the potential changes to the recreation opportunity spectrum. Present activities include timber harvest, fuel reduction (prescribed fire and mechanical), road construction and maintenance, silvicultural treatments, special use permits, and providing recreational opportunities. There is also the potential for wildland fires (suppression and for resource benefit). Foreseeable and present actions also include stream, meadow, and wetland restoration as well as road decommissioning and obliteration.

Measurement Indicators

Forest Service Manual chapter 2550 Soil Management directs soil resource management on NFS lands. The objectives of the national direction are 1) to maintain or restore soil quality on NFS lands and 2) to manage resource uses and soil resources on NFS lands to sustain ecological processes and function so that desired ecosystem services are provided in perpetuity.

Soil function is defined as an ecological service, role, or task that soil performs. The Forest Service manual identifies the following six soil functions: soil biology, soil hydrology, nutrient cycling, carbon storage, soil stability and support, and filtering and buffering. In order to provide multiple uses and ecosystem services in perpetuity, these six soil functions need to be active and effectively working. These six soil functions play an integral role in assessing the two main indicators: soil quality and productivity and soil stability.

Within the Chugach National Forest, recreation use and mining operations affect soil productivity and soil stability and can convert productive sites and soils to an essentially non-productive site for more than 50 years. This can be used as an indicator for soil productivity and soil stability to compare alternatives.

Analysis Methods and Assumptions

Soil resources within the Chugach National Forest were analyzed using geographic information system (GIS) data; soils survey data; corporate soils data layers, including geology layers; a variety of reports and assessments completed for the 2002 forest plan revision process; the forest plan assessment; and professional experience and judgment using scientific literature. Several specialists from the Chugach National Forest and the soil scientist from the Tongass National Forest were consulted.

No field observations were performed and no site-specific soils information was collected to support this analysis. Very little soil monitoring data is available for the Chugach National Forest. There is no GIS data locating potentially sensitive soils or soil stability maps displaying landslide or erosion potential across the landtype associations within the national forest.

Assumptions:

- Current Region 10 Soil Quality Standards apply to all alternatives (USDA 2006)
- Current forest management practices, including timber harvesting, watershed restoration projects, system road mileage, special use permits, and noxious/invasive plant treatments, will continue at a similar rate to the current rate and will not change across alternatives
- Soil resource protection measures and State of Alaska and national best management practices (BMPs) (USDA 2012) would continue to be applied for all alternatives

Affected Environment

Landtype Associations

The Chugach National Forest includes three distinct geographical areas: the Copper River Delta, the Kenai Peninsula, and the Prince William Sound. The dominant geology of the national forest is folded and faulted, weakly metamorphosed shales, greywackes, and volcanic rocks of the Mesozoic age (Hohensee n.d.; USDA 1978; USDA 1980). The most recent event that shaped the soils and landforms of the Chugach National Forest was glaciation that occurred approximately two million years ago creating rounded mountains, glacial valleys, glacial till, outwash and marine sediments.

The national forest has been delineated into eight landtype associations (Davidson 1998) that depict broad patterns of soil families or subgroups, the potential natural vegetation series, and, on occasion, show successional dynamics (Winthers et al. 2005). A general description of the soil characteristics by landtype association follows:

- *Glaciers and ice fields:* Some surface deposited soil (ice and rocks dominate).
- *Mountain summits:* Shallow coarse textured soil between rock outcrops. These soils are sensitive to disturbance because they are thin and easily displaced.
- *Mountain side slopes:* Medium textured soil with moderate amounts of coarse fragments often with substantial ongoing erosion.
- *Depositional slopes:* Both deep, well drained, medium textured soil with variable amounts of coarse fragments and areas of fine textured soil that pond water and form wetlands.
- *Glacial moraines:* Poorly- to well-drained soils with coarse fragments consisting of non-sorted gravel, cobbles, and stones in a moderate to fine textured matrix. Poorly drained and somewhat poorly drained soils can be highly susceptible to compaction due to wetness.
- *Coastal landscapes:* Both deep, excessively drained sand on beaches and dunes exposed to continuous erosion and deep, poorly drained silts on tidal flats.
- *Fluvial valley bottom outwash:* Dominated by deep, stratified soils with rounded coarse fragments. Pond water or wetlands may occur on fine textured soil. High water tables are common.
- *Hills and plateaus:* Both coarse to medium textured soil with 15 to 65 percent coarse fragments and organic soils in basins between hills where the organic material rests on glacial till or bedrock.

The national forest is dominated by glaciers and ice fields, which comprise 38 percent of the land. Wetlands are also a major component of the Chugach National Forest. Within wetlands, organic soils are present with organic layers thicker than 40 centimeters (15.7 inches). Wetlands make up about 23 percent of the Chugach National Forest. Wetlands are generally components of the different landtype associations.

Soil Productivity and Soil Quality

Soil quality is the capacity of a specific kind of soil to function within natural or managed ecosystem boundaries to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation and ecosystem health. Soil productivity is defined as the inherent capacity of a soil to support the growth of specified plants and plant communities, or sequence of plant communities. Plant growth is generally dependent on available soil moisture, nutrients, texture, structure, organic matter, and the length of the growing season.

Soil porosity and soil organic matter are important components of soil productivity (Jurgensen et al. 1997). The soil organic component contains a large reserve of nutrients and carbon, and it is dynamically alive with microbial activity. The character of forest soil organic matter influences many critical ecosystem processes, such as the formation of soil structure, which in turn influences soil gas exchange, soil water infiltration rates, and soil water holding capacity. Soil organic matter is also the primary location of nutrient recycling and humus formation, which enhances soil cation exchange capacity and overall fertility. Organic matter, including the forest floor and large woody material, are essential for maintaining ecosystem function by supporting moderate soil temperatures, improved water availability and biodiversity (Page-Dumroese et al. 2010).

Soil porosity refers to the amount and character of void space within the soil. In a typical soil, approximately 50 percent of the soil volume is void space. Pore space is lost primarily through mechanical compaction. Three fundamental processes are negatively impacted by compromised soil pore space: gas exchange, soil water infiltration rates, and water holding capacity.

The most productive soils within the national forest are moderately well drained to well drained soils with medium texture and are found on older less active, alluvial fans and floodplains (landtype association 80) and on lower sideslopes, foot slopes, and terraces (landtype associations 30 and 40). Soils in the Prince William Sound area are generally more productive because the temperatures are more moderate with higher precipitation amounts. Key soil properties needed to support ecosystem integrity can be impacted by soil disturbance.

Harvesting

Past timber harvesting activities have occurred within the Chugach National Forest, but are not extensive. Most of the timber harvesting has occurred in the Cooper Landing area (early 1990s) on the Kenai Peninsula, on the Knowles Head land acquisition from the Tatitlek Native Village (1990 to 1995 in northeastern Prince William Sound, and on the west side of Montague Island (1970s). More recent harvesting activities have also occurred between 2008 and 2016 on approximately 3,571 acres and includes fuels treatments within the wildland urban interface and treatments to reduce the risk of catastrophic wildfire. No recorded harvesting activities have occurred within the Copper River Delta Geographic Area.

These treatments likely led to local areas of compaction, soil loss, and erosion, especially where skid trails and temporary roads were used. Some post-harvest soil monitoring has been conducted in the Cooper landing area and soil disturbance levels were measured between 18 and 33 percent (Davidson 1993), but no other post-harvest and activity monitoring is available for the national forest, so trends in soil disturbance are hard to describe. However, over time, practices have evolved to be more conscious of the impacts to soils; logging practices have shifted to less-impactive equipment (e.g., cable and skyline methods), and in current national forest management, soil restoration is included in the majority of projects in order to meet the desired conditions for the land.

The extent of impacts to soils can be influenced by soil texture and organic matter (Powers et al. 2005; Page-Dumroese et al. 2010) but often as confounding variables. For example, coarse textured soils appear resistant to compaction (Gomez et al. 2002) but also are nutrient poor and so are particularly at risk to the nominally least risky treatments that remove forest floor (Page-Dumroese and Jurgensen 2006; Page-Dumroese et al. 2010). Forestry research has underscored the importance of organic matter, documenting the soil benefits of downed wood (Harvey et al. 1987; Graham et al. 1994), forest floor, and soil organic matter (Jurgensen et al. 1997).

Prescribed Fire and Wildland Fire

Fires are an important ecological driver for portions of the Chugach National Forest, especially in the Kenai Peninsula Geographic Area. There have been several landscape scale fires throughout the national forest along with several human caused fires on approximately 60,590 acres. Prescribed fire and fuel reduction treatments have also occurred.

The effect to soil functions from fire are likely a result of burn severity but also the climate, topography and vegetation present on the site (Certini 2005). Within prescribed burn areas, litter layers and organic matter was likely kept intact and nutrient losses were likely minimal due to low to moderate burn severity in a controlled environment (Certini 2005). Wildland fires, however, are more unpredictable and burn severities tend to be higher, while loss of organic matter, soil cover, and soil microbial changes are more likely to occur (Certini 2005) along with increased erosion (Wondzell and King 2003; Larson et al. 2009), further reducing the nutrient pool available (Megahan 1990; Certini 2005). Nitrogen-fixing plants can colonize sites following fire and help restore Nitrogen in the ecosystem (Newland and DeLuca 2000; Jurgensen et al. 1997). Generally, if plants colonize sites following fire, nutrient levels can reach pre-fire levels quickly (Certini 2005). Charcoal deposited following fire adds carbon to the soil (DeLuca and Aplet 2008) and increases the carbon stores overall.

Roads and Trails (Off-highway and Over-snow Vehicle use)

Road building associated with timber harvesting, mining activities, and recreational activities within the national forest has impacted the soil resource and many of the historic roads remain on the landscape today. There are approximately 82 miles of NFS Roads currently open with 12 miles closed. There are 210 miles of state highways and other major state roads, but these roads are only on four percent of the national forest. Approximately 75 percent of the roads are on the Kenai Peninsula with 25 percent in the Copper River Geographic Area and none within the Prince William Sound Geographic Area.

Approximately 2,167 miles of trails are open to use across the national forest. Monitoring of OHV use occurred in 2008 and 2009. Portions of the Copper River Delta area were identified as having increased soil disturbance levels from OHV use. Monitoring has not occurred in other years.

Developed Recreation Sites

The use and development of recreation sites, such as campgrounds, cabins, administrative sites, day use facilities, parking lots, and viewing sites, are generally considered long term and the soils at these sites are unproductive or have very reduced productivity. Many sites have associated roads or trails and are intensively used. There are approximately 109 recreation sites.

Carbon Storage

Globally, more carbon is stored in soil than in the atmosphere and above-ground biomass combined (Yanni et al. 2003). Limiting factors of soil carbon storage are depth and rockiness of the soil. Carbon compounds are inherently unstable and owe their abundance in soil to biological and physical environmental influences that protect carbon and limit the rate of decomposition (Schmidt et al. 2011).

Soil organic matter is formed by the biological, chemical, and physical decay of organic materials that enter the soil system from sources aboveground (e.g., leaf fall, crop residues, and animal wastes and remains) and belowground (e.g., roots and soil biota). The organic compounds enter the soil system when plants and animals die and leave their residue in or on the soil. Soil organisms immediately begin consuming the organic matter; extracting energy and nutrients; and releasing water, heat, and carbon dioxide back to the atmosphere. Thus, if no new plant residue is added to the soil, soil organic matter would gradually disappear. If plant residue is added to the soil at a faster rate than soil organisms convert it to carbon dioxide, carbon would gradually be removed from the atmosphere and stored (sequestered) in the soil.

Large quantities of soil organic matter accumulate in environments such as wetlands, where the rate of decomposition is limited by a lack of oxygen, and high altitude sites where temperatures are limiting to decomposition. Most carbon in mineral soil comes from root turnover (Schmidt et al. 2011), although some is moved from the forest floor into upper mineral soil layers (Qualls et al. 1991). Soil carbon also plays a role in developing soil structure and soil stability, which influences water infiltration, reduces surface runoff, lowers sedimentation, and improves air infiltration into the soil to support plant root respiration and other soil biota.

Within the Chugach National Forest, soil organic carbon is estimated to be 427.6 million metric tons. By geographic area, the estimated soil organic carbon is 103.04 million metric tons on the Kenai Peninsula, 217.6 million metric tons in Prince William Sound, and 121.37 million metric tons on the Copper River Delta. Three landtype associations make up 75 percent of the total soil organic carbon storage in the national forest: the mountain summit, mountain sideslopes, and hills and plateaus landtype associations. The lowest storage is in clear water landtype associations, which have soil carbon storage similar to moraines and glacial water. The soil organic carbon in the water landtype associations is derived from map units that contain scrub vegetation, flood plains, and subaqueous vegetation soils. These areas, while not extensive, do contain fairly dense carbon stocks in some cases (USDA 2014a).

Landslides

Landslides are fairly common across the Chugach National Forest. They occur most frequently on slopes steeper than 72 percent (Julin 1997) and in soils that have a layer restrictive to downward water flow but have also been found to occur on slopes just above 40 percent slope. This restrictive layer is usually bedrock or compact till. Landslides are also common in clay/silt lacustrine (lake bottom) sediments. Landslides that occur as a result of human activities are caused by roads that cut a portion of the retaining slope, the concentration of water on otherwise stable slopes, timber harvest on shallow soils over bedrock on slopes upwards to 90 percent or more, and road construction over unstable soils on steep slopes when they are saturated. Natural landslides have been identified in the Knowles Head area in northeastern Prince William Sound, on Montague Island, and scattered across the Kenai Peninsula. All of these areas have some slides that may have resulted from previous management activities.

Soil Erosion

Surface erosion includes sheet, rill, gully, and stream channel bank erosion of exposed mineral soils. Within the national forest, since most mineral soils are covered by moss and decayed plants, surface erosion is usually not a major concern. The five major activities that expose mineral soil are road construction, timber harvest, placer mining, recreational development, and overuse by people trampling the vegetation and exposing the soils adjacent to streams.

Mineral soil is exposed from skid trails, road surfaces, cut and fill slopes, log transfer sites, and borrow sites on timber harvest sites. Monitoring of past timber harvesting has shown that erosion has been restricted to skid trails following major rainfall events and that other erosion on disturbed sites is minor (Davidson 1993).

Mineral soil exposed and compacted from overuse by people adjacent to major fish streams and at remote campsites is the most serious consequence to other resources (fish habitat, water quality, stream characteristics, etc.). The exposed mineral soil or stream bank then erodes during periods of high water or floods. The lower three miles of the Russian River, the Kenai River, and parts of Quartz Creek on the Kenai Peninsula have suffered the greatest erosion. Remote campsites along the major hiking trails on Kenai Peninsula and kayak campsites in Prince William Sound have numerous locations where mineral soils have been exposed and compacted. As of the 2002 forest plan, there were about 150 impacted campsites along trails on the Kenai Peninsula, of which 50 are designated as official sites. As of 1996 (Monz 1998) there were 63 inventoried sites in northwestern Prince William Sound with vegetation/soil disturbance that range from 9 to 225 square meters with an average of 28 square meters. There are an additional 40 sites that have been inventoried since 1996, but the specific data is not yet available. There are likely more sites in Prince William Sound that have not been found or inventoried. No updated information is available regarding monitoring between 2002 and present, but many restoration projects have occurred in these areas, reducing erosion and soil disturbance and restoring watershed health (5,515 acres).

Placer mining for gold in numerous streams on the Kenai Peninsula has severely impacted the adjacent alluvial soils and vegetation. Most of this mining took place in the early to mid-1900s, but much evidence still remains, especially where tailings or waste areas have yet to revegetate. The most significant sites are in Resurrection, Bear, Mills, Juneau, Quartz, Crescent, Canyon, and Sixmile creeks. A large scale restoration project was completed in 2006 on Resurrection Creek, reducing erosion and restoring watershed function across a large area (USDA 2017a).

Climate Change

The effects that climate change could have on soils are variable and integrated; changing one factor within the soil (i.e., increasing soil temperature) can have an effect on several soil functions overall. With an increase in soil temperature, there is generally an increase in soil microbial activity and soil respiration, which over time may increase nutrient cycling and decrease the amount of organic matter in the soil and at the soil surface, also releasing more carbon from the soil organic carbon pool (Brevik 2013; Haufler et al. 2010). The interactions of increased soil temperature and changes in type and amount of precipitation will also affect the soil functions differently, especially across different soil types. Finer soil textures are expected to buffer changes in climate more readily than coarse soil textures and those areas with finer soil textures will experience change more slowly.

Increased precipitation falling as rainfall could increase the likelihood of flooding, erosion, and landslides, especially in already susceptible areas where soils are shallow, have low water holding capacity or lie on landslide susceptible geologic formations. With a change in the timing of precipitation (rain) during the growing season, vegetation production may increase and further increase vegetation ground cover potentially decreasing soil loss from erosion, especially with the implementation of BMPs associated with land management practices.

Soil temperature increases along with changes in soil moisture will also affect nutrient cycling, specifically carbon and nitrogen cycling, and may include increases or decreases in carbon and nitrogen cycling rates or storage, changes in nutrient availability, and changes in microbial nutrient processing. Potential plant community changes, including increases of Sitka spruce with decreases in white spruce, potential afforestation, and changes in vulnerabilities to invasive species within the Chugach National Forest, could affect soil nutrient cycling, soil temperature, soil moisture contents, and soil cover overall.

Environmental Consequences

The first part of this section describes environmental consequences common to all alternatives, related to timber harvesting, prescribed fire, roads and trails, and mineral development. The second part describes consequences specific to each of the alternatives related to recreation and wilderness area recommendation.

Consequences Common to All Alternatives

Timber Harvesting

Although timber harvesting is not a primary management activity and there are no lands suitable for commercial timber production, timber harvesting will continue through silvicultural treatments, commercial subsistence harvesting, and general subsistence harvesting.

Timber harvesting has the potential to impact soil resources by displacing and decreasing vegetation ground cover, potentially causing compaction, and removing overstory vegetation cover thus exposing more soil to rain impact. This has the high probability of negatively impacting soil function by disrupting the soils nutrient cycling capability (Grier et al. 1989) and increasing runoff and erosion rates. Soil compaction decreases total pore space in the soil, decreases water infiltration rates, and decreases gas exchange, all of which are important for healthy functioning soil. Severely compacted soils do not allow appropriate water infiltration, leading to overland flow and associated erosion, sediment delivery, spring flooding, and low summer flows. However, potential soil damage would be largely mitigated through the implementation of BMPs and retention of vegetation ground cover. Most soil erosion comes from skid trails and landings where bare mineral soil is exposed. The use of litter and woody debris on these areas has been shown to reduce erosion and sedimentation rates (Han et al. 2009; Cram et al. 2007; Page-Dumroese et al. 2010). Organic matter is especially important for retaining nutrients, increasing water holding capacity, and erosion control (DeBano 1991; Harvey 1987).

Prescribed Fire

Areas subjected to prescribed fire could potentially show an increase of soil loss from current conditions because there would be a decrease in ground cover and the exposure of heat may influence soil structure and soil hydrologic dynamics. However, prescribed burns can also result in a positive response to the soil resources by improving soil fertility by expediting nutrient cycling (Choromanska and DeLuca 2002), decreasing woody canopy cover, improving herbaceous response, and improving overall vegetation ground cover, which improves soil stability (Beschta et al. 2004). If litter layers and organic matter is kept intact throughout the rest of the stand, nutrient losses would be minimal from burning slash and would be localized. Nitrogen-fixing plants can colonize sites following fire and help restore nitrogen in the ecosystem (Newland and DeLuca 2000; Jurgensen et al. 1997). Following fire, soil erosion can increase, which could also reduce the nutrient pool (Megahan 1990). Generally, if plants colonize sites following fire, nutrient levels can reach pre-fire levels quickly (Certini 2005). Charcoal deposited following fire also adds carbon, a valuable nutrient, to the soil (DeLuca and Aplet 2008).

Road and Trail Use and Maintenance

The permanent transportation system is not land dedicated to growing vegetation and so there is no mandate to maintain soil productivity on these sites. Effects to the soil functions from the use and maintenance of roads and trails is limited to areas where maintenance may impact areas outside of the road or trail prism. The effects are generally minor and of limited extent.

Mineral Development

Although there are differences in acreages available for mineral development between the alternatives, the general effects to soils will be similar, just over different acreages. Mining, both on the surface and underground, eliminates soil productivity for the area where the soil is removed and the area where the tailings are placed. Normal practices require the stockpiling of the topsoil that would accelerate revegetation and restore some of the soil productivity once mining has been completed and the topsoil has been replaced.

Recreation

Summer

The use of developed recreation sites, such as campgrounds, cabins, parking lots, and scenic overlooks, will continue within the Chugach National Forest. The effect of recreation sites on soil productivity and stability is somewhat dependent on maintenance and BMPs being implemented on specific sites. Newer sites and upgraded sites would have limited soil impacts because of BMPs and design feature implementation to protect the soil resource. Compaction, loss of organic matter and changes in nutrient cycling, water holding capacity, and runoff would be expected in most recreation sites. Recreation sites are generally dedicated use sites where soil productivity is not expected to be maintained. Concentrated use outside of these recreation sites could decrease soil productivity over time by compacting soil, changing the soil water balance, and reducing infiltration rates. Dispersed recreation sites are similar to developed sites. Hardening of these sites limits the potential for soil loss and the effects to soils from this type of recreation are generally low with some potential for detrimental effects from off road use of motorized vehicles, especially if this occurs in riparian, wetland, or other fragile soil sites.

Winter

Incidental effects of over the snow vehicles (OSVs) use on and off trails could include compaction, rutting, and disturbance of the forest floor and organic matter within the soil in low snow areas. Although snowmobiles generally have low ground pressure, the tracks on snowmobiles could churn soil and cause compaction with repeated travel over areas with low snow conditions (Baker and Buthmann 2005; Gage and Cooper 2009). This type of incidental contact with the soil surface or low snow conditions would likely occur during the fall or spring season, would more likely be found on ridges that are windy and exposed or on south-facing slopes, and would be very limited. Repeated compaction of snow can also alter soil temperatures potentially changing or reducing microbial activity, but some research has shown that with repeated compaction, soil temperatures were not affected (Gage and Cooper 2009; Keller et al. 2004). With adequate snow depths, cross-country over-snow vehicle use is unlikely to affect soil stability. Depending on site-specific factors, including slope, aspect, elevation, level of use, weather conditions, trails, and off-trail riding on steep slopes, over-snow vehicle use could contribute to erosion (Baker and Buthmann 2005; Olliff et al. 1999), but adequate snowpack would likely mitigate the potential for erosion overall.

Alternative A No Action

Alternative A would continue current management as described in the 2002 forest plan. Resource protection measures would continue to be implemented along with the Region 10 (USDA 2006) and national BMPs (USDA 2012). Soil and watershed restoration activities would continue at a rate similar to the current rate of restoration.

Minerals

Under alternative A, approximately 2,985,147 acres are open to mineral development and potential soil disturbance leading to reduced soil function overall with the potential to reduce soil stability at mineral development sites depending on landtype, soil conditions, slope, and precipitation patterns at the time.

Recreation and Wilderness Area Designation

Under alternative A, recreation opportunity spectrum classes would remain the same as under the 2002 forest plan. Approximately 1,380,773 acres would be in motorized (summer or winter) classes, though not all of this area would be open to motorized use. Potential impacts to soils from motorized use and non-motorized use would continue at current levels. Outfitter and guide services would continue in a similar way and the number of permits and party size would remain the same. Soil design features and BMPs outlined in the 2002 forest plan would continue to be implemented in order to reduce the potential for soil erosion, compaction outside of the recreational footprints, and general loss of soil productivity.

The recommendation for wilderness area designation would be 1,387,210 acres. Soil disturbance within the recommended wilderness area is only expected from natural disturbances, including wildfire, landslides, windthrow events, and earthquakes. Under alternatives A and B, the fewest acres are proposed for wilderness area designation, so the potential for soil disturbance is greater under these alternatives compared to alternatives C and D as there is more acreage open to mineral development, recreational opportunities, and ground disturbing land management activities.

Alternative B

Alternative B is very similar to alternative A with a few differences in mineral development acreage available and slightly different recreation opportunities within the Kenai Peninsula Geographic Area. Resource protection measures would continue to be implemented along with the Region 10 (USDA 2006) and national BMPs (USDA 2012). Soil and watershed restoration activities would continue at a rate similar to the current rate of restoration, but under alternative B there is more of an emphasis placed on soil function resilience in the face of changing conditions and climate.

Minerals

Effects to soils from mineral development would be similar to those described under alternative A.

Recreation and Wilderness Area Designation

Under alternative B, the recreation opportunity spectrum classes would be similar to that under alternative A, but there would be less acreage open to motorized use overall. Approximately 1,358,711 acres would be in motorized (summer or winter) classes, though not all of this area would be open to motorized use. This would be 22,062 acres less than alternative A and 315,391 acres less than alternatives C and D. Potential impacts to soils from motorized use and non-motorized use would be similar, but over fewer acres, potentially concentrating some of the use and having a greater potential for soil disturbance in localized areas. Soil design features and BMPs would still be implemented as outlined in the revised forest plan in order to reduce the potential for soil erosion, compaction outside of the recreational footprints, and general loss of soil productivity.

The recommendation for wilderness area designation would be 1,387,510 acres. Soil disturbance within the recommended wilderness area is only expected from natural disturbances, including wildfire, landslides, windthrow events, and earthquakes. Under alternatives A and B, the fewest acres are proposed for wilderness area designation, so the potential for soil disturbance is greater under these alternatives compared to alternative C and D as there is more acreage open to mineral development, recreational opportunities and ground disturbing land management activities.

Alternative C

Alternative C recommends more wilderness and more acreage open to motorized recreation than alternatives A and B. Assuming recommended wilderness were designated, this would reduce acres open to mineral withdrawal, potentially decreasing soil impacts from mining, as compared to alternatives A and B. Resource protection measures would continue to be implemented along with the Region 10 (USDA 2006) and national BMPs (USDA 2012). Soil and watershed restoration activities would continue at a rate similar to the current rate of restoration, but, similar to alternative B, there is more of an emphasis placed on soil function resilience in the face of changing conditions and climate.

Minerals

Under alternative, C approximately 2,552,957 acres would be open to mineral development and potential soil disturbance, leading to reduced soil function overall with the potential to reduce soil stability at mineral development sites depending on landtype, soil conditions, slope, and precipitation patterns at the time. Assuming recommended wilderness were designated, there would be fewer acres open to mineral development than under the previous alternatives (432,190 acres less than alternatives A and B), but more acreage open to mineral development than under alternative D (64,500 acres more). Similar effects to soils from mineral development could occur as described under alternative A, just over less acreage.

Recreation and Wilderness Area Designation

Under alternative C, the recreation opportunity spectrum classes would be different than under alternatives A and B. Motorized use is proposed on 1,674,272 acres, which is greater than alternative A (293,499 acres more) and alternative B (315,391). The majority of the motorized use acres are within the Kenai Peninsula, so there may be more concentrated use in the Kenai Peninsula, increasing the effects to the soil resource through potential increases in concentrated use in that geographic area.

Under alternative, C more wilderness area acres are proposed (1,819,700 acres) than under alternatives A and B (432,190 acres more). More proposed wilderness area acreage under this alternative would likely lead to less use, smaller group sizes allowed in outfitter and guide permits, and fewer impacts overall to the soil resource.

Alternative D

Indirect Effects

Alternative D proposes the most wilderness area acres and similar acres as under alternative C would be open to motorized use. The fewest acres would be open to mineral development. Resource protection measures would continue to be implemented along with the Region 10 (USDA 2006) and national BMPs (USDA 2012). Soil and watershed restoration activities would continue at a rate similar to the current rate of restoration, but, similar to alternatives B and C, there is more of an emphasis placed on soil function resilience in the face of changing conditions and climate.

Minerals

For alternative D, assuming wilderness were designated as recommended, approximately 2,488,457 acres would be open to mineral development, which would be the fewest acres compared to the other alternatives (496,690 acres less than alternatives A and B and 64,500 acres less than alternative C). This alternative would have the least potential to impact soil functions (soil productivity and soil stability) and the soil resource as a whole.

Recreation and Wilderness Area Designation

The effects to soils under alternative D from the recreation opportunity spectrum classes would be similar to those under alternative C with a difference only within the Prince William Sound Geographic Area. Motorized recreational opportunities are similar to those under alternative C with 1,674,102 acres open to motorized use. Effects to soils from motorized use would be similar to those under alternative C, but greater than those under alternatives A and B because there is less acreage open to motorized use under those two alternatives.

More acres are proposed for wilderness area designation under alternative D at 1,884,200 acres and all of the additional acres proposed are within the Prince William Sound Geographic Area. With more acreage in the primitive recreation opportunity spectrum class, it is assumed outfitter and guide party sizes would be smaller, along with decreasing the potential impact to the soil resource over a greater number of acres. Increasing the acres of potential wilderness area could concentrate recreational uses in other areas and potentially increase soil disturbance in localized places.

Cumulative Effects Common to all Alternatives

Cumulative effects include a discussion of the combined, incremental effects of human activities. For activities to be considered cumulative, their effects need to overlap in both time and space with those of the proposed actions. For the soil resource, the area for consideration is the Chugach National Forest plan area. Past activities are considered part of the current conditions described previously in the affected environment.

Wildfire and Fire Suppression

The potential for wildfire exists across the Chugach National Forest. There are benefits of fires with lower intensity and severity, and those would include a reduced potential of excessive soil heating and sterilization as well as the development of hydrophobic conditions that tend to increase sediment movement, flooding, and possible slope instability (de Dios Benavides-Soloria and McDonald 2005; Neary et al. 2005). The occurrence of a high intensity wildfire would have an increased potential for impacts to soils and soil productivity in severely burned areas, especially since the risk of soil erosion increases proportionally with fire intensity (Megahan 1990). Other effects would include the potential loss of organic matter, loss of nutrients, and a reduction of water infiltration (Wells et al. 1979). High surface temperatures from high severity wildfire, particularly when soil moisture is low, result in an almost complete loss of soil microbial populations, woody debris, and the protective duff and litter layer over mineral soil (Hungerford et al. 1991; Neary et al. 2005). Nutrients stored in the organic layer (such as potassium and nitrogen) can also be lost or reduced through volatilization and as fly ash (DeBano 1991; Amaranthus et al. 1989). Fire-induced soil hydrophobicity (soil impermeability to moisture) is presumed to be a primary cause of the observed post fire increases in runoff and erosion from forested watersheds (Huffman et al. 2001). Though hydrophobicity is a naturally occurring phenomenon that can be found on the mineral soil surface, it is greatly amplified by increased burn severity (Doerr et al. 2000; Huffman et al. 2001; Neary et al. 2005). Soil hydrophobicity usually returns to pre-burn conditions within six years (DeBano 1981). Dyrness (1976) and other studies have documented a much more rapid recovery of one to three years (Huffman et al. 2001). The persistence of a hydrophobic layer will depend on the strength and extent of hydrophobic chemicals after burning and the many physical and biological factors that can aid in breakdown (DeBano 1981). This variability means that post fire impacts on watershed conditions are difficult to predict and to quantify.

Where wildfires occur in time and space with the proposed actions, including mining, harvesting, prescribed fire, and recreational activities, there could be cumulative soil impacts exacerbating the impacts discussed above from wildfires.

On small wildfires, disturbance from fire suppression activities is usually limited to hand tools; most hand fireline construction has only minor (insignificant) impacts to the soil resource. Machine line using heavy equipment is also built during wildfire suppression. These machine lines are rehabilitated following suppression activities. During fire suppression, closed roads may be reopened for access and incorporated as fire line. As part of the post fire work, the areas of disturbance are rehabilitated and the roads are returned to their previous condition in most cases.

Analytical Conclusions

Within the Chugach National Forest, there are two main drivers that affect soil productivity and soil stability: recreation use and mining operations. Recreational activities and mining activities are generally activities that convert productive sites and soils to an essentially non-productive site for a period of more than 50 years. This can be characterized as the total soil resource commitment across the national forest and can be used as an indicator for soil productivity and soil stability to compare alternatives. Under all the alternatives soil, productivity and soil stability are expected to be maintained across the national forest overall in the long-term and the effects of the implementation of any of the alternatives are expected to be minimal to the soil resource except on a very site specific basis, but implementation of BMPs would ensure reduced impacts.

Under all four alternatives, resource protection measures would continue to be implemented along with the Region 10 (USDA 2006) and national BMPs (USDA 2012). Alternative A would continue current management as described in the 2002 forest plan. Soil and watershed restoration activities would continue at a rate similar to the current rate of restoration. Alternative B is very similar to alternative A with a few differences in mineral development acreage available and the recreation opportunity spectrum classes are slightly different within the Kenai Peninsula (see table 75). Alternative C recommends more area for wilderness designation, than the previous two alternatives, with more acreage open to motorized recreation. Alternative D proposes the most acres as potential wilderness areas (primitive recreation opportunity spectrum class) but similar acres would be open to motorized use as alternative C and the fewest acres would be open to mineral development if wilderness were designated. Under alternatives B, C, and D, soil and watershed restoration activities would continue at a rate similar to the current rate of restoration, but there is more of an emphasis placed on soil function resilience in the face of changing conditions and climate under these three alternatives compared to the no-action alternative.

Table 75. Summary of consequences by alternative

Measurement Indicator	Alternative A No Action (acres)	Alternative B (acres)	Alternative C (acres)	Alternative D (acres)
Acres available for mineral development	2,985,147	2,985,147	2,552,957	2,488,457
Acres open to summer motorized use	675,775	666,396	539,590	539,552
Acres open to winter motorized use	1,380,773	1,358,711	1,674,272	1,674,102
Acres of proposed wilderness area	1,387,510	1,387,510	1,819,700	1,884,200

Watersheds and Water Resources

Introduction

Specific water resources described and evaluated in this section include water quantity, water quality, watershed condition drivers and stressors, and overall watershed conditions and trends.

Properly functioning watersheds provide many important ecosystem services. Functioning watersheds generally provide high quality water, recharge of streams and aquifers, moderation of climate variability, and long-term soil productivity. Additionally, healthy watersheds generally create and sustain resilient terrestrial, riparian, aquatic and wetland habitats that support diverse populations of plants and animals capable of rapid recovery from natural and human disturbances.

Watersheds and water resources within the Chugach National Forest provide a substantial contribution to social and economic sustainability in southcentral Alaska. Water from the national forest provides drinking water for communities, private residences, businesses and lodges, and visitors at campgrounds. Hydroelectric facilities within the national forest provide electricity to communities throughout southcentral Alaska. Watersheds and water resources also provide a large local economic off-set for food through fishing and hunting and are culturally important for subsistence. Mining operations within the national forest utilize water resources for wash plants and camp facilities.

Much recreation use within the national forest revolves around water bodies and glaciers, including sight-seeing, camping, fishing, and boating. Most campgrounds within the national forest are located near lakes and streams. The Forest Service issues large numbers of outfitter/guide permits each year to companies that use national forest watersheds and water resources. The 2011 Commercial Recreation Monitoring Report showed that water based activities made up a very significant part of guided use across the national forest (Clark pers. comm. 2013). These activities included, but were not limited to, rafting, fishing, motorboat tours, kayak trips, canoeing, flight seeing and glacial tours, skiing, and snow machining. There are also nine suitable and recommended Wild and Scenic Rivers within the national forest which are managed to maintain their outstandingly remarkable values pending congressional designation (appendix E).

Chugach National Forest watersheds and water resources are abundant and complex. There are 275 6^{th} level (12-digit) Hydrologic Unit Code (HUC) watersheds, varying in size from 8,000 to more than

300,000 acres, spread across three geographic areas: the Kenai Peninsula, Prince William Sound, and the Copper River Delta (see map 18). Watersheds exhibit wide variation due to complex topography, geomorphology, and climate patterns. Elevations range from sea level to over 13,000 feet with a little more than 40 percent of the watersheds having some glacial component.

Methodology

Spatial Scale

The water resources analysis area for the indirect and cumulative effects analysis is bounded spatially by watershed boundaries. The watershed scale utilized in this analysis is the 6th level HUC. The 6th level (12-digit) HUC watersheds are delineated by the U.S. Geological Survey as part of their Watershed Boundary Data Classification System. This 6th level (12-digit) HUC watershed scale is commonly used for effects analyses and is consistent with the spatial scale utilized in the National Watershed Condition Framework and Classification guidance (USDA 2011a; USDA 2011b).

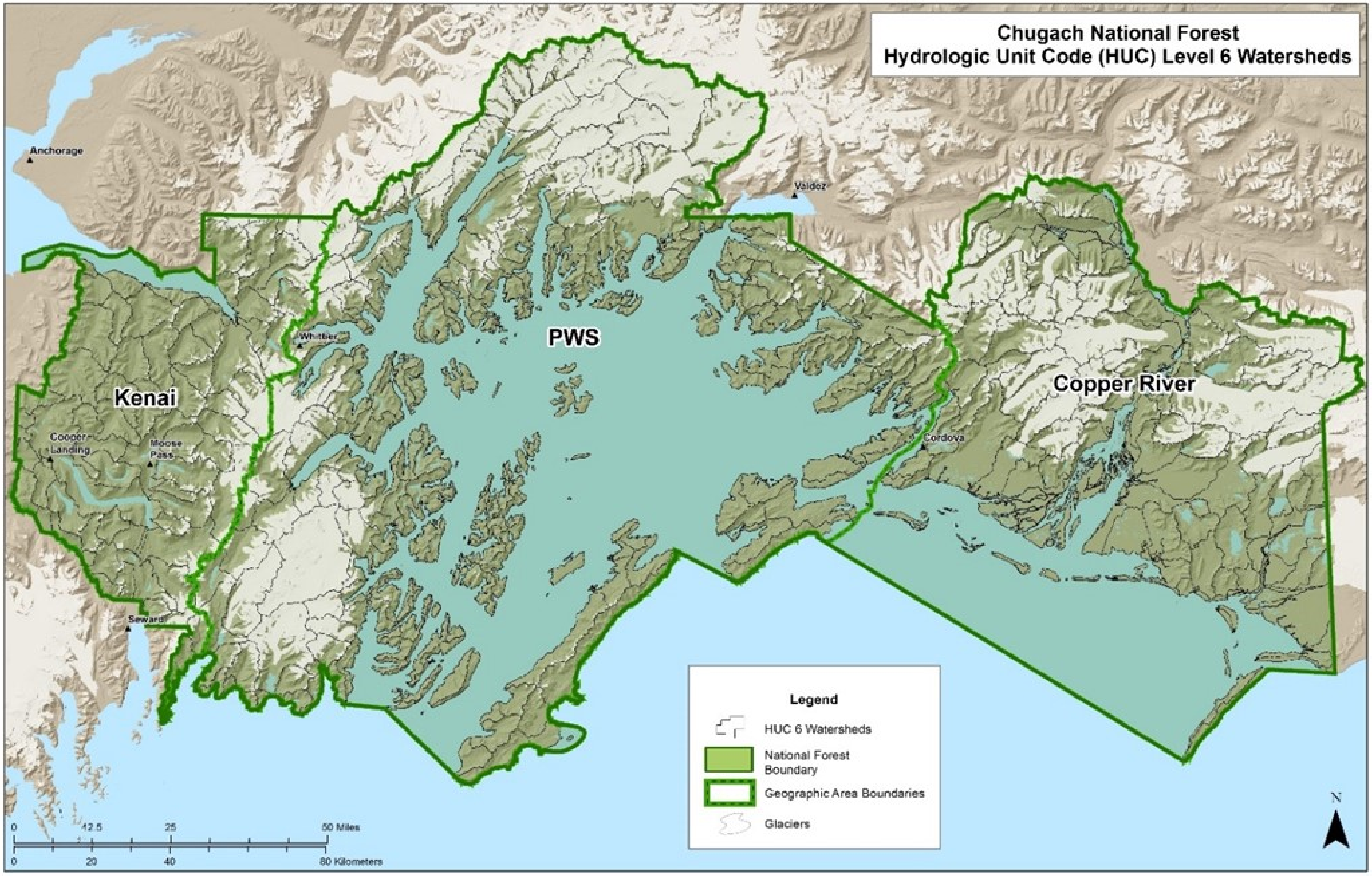
Temporal Scale

This analysis is bounded in time by foreseeable future period during which the effects of plan implementation may persist as detectable. In general, effects are described as short-term (less than a year) and long-term (persistent or lasting several years.) The planning timeframe is 15 years; however, trends are described for a much longer timescale, including several decades.

Measurement Indicators

The watershed and water resource conditions described within the Chugach National Forest are based on the national Watershed Condition Framework and the Forest Service Watershed Condition Classification (WCC) Technical Guide (USDA 2011a; USDA 2011b). The national protocols utilize a wide array of indicators and attributes from aquatic physical, aquatic biologic, terrestrial physical, and terrestrial biological process categories. The categories represent ecosystem processes or mechanisms by which management actions can affect the condition of watersheds and associated resources. Table 76 provides a summary of the watershed condition indicator model. Using this model, Chugach National Forest watersheds were classified by each attribute into one of three condition classes: Class 1 (good, functioning properly); Class 2 (fair, functioning at risk); or Class 3 (poor, functionally impaired).

Attributes were rated using data from internal sources, such as landscape assessments, watershed restoration plans, hydrologic assessments, culvert surveys, and fire regime maps, along with data from external sources, such as the Alaska Department of Environmental Conservation (ADEC) and Alaska Department of Fish and Game (ADF&G). The attribute scores for each indicator were then summed and averaged to produce an indicator score. Indicator scores for each ecosystem process category were then averaged to provide a process category score. This section provides details of the water quantity and water quality indicator and attributes of the aquatic physical processes. Please refer to the Aquatic Ecosystems Fish section for more detailed information about the aquatic biota and aquatic habitat indicators and the Aquatic Ecosystems Riparian and Wetlands section for more detailed information about the riparian vegetation indicator of the Aquatic Biological Process Category. More detailed information about the terrestrial, physical, and biological processes are described in the Terrestrial Ecosystems sections. Overall watershed conditions for the Chugach National Forest, based on all of the table 76 core indicators and attributes, are also included in this section. The overall watershed condition score was computed as a weighted average of the four process category scores.



Map 18. Two hundred and seventy-five 6th level (12-digit) HUC watersheds, spread across three different geographic areas, exist within the Chugach National Forest boundary. More than 40 percent have some glacial component.

Table 76. Core national watershed condition indicator and attributes (USDA 2011a; USDA 2011b)

Process Category	Indicator	Attribute
Aquatic physical	Water quality	Impaired waters
		Water quality problems
	Water quantity	Flow characteristics
	Aquatic habitat	Habitat fragmentation
		Large woody debris
		Channel shape and function
Aquatic biological	Aquatic biota	Life form presence
		Native species
		Exotic and/or aquatic invasive species
	Riparian vegetation	Vegetation condition
Terrestrial physical	Roads and trails	Open road density
		Road and trail maintenance
		Proximity to water
		Mass wasting
	Soils	Soil productivity
		Soil erosion
		Soil contamination
Terrestrial biological	Fire regime	Fire regime condition
	Forest cover	Forest cover condition
	Rangeland vegetation	Rangeland vegetation condition
	Terrestrial invasive species	Terrestrial invasive species condition
	Forest health	Insects and diseases
		Ozone

Affected Environment

This section describes the existing condition and trends of the watersheds and water resources within the Chugach National Forest by geographic area. Details of the water quantity and water quality indicator and attributes of the aquatic physical processes are provided. Overall watershed conditions for the Chugach National Forest, based on all of the table 76 core indicators and attributes, are also included in this section.

Water Quantity

Functional flow regimes with respect to the magnitude, duration, and timing in rivers, streams, springs, lakes, ponds, wetlands, and underground aquifers are critical components of water supply, water quality, and the ecological integrity of watersheds. The complex topography and precipitation patterns coupled with the presence of glaciers across the Chugach National Forest naturally creates a wide and dynamic variety of drainage and flow characteristics. Refer to the Water Quantity Section of chapter 2 (Ecological Conditions and Trends) in the forest plan assessment (USDA 2014a) for more details. This section describes the current condition, drivers and stressors and trends of surface and subsurface water quantity within the Chugach National Forest.

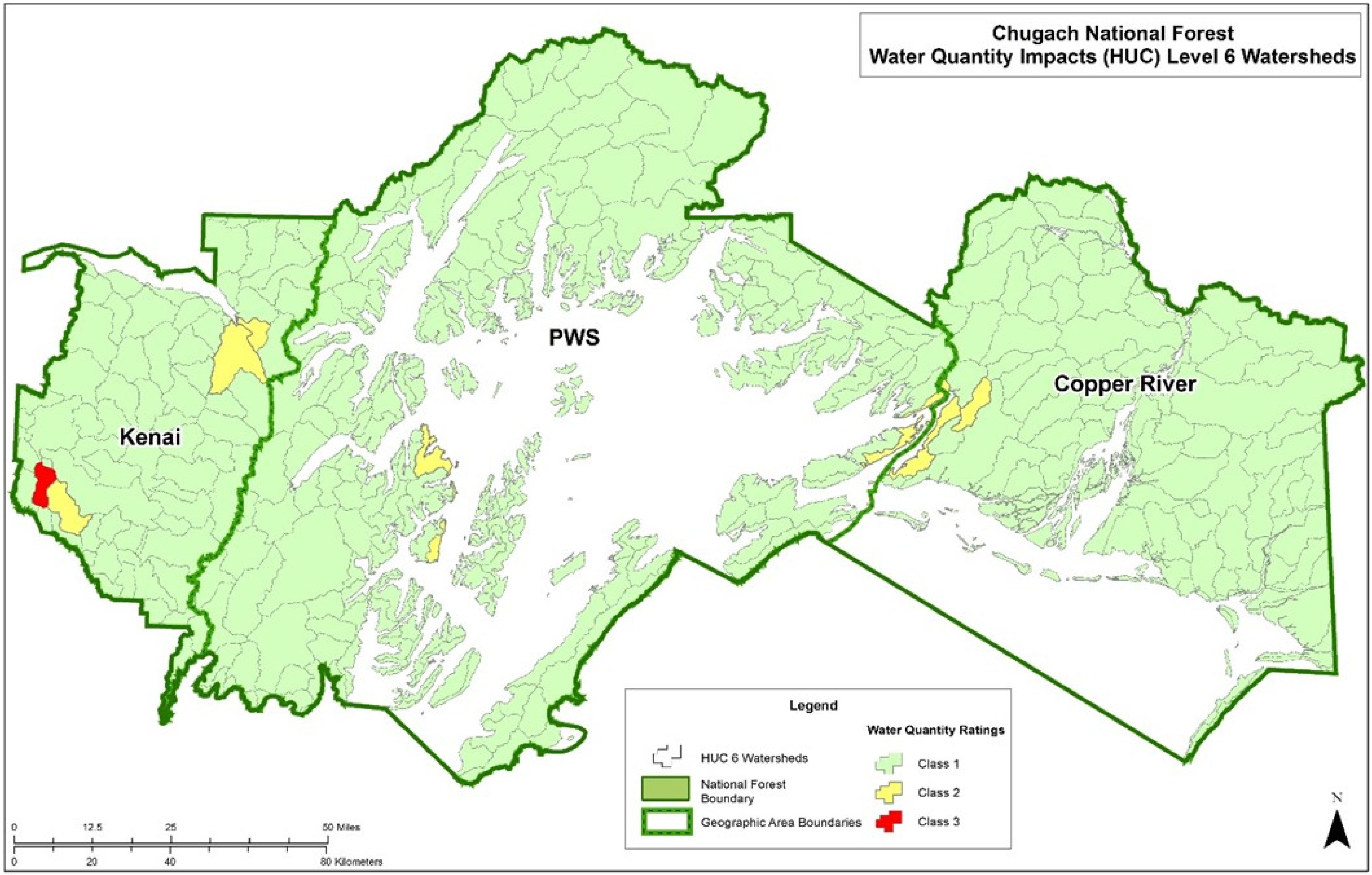
Chugach National Forest surface and groundwater water quantity condition was evaluated as part of the watershed condition classification effort. The water quantity condition attribute evaluates changes to the natural flow regime with respect to the magnitude, duration, or timing of natural streamflow hydrographs. Disturbance regimes to water quantity include human influences, such as reservoirs, diversions, and withdrawals tied to social and economic development, as well as other influences, such as climate change and changes in vegetation due to fires and insects and disease. Based on parameters outlined in watershed condition classification, the later influences were not included in the water quantity condition assessment; however, it is important to note them as drivers and stressors so they will be briefly discussed later in this section.

Overall, most Chugach National Forest watersheds have little to no human impacts to water quantity in terms of diversions or reservoirs, and stream hydrographs are generally unaltered by human actions. Exceptions to this occurs in a few localized areas near communities and along the road system. The main consumptive surface water uses include drinking water (primarily from groundwater wells), water use for Forest Service facilities (i.e., campgrounds, maintenance, and fire and management activities), hydropower generation, fish hatcheries, mining operations, highway construction, dust abatement, and special use permits. Refer to the Watershed and Water Resources section of chapter 3 (Cultural, Social, and Economic Uses) in the forest plan assessment for more detail on these uses (USDA 2014a). The majority of the watersheds lack significant man-made reservoirs, dams, or diversion facilities. Most of the watersheds have free-flowing rivers and streams, unmodified lakes and limited large-scale industrial groundwater withdrawals. The results of the watershed condition classification rating for water quantity within the Chugach National Forest are displayed in table 77 and on map 19.

Table 77. Results of the watershed condition classification water quantity condition ratings for the Chugach National Forest (Coleman et al. 2016)

Rating	Number of Watersheds
Good (1) Functioning Properly	268
Fair (2) Functioning at Risk	6
Poor (3) Impaired Function	1

Effects to water quantity condition within the Chugach National Forest will likely increase, particularly on the Kenai Peninsula, with increased demands for hydroelectricity, mining operations, gravel extraction, and development. There are several proposed (not yet constructed) hydroelectric projects as well as two hydropower withdrawals (powersite reserves) within the Chugach National Forest on the Kenai Peninsula. The Grant Lake FERC hydroelectric project is near Moose Pass and the two hydropower withdrawals for power sites, Nellie Juan Lake and River and Resurrection River, are near Seward, Alaska. These projects have the potential to affect water quantity by diverting and/or impounding water and altering the natural stream hydrographs in these watersheds.



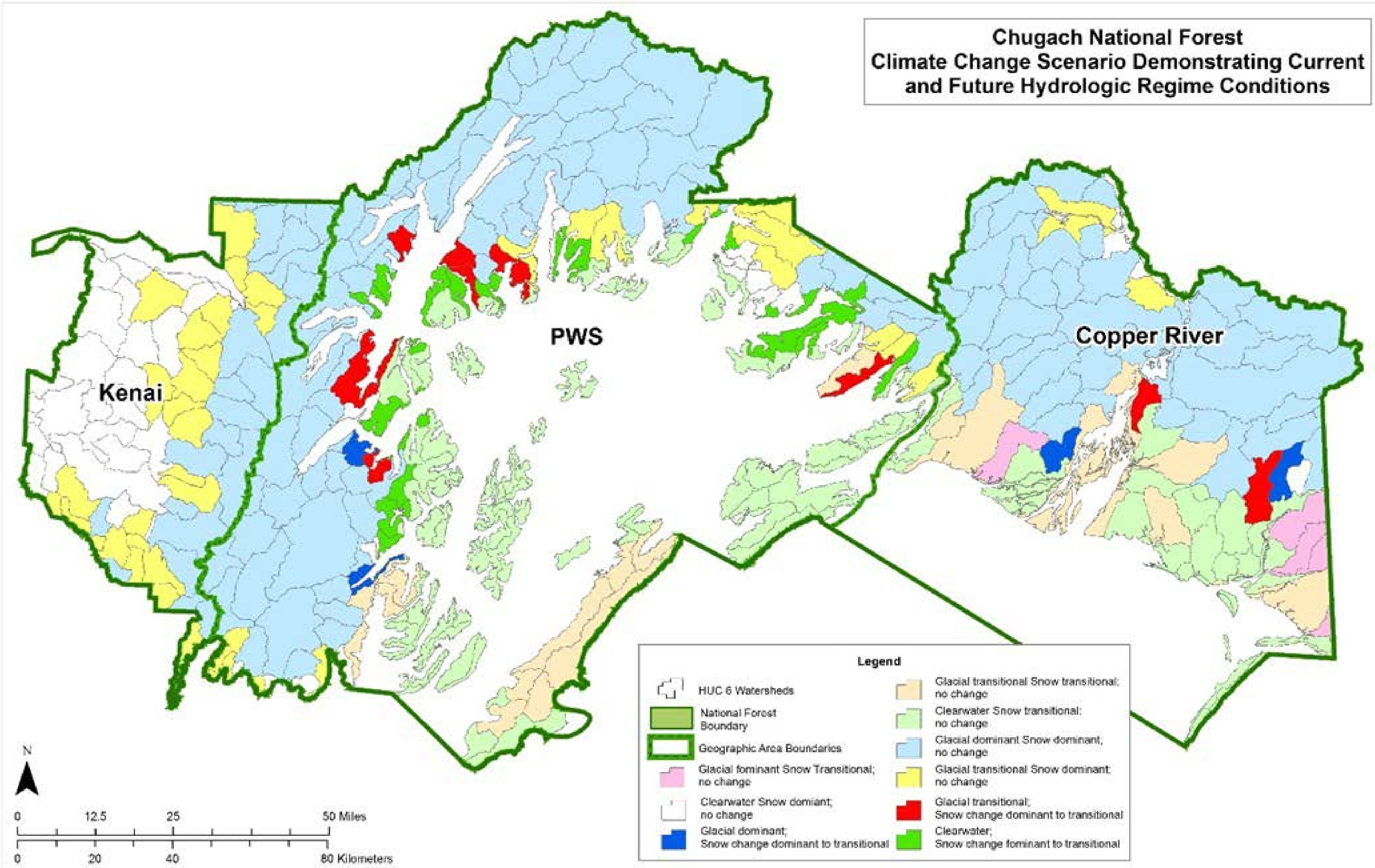
Map 19. Chugach National Forest watersheds with water quantity impacts

Nearly 500 state-issued surface and subsurface (groundwater) water rights, administrated by the Water Resources Program of the Alaska Department of Natural Resources, Division of Mining, Land, and Water, currently exist within the Chugach National Forest boundary. Seven include in-stream flow reservations for fish and wildlife habitat. The majority of these are within the Kenai Peninsula Geographic Area. The Forest Service holds approximately 15 percent of those surface water rights and 12 percent of those subsurface rights within the boundary (USDA 2014a). The majority of the Forest Service's rights are for consumptive water use for service administrative and recreational facilities, such as cabins and campgrounds. The Forest Service has not applied for any water rights for in-stream flow reservations within the national forest. With trends for increased demands, filings of water rights, the influence of lands of other ownership, and climate change projections on water resources, it would behoove the Forest Service to pursue applications for securing in-stream flow reservations within high value and at risk watersheds.

Climate is an important physical driver for watersheds and water resources, such as water quantity. Consequently, climate change will have a strong influence on future watersheds and water quantities. Impacts from climate change to Chugach National Forest water resources on water quantity may include changes in the timing and magnitude of flows, such as increased flood frequency, and magnitude and the amount and timing of mean, peak and low flows, changes in distributions, timing and magnitudes of glacial outburst floods, an increase in fire potential in some locations and shifts in watershed hydrologic regimes (Fresco 2012; Haufler et al. 2010; USDA 2014a). Those changes in hydrologic regime will affect the timing and magnitude of discharges, may affect glacial outburst floods, and will change contributions of freshwater discharge into the Gulf of Alaska (Neal et al. 2010), potentially affecting ocean productivity and salmon abundances and water quality and may affect other multiple uses of water resources. Again, due to the complex topography, geomorphology, and precipitation patterns coupled with the presence of glaciers across the Chugach National Forest, many of these effects will vary across geographic zones and from one watershed to another (Hayward et al. 2017; USDA 2014a).

The climate change assessment and other climate modeling suggest that the Chugach National Forest plan area overall will become warmer in the next few decades with earlier springs, later autumns, and shorter, less severe winters. Increases in precipitation are likely, but overall snowfall will decrease owing to higher temperatures, particularly in late autumn, and at lower elevations. The snowline will move higher in elevation and farther from the coast. This warming may increase glacial melt and loss of snowpack.

The climate change assessment identified approximately 15 percent of national forest watersheds as likely to change hydrologic regimes within the next 30 to 50 years (see map 20). The anticipated changes will be shifts from snow-dominated watersheds to transitional snow-dominated watersheds. The majority of those watersheds exhibiting expected hydrologic regime changes are along the southern coastline that rings Prince William Sound (see map 20). Anticipated effects may include a shift in peak flows from early summer (June and early July) to late spring (May and June) and decreased flows resulting from less snowpack. Additionally, these watersheds will have an increased peak flow in the autumn, which in some cases may be greater than the peak flow in May and June due to a shift in precipitation falling as rain rather than snow. The frequency and magnitude of floods in fall and winter may increase due to higher potential for rain on snow events. There may also be slightly higher mean flows throughout the winter than currently exists within these watersheds due to more precipitation falling as rain than snow.



Map 20. Climate change scenario demonstrating current and future hydrologic regime conditions of the plan area using 6th level (12-digit) HUC watersheds (Hayward et al. 2017; USDA 2014a)

Approximately 11 percent of this will occur in the non-glacial clearwater watersheds, a little over three percent will occur within the transitional glacial watersheds, and less than two percent will occur within the glacial watersheds. Additionally, it is anticipated that some transitional glacial watersheds may have a shift in their hydrographs as their peak mid-summer flows (July and August) and daily diurnal flow pattern diminish with receding glaciers and some glacial watersheds may have increased mid-summer flows (July and August) and diurnal flows as more melt occurs with the receding glaciers and increased temperatures.

This assessment was completed at the 6th level (12-digit) HUC watershed level. It is important to note that these results have errors and over accountability due to numerous 6th level HUC watersheds having upstream headwater 6th level HUC watersheds not displaying hydrologic regime shifts. These headwater 6th level watersheds connected to the modeled watersheds displaying changes may in fact buffer changes in water quantity and quality in many cases. Additionally, this analysis does not take into account the important influences of groundwater and lakes. Future modeling recommendations include completing an assessment on the drainage scale.

The impacts of severe wildland fire and insects and disease can have effects on the hydrologic regime and hydrograph of watersheds. In general, some of these effects have included increased snow accumulation and melt, reduced interception loss and evaporation, and increased runoff and streamflow (Gleason et al. 2013; Pugh and Small 2011; Pugh and Gordon 2013; Winkler 2011).

Water Quality

Water quality refers to the chemical, physical, and biological characteristics of water. The quality of water, both surface and groundwater, affects the health of the entire watershed, including all of the components of the aquatic and terrestrial ecosystems, as well as social and economic sustainability. This section describes the uses, current condition, drivers and stressors, and trends of surface and subsurface water quality within the Chugach National Forest.

Water resources within the Chugach National Forest, such as water quality, are an extremely valuable ecosystem service. Waters within the Chugach National Forest supply source water for more than 150 public water systems. Source Water Protection Areas are delineated by the state for a public water system or include numerous public water systems, whether the source is groundwater or surface water or both, as part of the State Water Assessment Program approved by EPA under section 1453 of the Safe Drinking Water Act. The majority of these public water systems are within the Kenai Peninsula Geographic Area with groundwater providing most of the supplies. Refer to the Watershed and Water Resources section, chapter 3 (Cultural, Social, and Economic Benefits) of the forest plan assessment (USDA 2014a) for more detail on water resources used by the public.

Water quality drivers and stressors within the Chugach National Forest include natural and human caused disturbances. Natural disturbances primarily include climate change, landslides, and floods. Human caused physical, biological, and chemical impacts to water quality were assessed for 275 watersheds within the Chugach National Forest as part of the Watershed Condition Classification assessment. Water quality, both surface and ground water, function and condition were evaluated based on two attributes: impaired waters listed in the State of Alaska Department of Environmental Conservation Section 303(d) (of the Clean Water Act) list and known water quality problems not listed as impaired waters. Listed watersheds were ranked by impaired waters based on categorical listings from Alaska Department of Conservation (ADEC 2013) as described in the technical guide (USDA 2011b). The state of Alaska assigns categories to water bodies by the degree to which water quality standard goals are attained. The five categories and three subcategories follow:

- Category 1: All water quality standards for all designated uses are attained
- Category 2: Some water quality standards for the designated uses are attained, but data and information to determine whether water quality standards for the remaining uses are attained is insufficient or absent
- Category 3: Data or information is insufficient to determine whether the water quality standards for any designated uses are attained
- Category 4: The waterbody is determined to be impaired but does not need a total maximum daily load (TMDL)
    - Category 4a. An established and EPA-approved TMDL exists for the impaired water
    - Category 4b. Requirements from pollution controls have been identified to meet water quality standards for the impaired water
    - Category 4c. Failure to meet water quality standards for the impaired water is not caused by a pollutant; instead, the impairment is caused by a source of pollution, such as a nuisance aquatic plants, degraded habitat, or a dam that affects flow
- Category 5: Water quality standards for one or more designated uses are not attained and the water body requires a TMDL or recovery plan; Category 5 waters are those waters identified by the Section 303(d) list of impaired waters

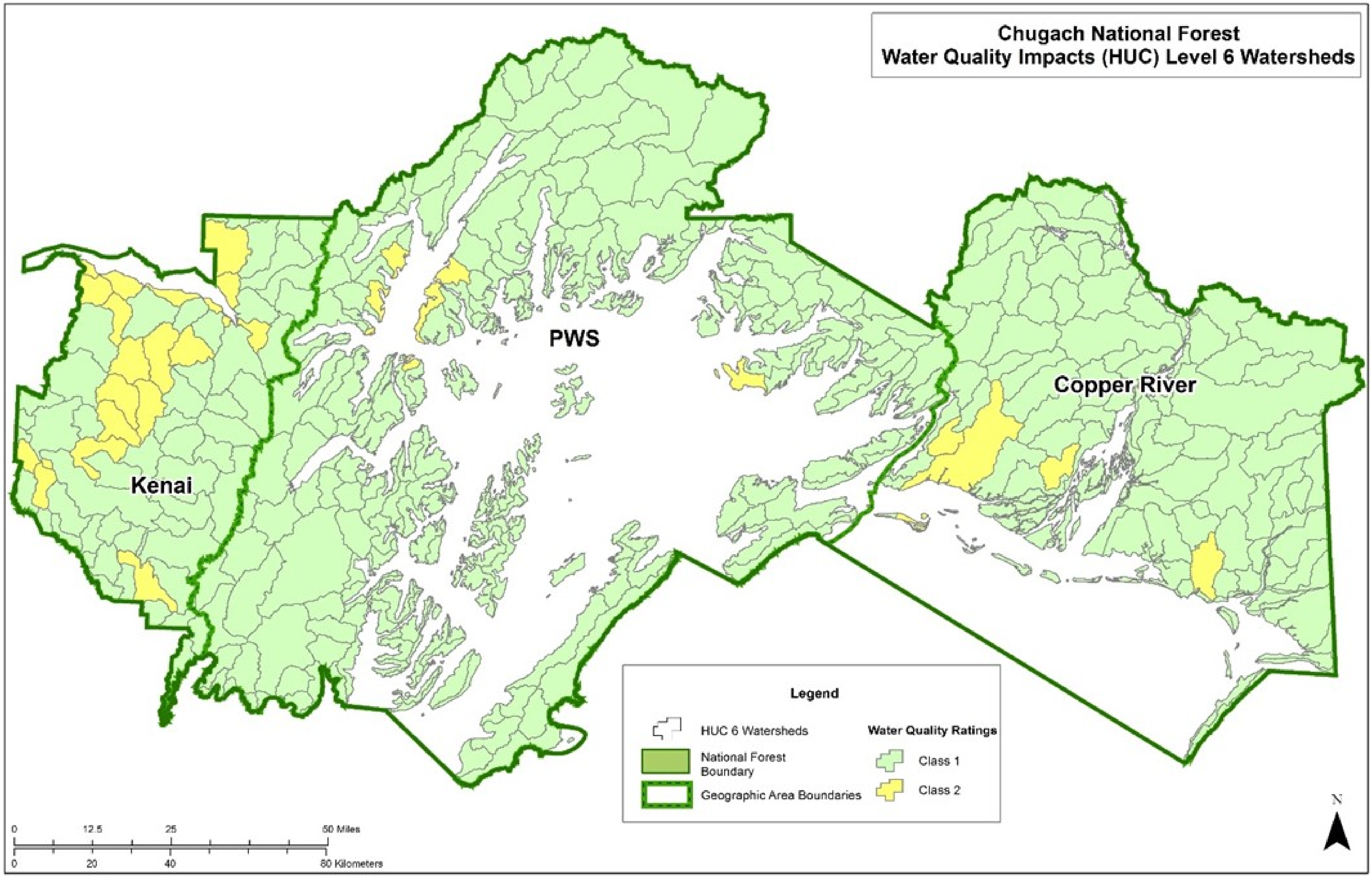
Non-listed watersheds were ranked and analyzed qualitatively on water quality problems based on input by resource professionals, knowledge, reports, and professional judgment of conditions in the watersheds using the guidelines in the technical guide (USDA 2011b).

Overall, water quality, both surface and subsurface, is good within the Chugach National Forest. Natural processes, such as glaciers, mass wasting, and natural bank erosion, remain the primary sources of sediment loads and turbidity in streams and rivers across the national forest. Human associated water quality concerns exist in limited locations primarily in heavily visited areas close to roads and in developed locations. The results of the water quality attribute rating for the watershed condition classification assessment for non-listed impaired waters are shown in table 78 and map 21.

Table 78. Water quality condition rating for impaired waters that are not 303(d) listed (Coleman et al. 2016)

Number of Watersheds	Rating
257	Good (1) Functioning Properly
18	Fair (2) Functioning at Risk
zero	Poor (3) Impaired Function

Despite the majority of Chugach National Forest watersheds water quality being rated Class 1, water quality concerns exist in a number of watersheds in limited locations. The following localized water quality concerns exist: erosion, sedimentation, and/or wetland damage from off-highway vehicles (OHVs) on authorized and unauthorized routes; sedimentation and pollutants associated with backcountry motor vehicle use; fecal coliform pollution from recreation related human waste; aquatic invasive species, sedimentation from mining activities; and sedimentation from roads, trails, and recreational activities.



Map 21. Chugach National Forest watersheds with water quality impacts

Eyak Lake, near Cordova, was placed on the 303(d) list for impaired waters in 2002-03 for non-attainment of the petroleum hydrocarbons oils and grease standard for petroleum products as a result of above ground storage tank spills. Remedial actions at the Cordova Electric power plant on Eyak Lake have been effective at eliminating sheen on the surface of the lake, which was observed in 2005. Groundwater treatment and monitoring is anticipated to continue at this site. Water quality studies were completed in 2005, 2006, and 2009. Alaska Department of Conservation removed Eyak Lake from the Category 5/Section 303(d) list and placed the waterbody in Category 2 in the final 2012 report (ADEC 2013).

A number of beaches in Prince William Sound were previously Section 303(d) listed in 1990 as a result of the petroleum products remaining from the *Exxon Valdez* oil spill but have been placed in Category 4b because of restoration efforts specified in the *Exxon Valdez* Restoration Plan.

A number of waterbodies within or near the Chugach National Forest are classified as Alaska Department of Conservation Category 3 for water quality impairment (ADEC 2010), including Bear Creek near Hope, Cooper Creek, Eyak River, Mills Creek, Quartz Creek, Resurrection Creek, and Two Moon Bay. While specific water quality issues have not necessarily been identified on these streams, they have been identified as being of concern for various reasons, which the State of Alaska and Forest Service have documented. Many of these have also been ranked as ACWA. All of these watersheds received a water quality Class 2 rating. Some watersheds with major highways immediately adjacent to streams or lakes on NFS lands also received a water quality Class 2 rating to account for road-derived pollutants. Refer to the Water Quality Section of chapter 2 (Ecological Conditions and Trends) in the forest plan assessment for more detail on the associated water quality impacts for these watersheds.

Elodea canadensis, an aquatic invasive species, is present within six watersheds on the Copper River Delta. Studies have shown that *Elodea* spp. can form large mass stands, which, during its life cycle, can alter water body chemical composition by depleting dissolved oxygen and lowering pH (Josefssn 2011). The water quality effects from *Elodea* spp. are not included in the watershed condition classification water quality condition rating. However, effects are currently being studied and the Alaska Department of Conservation is in the process of determining if aquatic invasive infested waters (i.e., *Elodea* infested) will be listed as state impaired water bodies in the future. Refer to the forest plan assessment and the Watershed Condition Classification Framework 5-Year Reassessment for the Chugach National Forest for more details on the water quality condition ratings for each 6th level (12-digit) HUC watershed (Coleman et al. 2016; USDA 2014a).

Studies of groundwater in the Cook Inlet Basin and on the Kenai Peninsula indicate that some domestic and public water supply wells yield water containing concentrations of arsenic that exceed the Alaska standard (Glass 1996). These studies and samples occurred outside, but close to the Chugach National Forest boundary and were not included in the watershed condition classification analysis. It is possible that these concentrations exist in national forest aquifers. Analyses of streambed substrate samples indicate that concentrations of arsenic in the Cook Inlet Basin appear to be naturally high (Frenzel 2000). Arsenic in surface water is derived primarily from the natural weathering of soils and rocks and from discharge of groundwater. Despite high concentrations in streambed substrate and groundwater samples, detectable arsenic concentrations were documented to be uncommon in surface waters of Cook Inlet basin streams (Glass 1996).

Trends in increased use, activities, and development coupled with the spread of aquatic invasive species and climate change may increase the potential for future impacts to water quality. The most significant effects of climate change to watersheds within the next few decades will be anticipated increased temperatures and changes in the amount, timing, and type of precipitation, such as rain and snow. The influence of these temperature and precipitation changes on different water quality attributes, such as turbidity and stream temperature, will vary across geographic areas and from one watershed to another due to the complex topography, surface geology, precipitation patterns, and presence of glaciers within the Chugach National Forest.

In glacial lacking, lower elevation watersheds there may be potential for streams, ponds, and wetlands to experience increased water temperatures due to the projected increase in the frequency of above freezing winter temperatures and reductions in snowpack. However, watersheds with more groundwater contributions and upwelling may be less thermally sensitive to be impacted by climate change (Adelfio 2016). The watersheds may also experience heightened turbidity levels from bank erosion due to increased fall and winter flood frequency and magnitudes, rain-on-snow events, and landslides as more precipitation falls as rain rather than snow. The sensitivity of run-off and erosion within watersheds will vary by geographic location and be influenced by the geology, Alaska stream type channel classification, and aquatic and riparian habitat characteristics.

Glacial watersheds may exhibit increased turbidity due to increased mid-summer flows as more melt occurs with the receding glaciers. However, in some susceptible watersheds with low glacial volumes, climate change may actually improve water quality by lessening turbidity as the glaciers retreat (Hayward et al. 2017; USDA 2014a).

Projected increased temperatures from climate change may also influence the frequency, extent, and severity of wildfires within the Chugach National Forest, particularly within the Kenai Peninsula Geographic Area (EPA 2016; Haufler et al. 2010). As fires increase in frequency, size, and severity, there will be increased likelihood for erosion and water quality degradation in fire affected watersheds.

Watershed Condition

Watershed condition is the state of physical and biological characteristics and processes within a watershed that affect the hydrologic and soil functions supporting aquatic and terrestrial ecosystems. This section describes the overall condition and trends of Chugach National Forest watersheds, as assessed as part of the watershed condition classification assessment.

Overall, the majority of Chugach National Forest watersheds are in a good, functioning properly condition (Class 1). Results of the Chugach National Forest watershed condition classification analysis are displayed in table 79 and on map 22 (Coleman et al. 2016; USDA 2011b). Much of this may be attributed to a combination of the glacial coverage and roadless character of the national forest. Minimal human impacts exist on 64 percent of the watersheds with 21 percent of the watersheds containing greater than 50 percent glacier coverage and 43 percent of the watersheds dominantly roadless and/or only accessible by boat and/or floatplane. Variable degrees of human impacts exist in 36 percent of the watersheds with half of these located along road systems (MacFarlane et al. 2011). The only two watersheds that are not rated as overall watershed condition Class 1, and are rated Class 2 (fair, functioning at risk) are Resurrection Creek near Hope and Cooper Creek near Cooper Landing. Refer to the Aquatic Ecosystems-Watersheds section of chapter 2 (Ecological Conditions and Trends) in the forest plan assessment for more detail on all of the overall watershed condition ratings for each watershed.

Table 79. Overall current watershed condition ratings for the Chugach National Forest (Coleman et al. 2016)

Number of Watersheds	Rating
273	Good (1) Functioning Properly
2	Fair (2) Functioning at Risk
zero	Poor (3) Impaired Function

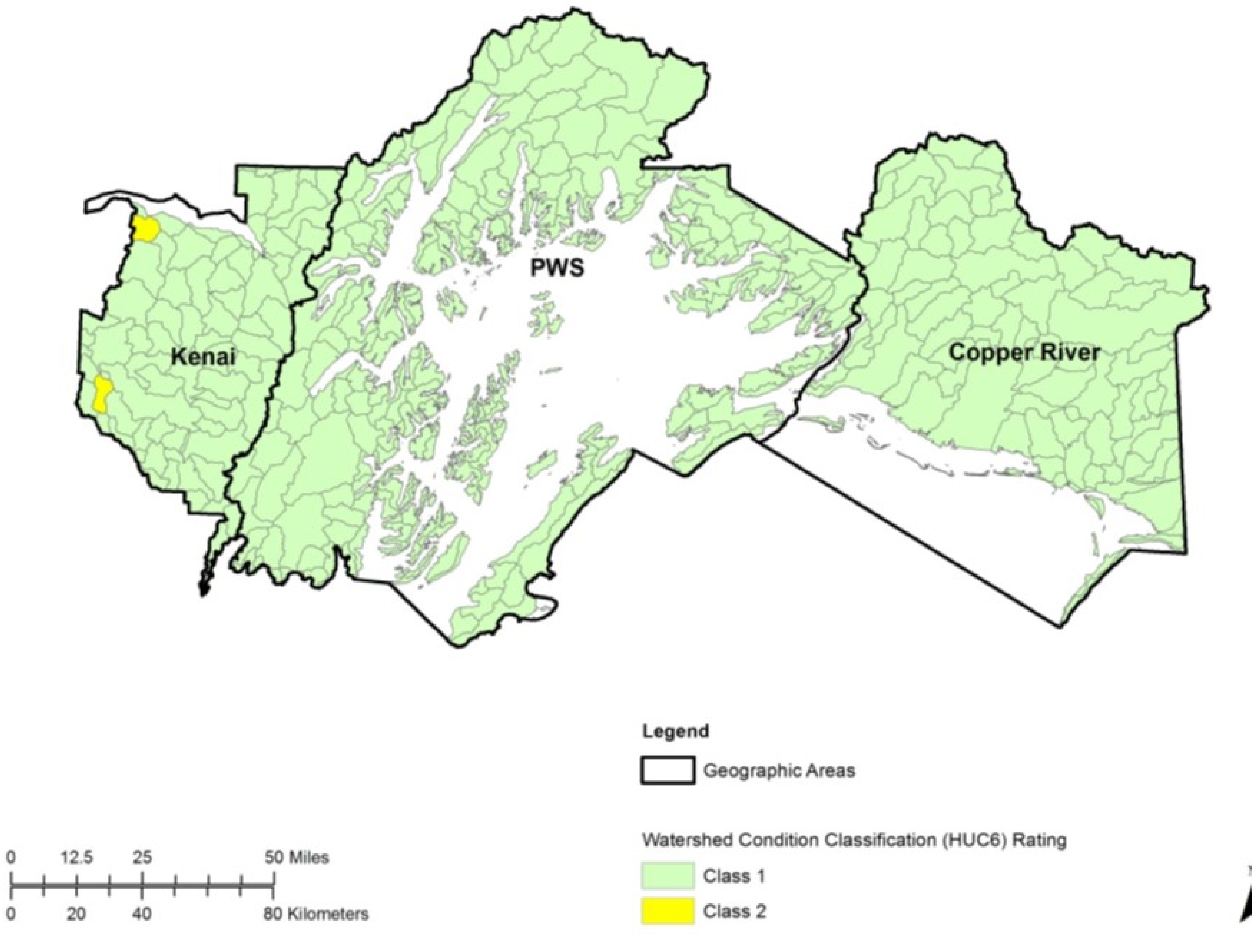
Because 99 percent of Chugach National Forest watersheds are in Class 1 (good, functioning properly condition) they are considered to have good integrity and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities. Despite this, concerns associated with human impacts exist in a number of watersheds in limited locations. The major sources of human impacts to watersheds within the Chugach National Forest, particularly to stream channel morphology, include bank degradation from recreational uses, such as fishing the Russian River, erosion, sedimentation, and wetland damage from user trails (foot and OHV), particularly on the Copper River Delta, historic placer mining on Resurrection and Cooper Creeks, existing placer mining operations, gravel extraction (such as in Portage Valley), recreational dredging, and roads. Other impacts, such as invasive species, also affect watershed conditions. The aquatic invasive species *Elodea canadensis*, first documented in 1982 in Eyak Lake near Cordova, has now spread via floatplanes and boats and infests six Copper River Delta watersheds within the Chugach National Forest.

Watershed restoration projects have included large scale stream and riparian restoration projects, small scale stream bank restoration projects, trail improvements, and abandoned mine cleanup efforts. In high use areas within the national forest, bank erosion from angler trampling has been a persistent problem and has been difficult to address. The construction of angler trails, boardwalks, and river access stairs on the Russian River in conjunction with bank reconstruction has improved some of these conditions. Other restoration projects, such as Resurrection Creek (Phase I), have successfully dealt with historic mining impacts as will future anticipated projects (Resurrection Creek Phase II and Cooper Creek). Rerouting OHV trails and user education have also benefited areas within the Copper River Delta. Watershed restoration work and monitoring on lands affected by the *Exxon Valdez* oil spill, including acquired lands on Knowles Head, have also been implemented. All of these projects have improved the functions of streams and riparian areas and water quality associated with impacts from past or historic land management and current activities.

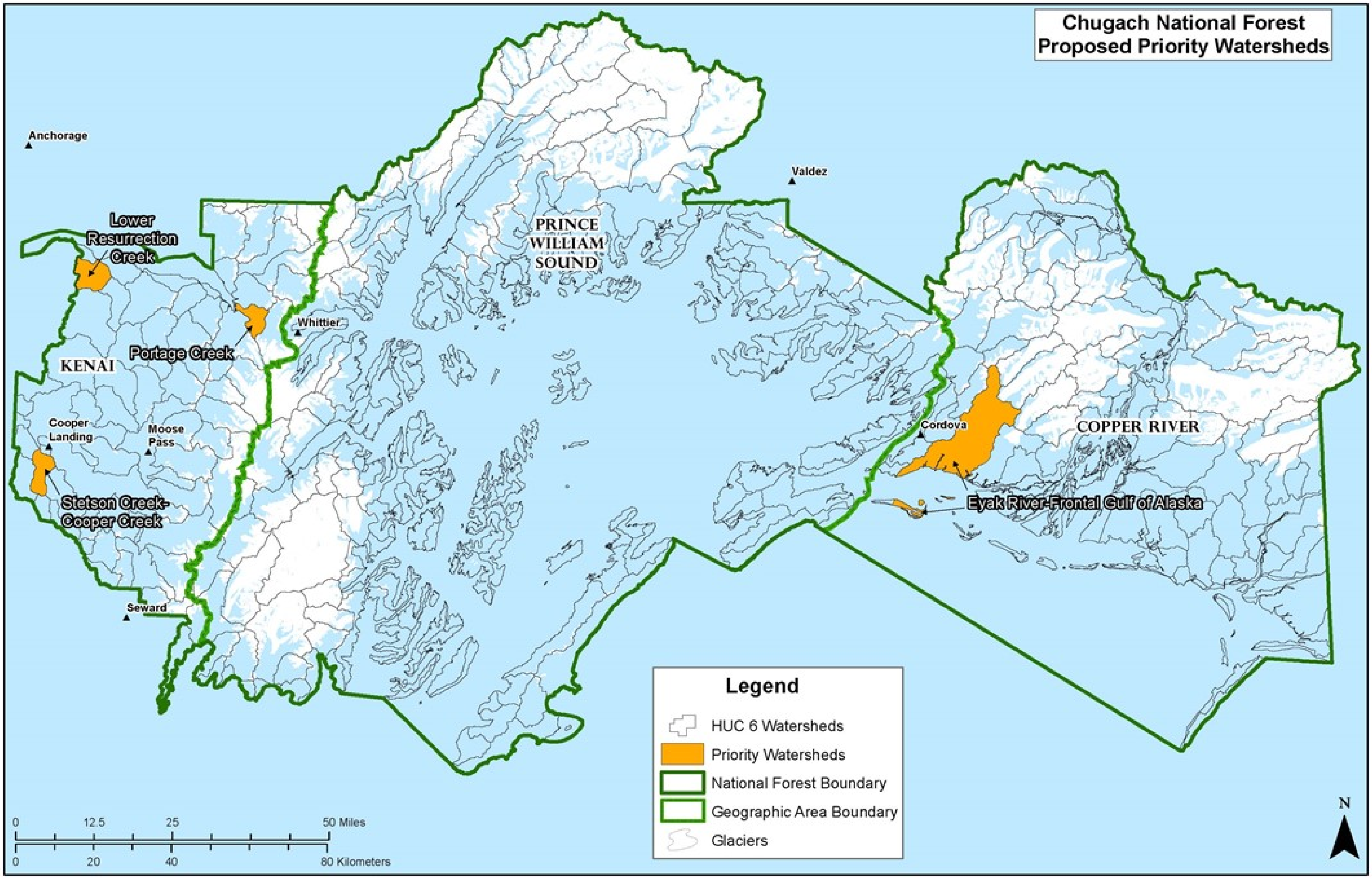
Herbicide treatments for eradicating *Elodea canadensis* in a few ponds and sloughs on the Copper River Delta has also occurred within the last few years and future work is planned. Continuing to restore priority watersheds will maintain and improve watershed integrity. Additionally, mechanisms, such as BMPs, reclamation, access control, and forest plan standards and guidelines, are in place to mitigate the impact of Forest Service activities and protect water quality.

Trends in increased use, activities, and development coupled with the spread of aquatic invasive species and climate change may increase the potential for future degradation.

The most significant effects of climate change to watersheds will be anticipated increased temperatures and changes in the amount, timing, and type of precipitation, such as rain and snow. These temperature and precipitation changes may influence overall watershed conditions by changing water quantity, water quality, wetlands and riparian areas, fire regimes, and insect infestations (Berg et al. 2006; Berg et al. 2009; EPA 2016; Haufler et al. 2010; Wilken et al. 2011).



Map 22. Overall current watershed condition classification ratings for 6th level (12-digit) HUC watersheds within the Chugach National Forest (Coleman et al. 2016)



Map 23. Chugach National Forest priority watersheds

Identification of priority watersheds using the Forest Service national watershed condition framework was completed by an interdisciplinary team process to focus efforts on five-year integrated restoration of watershed conditions in those areas based on criteria listed in FSH 1909.12 chapter 20. Priority watersheds were selected based on existing restoration priorities and included sites of ongoing restoration, or restoration actions that are expected to be completed or started during the life of the plan, so that priority watersheds consist of those areas where restoration actions are proposed or are being planned during the next 10 to 20 years. It is expected that when work is completed in priority watersheds that new sets of priority watersheds will be developed so that restoration needs are met over the long term but work remains focused in a smaller set of watersheds at any given time. Table 80 and map 23 display the current Chugach National Forest priority watersheds. Refer to the watershed condition framework map viewer for the most up to date and current priority watersheds and Watershed Restoration Action Plans.

Table 80. Chugach National Forest priority watersheds

Subbasin	12-digit HUC	6th level Sub-Watershed Name	NFS acres (land)	Percentage of land as NFS	Geographic Area
Lower Cooper River	190201041605	Eyak River-Frontal Gulf of Alaska	63,084	83	CRD
Upper Kenai Peninsula	190203020304	Portage Creek	8,737	90	KPZ
	190203020504	Lower Resurrection Creek	12,984	91	KPZ
	190203021403	Stetson Creek-Cooper Creek	11,054	99	KPZ

Environmental Consequences

The indirect effects to watersheds and water resources, are addressed under each alternative qualitatively. Each revision topic, highlighted in chapter 1, the Need for Change, are addressed across the alternatives. The cumulative effects to watersheds and water resources are described as common across all alternatives.

Consequences Common to all Alternatives

Watershed Integrity, Sustainability and Resilience to Climate Change

A major driver of change to Chugach National Forest watersheds is climate change. The effects of climate change on watersheds and water resources will remain the same under all of the alternatives. Other drivers of change, including aquatic invasive species, wildfires, and insects and disease, will also remain the same under all of the alternatives. Because 99 percent of Chugach National Forest watersheds are in Class 1 condition (good, functioning properly), they are considered to have high integrity and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities.

Water Resources and Watersheds to Cultural, Economic, and Social Sustainability

Chugach National Forest water resources and watersheds will continue to contribute to the social, economic, and cultural sustainability of communities in the plan area under all of the alternatives. The likely increase in future water use, both consumptive and non-consumptive, and impacts from climate change on those uses will also remain the same under all alternatives. The suitable and recommended

Wild and Scenic Rivers and their management direction will also remain the same under all alternatives.

Alternative A No Action

Alternative A would continue current management as described in the 2002 forest plan. This alternative would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. While adequate measures are provided for providing instream flow to maintain and support aquatic life and habitat, recreation, and aesthetics, the natural flow conveyance of water and sediment, and other resources that depend on such flows on NFS lands, there is no strong direction for reserving in steam flow reservations and acquiring water rights.

The designated wilderness study area boundary and wilderness recommendation would remain consistent with the 2002 forest plan. There are 4,372,657 acres open to mineral entry under alternative A (no-action) if the recommended wilderness area is not acted upon and the current condition remains unchanged. There would be 2,985,147 acres open to mineral entry under alternative A in the event that the recommended wilderness area becomes a designated wilderness area. Upon designation, 1,387,510 additional acres of land would be withdrawn from mineral entry, subject to valid existing rights. Under alternative A, current short term and long term potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development would retain the same footprint. Additionally potential short term and long term water quality environmental consequences, such as sedimentation, erosion and contamination, associated with mineral development would remain the same within the national forest.

Recreation opportunity spectrum classes and management prescription areas would remain consistent with the 2002 forest plan. The current opportunities for summer and winter motorized and non-motorized activities and guided special uses would remain the same. Potential impacts to water quality and overall watershed conditions from snowmachines, helicopters and all-terrain vehicles (ATVs) would remain at current levels. Water quality and overall watershed condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would also remain the same. In general all of these recreation effects are short term and low except at points of concentrated use. Proper management, use of BMPs and standards and guidelines outlined in the 2002 forest plan would continue to reduce potential recreational impacts to water resources and overall watershed conditions.

Alternative B

Alternative B, similar to alternative A, would continue management direction providing for ecological sustainability. This alternative would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Plan components have been modified and added to provide more of an emphasis towards providing ecosystem resilience for changing conditions. Some of these changes include additional objectives and management strategies to file for instream flow reservations with the state to meet critical water demands on NFS lands to maintain fish and wildlife species and habitats and support recreational activities.

The alternative B wilderness area recommendation, similar to alternative A, would remain consistent with the 2002 forest plan. Upon designation, the number of acres of land withdrawn from mineral entry would remain the same (1,387,510 acres). The footprint of the potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development would remain the same. Additionally, the footprint of potential water quality stressors and impacts, such as sedimentation, erosion and contamination, associated with mineral development would remain the same.

Alternative B recreation opportunity spectrum classes and management prescription area changes from alternative A would have potential minor effects on water resources and watershed conditions. Most of these changes are focused on the Kenai Peninsula and reflect changes that incorporate the Kenai Winter Access Project Record of Decision (2007) management direction. Overall, there would be a small decrease (less than 1 percent) in Semi-primitive opportunities for winter and summer Motorized use. Potential impacts to water resources and overall watershed conditions from snowmachines, helicopters and off-highway vehicles (OHVs) would decrease negligibly compared to alternative A. Water quality and overall watershed condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would remain the same as alternative A.

Alternative C

Alternative C, similar to alternatives A and B, would continue management direction providing for ecological sustainability. This alternative would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Plan components, similar to alternative B, have been modified and added to provide more of an emphasis and more proactive approach towards providing ecosystem resilience for changing conditions. Under this alternative, the Forest Service would be proactive in collaboratively acquiring instream flow reservations through the State of Alaska.

Wilderness area recommendation, upon designation, would have more acres withdrawn from mineral entry than alternatives A and B (1,819,700 acres). This increase in the number of acres withdrawn from mineral activities under alternative C would reduce the acreage of potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development. Additionally, potential water quality stressors and impacts, such as sedimentation, erosion, or contamination, associated with mineral development would also be reduced.

Recreation opportunity spectrum classes and management prescription area changes and associated potential water resources and watershed condition effects vary from alternatives A and B. These variations will be explored by geographic area.

Within the Kenai Peninsula Geographic Area, alternative C offers a small increase (6 percent) in the primitive recreation class and backcountry management area. With the backcountry management area and the primitive recreation class, it is reasonable to assume that there will be fewer people and smaller parties than with the alternatives A and B semi-primitive recreation class. Associated impacts from special use authorizations, such as outfitters and guides, may decrease slightly due to future limitations set by management on party size and number of permits. Thus, it is assumed that potential water quality and overall watershed condition impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly compared to alternatives A and B. Additionally, alternative C offers increased opportunities (16 percent) for winter recreational motorized use. Potential impacts to water quality and overall watershed conditions associated with snowmachine and helicopter use may increase. In general the environmental consequences would be low except at points of concentrated use.

Alternative C offers an increase (28 percent) in the primitive recreation class within Prince William Sound, primarily within the eastern portion. With the primitive recreation class, it is reasonable to assume that there will be fewer people and smaller parties than with the alternatives A and B semi-primitive recreation class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential water quality and overall watershed condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B. It is important to note that the Prince William Sound framework illustrated that outfitters and guide use only accounts for 10 percent of actual use. Thus, these small reductions in potential future special use permitting allocations may only result in nominal improvement in watershed conditions.

Alternative C, on the Copper River Delta, offers a decrease (25 percent) in the primitive recreation class and increases in semi-primitive motorized use south of the Copper River Highway (5 percent) and semi-primitive winter motorized use north of the Scott and Sheridan glaciers (20 percent) compared to alternatives A and B. Potential impacts to water resources and overall watershed conditions from snowmachines, helicopters, OHVs and motor boats would increase compared to alternatives A and B. Additional impacts from recreation opportunity spectrum class changes include increased opportunities for larger and more frequent outfitters and guide party sizes. Larger and more frequent groups have a higher potential for impacting streams, riparian areas, and water resources. In general, the environmental consequences to water resources and overall watershed conditions would be low except at points of concentrated use. Proper management and use of BMPs and standards and guidelines would reduce these impacts.

Alternative D

Alternative D, similar to all alternatives, would continue the management direction providing for ecological sustainability. All alternatives would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Plan components, similar to alternatives B and C, have been modified and added to provide more of an emphasis towards providing ecosystem resilience for changing conditions. As in alternative C, under this alternative, the Forest Service would be proactive in collaboratively acquiring instream flow reservations through the State of Alaska.

Alternative D, upon wilderness area designation, would have the largest number of acres withdrawn from mineral entry (1,884,200 acres). Alternative D would reduce the footprint of potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development more than any other alternative. Additionally, it would reduce potential water quality stressors and impacts associated with mineral development more than any other alternative.

Similar to alternative C, recreation opportunity spectrum classes and management prescription area changes and associated potential water resources and watershed condition effects vary from alternatives A and B. The variations between D and C are very minor, only occur within Prince William Sound, and are associated with the changes in the recommended wilderness area. Overall, alternative D offers an increase (less than 2 percent) in the primitive recreation class within the Prince William Sound compared to alternative C. Alternative D has the largest percentage of primitive recreation class of all of the alternatives. With the primitive recreation class, it is reasonable to assume that there will be less people and smaller parties than with the semi-primitive recreation class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly in the future due to management limitations on party size and number of permits. Thus, it is assumed that potential water quality and overall watershed condition impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B and decrease negligibly compared to alternative C. It is important to note that the Prince William Sound framework illustrated that outfitter guide use only accounts for 10 percent of actual use. Thus, it is difficult to quantify the amount of water resource and watershed condition improvement that would occur from these small reductions in potential future special use permitting allocations.

Cumulative Effects

Most watersheds within the national forest are in good condition and are functioning properly. Potential cumulative effects on watersheds and water resources resulting from past, current, and future management are based on the total amount of disturbance within the effects analysis area described previously. Past management activities have been concentrated within certain watersheds. These are the watersheds where most activities under any alternative would occur. The additional effects of reasonably foreseeable major projects and the plans for adjacent land ownerships are addressed qualitatively and are common across all alternatives.

The largest foreseeable major projects and plans within the analysis area include the State of Alaska DNR/Copper River Basin Plan, the State of Alaska DNR/Prince William Sound Area Plan, the State of Alaska DNR/ Kenai Area Plan, foreseeable development on CAC lands, the Kenai Hydro LLC Grant Lake Hydroelectric project, the Sterling Highway re-route, the Seward Highway improvements, and associated activities on the Kenai National Wildlife Refuge, and the Wrangell St. Elias and Kenai Fiords National Parks. For the most part, all of the aforementioned plans and the adjacent land owners' management directions align with Forest Service management direction. Due to these alignments, measureable effects would be negligible. The only discernable effects on watersheds and water resources within the analysis area would be from the Kenai Hydro LLC Grant Lake project, the Sterling Highway Re-route, the Seward Highway improvements, and foreseeable development of CAC lands.

Foreseeable direct effects on watersheds and water resources from the Kenai Hydro LLC Grant Lake project include short-term and long-term adverse impacts to water quality, water quantity, and overall watershed conditions. The construction of the hydroelectric facility will result in altered water quantity in Grant Lake and Grant Creek. The fluctuating water levels will be different from the natural hydrograph and may result in potential impacts to aquatic habitat, riparian habitats, and hydrologic connectivity on tributaries entering Grant Lake. These impacts will last the duration of the life of the dam. Water quality impacts from the project will be both chemical and physical and short term (construction phase) and long term (life of the dam) in nature. Implementation of BMPs will mitigate some of these effects. The cumulative effects on overall watershed condition from this project has a moderate to high potential to move one 6th level HUC watershed (Grant Lake-Grant Creek) from a Class 1 condition into a Class 2 condition due to alterations in water quality, water quantity, aquatic habitat, riparian vegetation, and the presence of new roads and trails.

Foreseeable effects on watersheds and water resources from the Sterling Highway Re-route project include short term direct effects and long term direct and indirect effects on water quality and overall watershed condition. Short-term direct effects include minor adverse effects to water quality related to construction. Implementation of BMPs should mitigate some of these effects. Long term direct adverse effects include loss of wetlands and hydrologic connectivity. Long term indirect beneficial effects include potential improved water quality for the Kenai River due to the decreased risk and likelihood of accidents, spills, and contaminants. The overall cumulative effects on watershed condition classification from this project may result in a few degraded watershed condition class attribute ratings due to the increased road miles and loss of wetlands from the re-route. These downgraded attributes have a low potential of changing one 6th level (12-digit) HUC watershed (Kenia Lake) watershed condition classification rating from a Class 1 to a Class 2.

Foreseeable effects on watersheds and water resources from the Seward Highway improvements project include minor short term adverse effects, long term indirect and direct adverse effects, long term beneficial effects to water quality, and overall watershed condition. Short term direct effects include minor adverse effects to water quality related to construction. Implementation of BMPs should mitigate some of these effects. Long term direct adverse effects include loss of wetlands and hydrologic connectivity alteration due to the expansion of the highway and parking lots. Long term indirect effects include increased winter snowmachine access and summer motorized boat access from improved parking areas along Placer and Twentymile rivers. Increased motorized access has the potential for impacts to water quality from petroleum containments and increased erosion from boat wakes, trampling, and general increased use. Long term beneficial effects of the project include improved aquatic organism passage and hydrologic connectivity for a few culverts The overall cumulative effects on watershed condition class from this project may result in a few degraded watershed condition classification attribute ratings due to the increased road and trail miles and loss of wetlands from the expansion; however, it is unlikely that there would be any changes to any watershed condition classification ratings.

Foreseeable effects on watersheds and water resources from future developments on CAC lands are also possible; however, it is difficult to quantify the magnitude and duration of these effects due to the unknown nature of the developments. It is anticipated that some of these developments may include construction of access roads and trails to inholdings, mineral extraction sites, including extraction from sub-surface estate lands owned by CAC, and timber harvest. Each of these activities has the potential to impact water quality, water quantity, and overall watershed conditions due to erosion, hydrologic connectivity alteration, and loss of wetlands.

Analytical Conclusions

Watersheds and water resources within the Chugach National Forest support many ecosystem services and provide a substantial contribution to social and economic sustainability in southcentral Alaska. Watersheds and water resources within the Chugach National Forest generally are in good condition and are functioning properly. Much of this may be attributed to a combination of the glacial coverage and roadless character of the national forest. Most of the watersheds have free-flowing rivers and streams, unmodified lakes and limited large-scale industrial groundwater withdrawals. Overall, water quality, both on the surface and subsurface, is good within the Chugach National Forest. Natural processes, such as glaciers, mass wasting, and natural bank erosion, remain the primary sources of sediment loads and turbidity in streams and rivers across the national forest. Exceptions to this occurs in a few localized areas, primarily in heavily visited areas near communities and along the road systems.

All alternatives would continue management direction providing for ecological sustainability. All alternatives would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available.

The effects of alternative B on watersheds and water resources are very similar to alternative A except where changes in recreation opportunity spectrum classes were made to address the 2007 Kenai Winter Access Project decision that changed access for winter motorized recreation. Potential impacts to water resources and overall watershed conditions from snowmachines, helicopters, and OHVs would decrease negligibly compared to alternative A.

The effects of alternative C on watersheds and water resources are very similar to alternatives A and B except where changes were made in the wilderness area recommendation and recreation opportunity spectrum classes. The alternative C wilderness recommendation, upon designation, would have a larger number of acres withdrawn from mineral entry than alternatives A and B. This increase in the number of acres withdrawn from mineral activities under alternative C would reduce the acreage of potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development. Additionally, potential water quality stressors and impacts, such as sedimentation, erosion, or contamination, associated with mineral development would also be reduced. Alternative C recreation opportunity spectrum class changes vary by geographic area.

On the Kenai Peninsula and within Prince William Sound, the indirect effects of the increase in the primitive recreation class and backcountry management of alternative C may result in slight improvement in water quality and overall watershed conditions compared to alternatives A and B. However, impacts to water quality and overall watershed conditions associated with increased snowmachine and helicopter use on the Kenai Peninsula may increase slightly compared to alternatives A and B. On the Copper River Delta, indirect effects of the decrease in the primitive recreation class and increase in the Semi-motorized class has the potential to impact water resources and overall watershed conditions from increased snowmachine, helicopter, OHV, and motor boat use compared to alternatives A and B. In general the environmental consequences to water resources and overall watershed conditions in alternative C would be low except at points of concentrated use. Proper management and the use of BMPs and standards and guidelines would reduce these impacts.

The effects of alternative D on watersheds and water resources are very similar to alternatives A, B, and C except where changes were made in the wilderness area recommendation and the recreation opportunity spectrum classes. Alternative D, upon wilderness area designation, would have the largest number of acres withdrawn from mineral entry. Alternative D would reduce the footprint of potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development more than any other alternative. Additionally, it would reduce potential water quality stressors and impacts associated with mineral development more than any other alternative. Similar to alternative C, recreation opportunity spectrum classes and management prescription area changes and associated potential water resources and watershed condition effects vary from alternatives A and B.

The variations between D and C are very minor, only occur within Prince William Sound, and are associated with the changes in the recommended wilderness area. Alternative D offers a slight increase in the primitive recreation class within the Prince William Sound compared to alternative C. Alternative D has the largest percentage of the primitive recreation class of all of the alternatives. Primitive recreation classes indicate that there will be less people and smaller parties than with semi-primitive recreation classes. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential water quality and overall watershed condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B and decrease negligibly compared to alternative C.

Overall, all of the alternatives would result in minimal environmental consequences to watersheds and water resources. Ninety-nine percent of the Chugach National Forest watersheds are in Class 1 (good, functioning properly condition) and are considered to have good integrity. Watersheds with good integrity are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities.

Riparian and Wetland Resources

Introduction

Riparian areas are the interface between terrestrial and aquatic ecosystems and are an integral part of watersheds. Riparian ecosystems are characterized by the presence of trees, shrubs, or herbaceous vegetation that require free or unbound water or conditions that are moister than surrounding areas. Typical examples include floodplains, streambanks, lakeshores, tidal flats and sloughs, saltwater marshes, estuaries, freshwater ponds, marshes, bogs, muskegs, and forested wetlands. Riparian ecosystems are generally inclusive of wetlands.

Properly functioning riparian and wetland areas improve water quality, reduce erosion, filter sediment, capture bedload, stabilize streambanks, and act as a sink for atmospheric carbon. Riparian vegetation is a source of nourishment for many animals from insects to mammals, including the organic matter that is an important source of nourishment to aquatic organisms. It also aids in providing leaf litter and terrestrial invertebrates to streams. Additionally, healthy riparian and wetland areas provide diverse habitats for fish, wildlife, waterfowl, and other species, many of which are obligates to this ecosystem for all or part of their life cycle. Riparian areas also provide travel corridors for wildlife, refugia for some species, and can provide essential temperature moderation.

High water availability within the national forest results in a great abundance and variety of wetlands. Total wetlands as inventoried by the National Wetlands Inventory using the Cowardin system (Cowardin 1979) cover about 23 percent of the national forest. More than half of these wetlands are in the Copper River Delta Geographic Area. The Copper River Delta is the largest contiguous wetland on the Pacific coast of North America. There are 700,000 acres of wetlands plus associated uplands, and the area is a two million acre management unit that provides important fish and wildlife habitat. Refer to the Aquatic Ecosystems-Riparian Areas and Wetlands Section in chapter 2 (Ecological Conditions and Trends) of the forest plan assessment for more detail on the types and distributions of wetlands within the Chugach National Forest.

Methodology

Spatial Scale

The watershed scale utilized in this analysis is the 6th level (12-digit) Hydrologic Unit Code (HUC). The 6th level HUC watersheds are delineated by the U.S. Geological Survey as part of their Watershed Boundary Data Classification System. This 6th level HUC watershed scale is commonly used for effects analyses and is consistent with the spatial scale used for National Watershed Condition Framework and Classification guidance (USDA 2011a; USDA 2011b). Watersheds analyzed included any 6th level HUC located within the Chugach National Forest boundary. Within this boundary, there are 275 6th level HUC watersheds (see map 18 in the Watersheds and Water Resources section).

Temporal Scale

This analysis is bounded in time by the foreseeable future period during which the effects of plan implementation may persist as detectable. In general, effects are described as short-term (less than a year) and long-term (persistent or lasting several years.) The plan period is 15 years; however, trends are described for a much longer timescale, including several decades.

Measurement Indicators

Riparian area and wetland vegetation condition was one of the attribute indicators for the watershed condition classification assessment. As part of this effort, function and condition of native riparian vegetation along streams, water bodies, and wetlands were evaluated for the Chugach National Forest. The overall riparian and wetland conditions described for the Chugach National Forest are based on the protocols developed for the national Watershed Condition Framework and the Forest Service Watershed Condition Classification Technical Guide (USDA 2011a; USDA 2011b). The national protocols utilize a wide array of indicators and attributes from aquatic physical, aquatic biologic, terrestrial physical, and terrestrial biological process categories. The categories represent ecosystem processes or mechanisms by which management actions can affect the condition of watersheds and associated resources.

Table 76 within the Watersheds and Water Resources section provides a summary of the watershed condition indicator model with table 81 of this section outlining the riparian/wetland vegetation condition rating rule set. Riparian areas and wetlands function and condition attributes evaluated include:

- Diverse age-class distribution of native riparian and wetland vegetation (recruitment for maintenance and recovery)
- Diverse composition of native riparian and wetland vegetation (for maintenance and recovery)
- Presence of native species that indicated maintenance of riparian/wetland soil moisture characteristics and connectivity between the riparian and wetland vegetation and the water table typical of riparian/wetland systems in the area
- Streambank native vegetation (with plants or plant communities that have root masses capable of withstanding high streamflow events)
- Native riparian and wetland vegetation adequately covers and protects the banks and dissipates energy during high flows

- Plant vigor: the presence of plant communities that will provide an adequate source of coarse and/or large woody material (for maintenance and recovery)

Using this model, Chugach National Forest watershed riparian and wetland conditions were classified by each attribute into one of three condition classes: Class 1 (good, functioning properly); Class 2 (fair, functioning at risk); or Class 3 (poor, functionally impaired).

Table 81. Riparian/wetland vegetation condition rating rule set (USDA 2011a; USDA 2011b)

Riparian/ Wetland Vegetation Condition Indicator	Native vegetation is functioning properly throughout the stream corridor or along wetlands and water bodies.	Disturbance partially compromises the properly functioning condition of native vegetation attributes in stream corridor areas or along wetlands and water bodies.	A large percent of native vegetation attributes along stream corridors, wetlands, and water bodies is not functioning properly.
Attributes	**Good (Class 1) Functioning Properly**	**Fair (Class 2) Functioning at Risk**	**Poor (Class 3) Impaired Function**
Vegetation Condition	Native mid to late seral vegetation appropriate to the site's potential dominates the plant communities and is vigorous, healthy, and diverse in age, structure, cover and composition on more than 80 percent of the riparian/wetland areas in the watershed. Sufficient reproduction of native species appropriate to the site is occurring to ensure sustainability. Mesic herbaceous plant communities occupy most of their site potential. Vegetation is in dynamic equilibrium appropriate to the stream or wetland system.	Native vegetation demonstrates a moderate loss of vigor, reproduction, and growth, or it changes in composition, especially in areas most susceptible to human impact. Areas displaying light to moderate impact to structure, reproduction, composition, and cover may occupy 25 to 80 percent of the overall riparian area with only a few areas displaying significant impacts. Up to 25 percent of species cover or composition occurs from early seral species and/or there exists some localized but relatively small areas where early seral vegetation dominates, but the communities across the watershed are still dominated by mid to late seral vegetation. Xeric herbaceous communities exist where water relationships have been altered but they are relatively small and localized, generally are not continuous across large areas, and do not dominate across the watershed.	Native vegetation is vigorous, healthy, and diverse in age, structure, cover, and composition on less than 25 percent of the riparian/wetland areas in the watershed. Native vegetation demonstrates a noticeable loss of vigor, reproduction, growth, and changes in composition as compared to the site's potential communities throughout the areas most susceptible to human impact. In these areas, cover and composition are strongly reflective of early seral species dominance although late and mid seral species will be present, especially in pockets. Mesic-dependent herbaceous vegetation is limited in extent with many lower terraces dominated by xeric species most commonly associated with uplands. Reproduction of mid- and late-seral species is very limited. For much of the area, the water table is disconnected from the riparian area and the vegetation reflects loss of available soil water.

Data sources for this analysis include resource specialist knowledge of local riparian conditions, information from various landscape assessments completed between 2000 and 2014, the FACTS GIS database delineating areas of past riparian harvest, Alaska-wide insects GIS database delineating areas of spruce bark beetle infestation, State and Private Forestry information, and Chugach National Forest corporate GIS database (legacy water features and streams).

Affected Environment

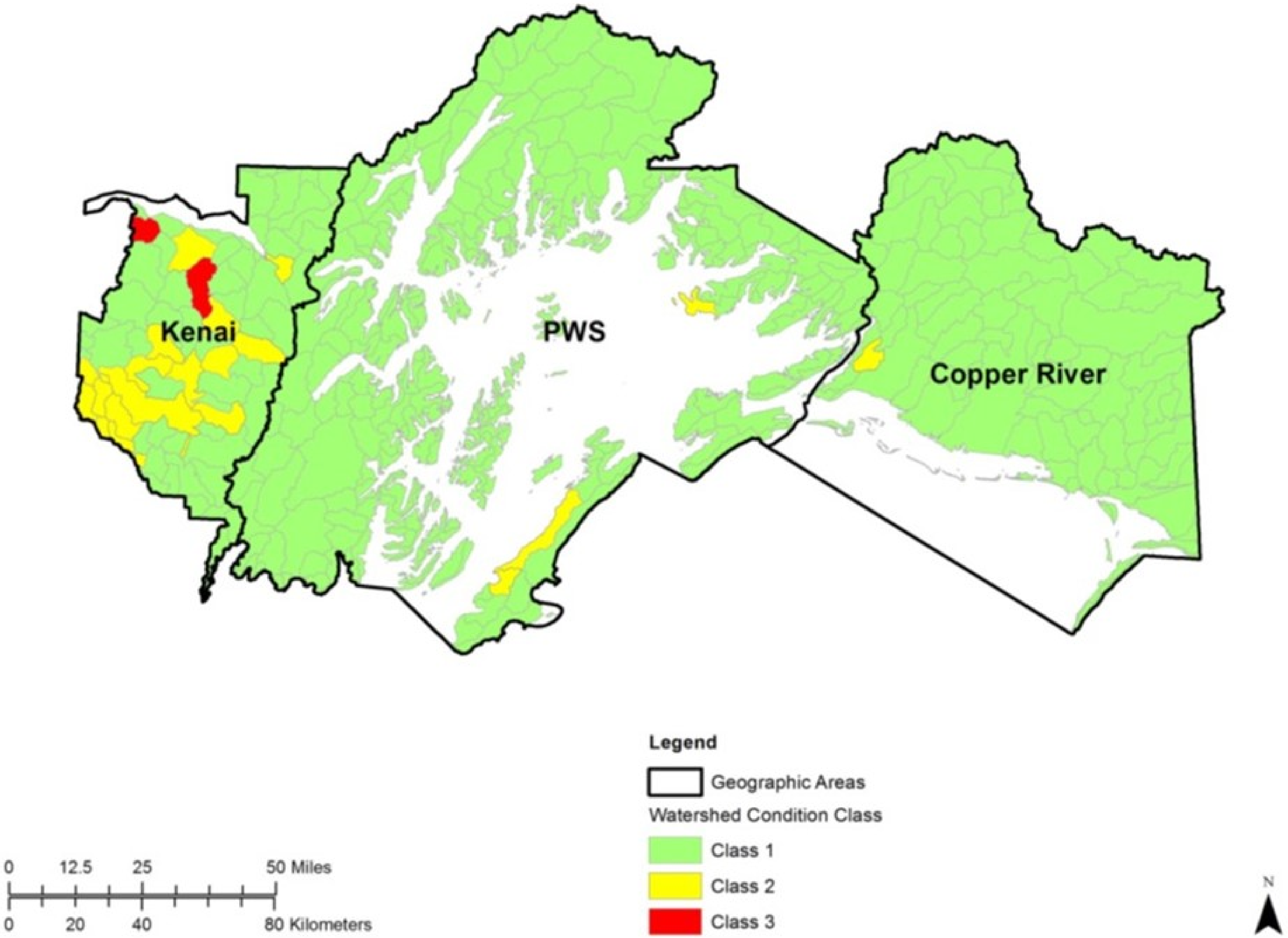
Chugach National Forest riparian and wetland vegetation function and condition was evaluated as part of the watershed condition classification effort. Overall, national forest riparian area and wetland conditions are good and are functioning properly (Class 1). The majority of riparian and wetland areas within the Chugach National Forest are unmanaged. Impacts to riparian area and wetland vegetation are limited and localized. These impacts primarily occur along roads; in OHV use areas; in places where fuelwood, timber harvest, and large scale mining have occurred; in high recreational use areas (i.e., Russian River); and in areas affected by the spruce beetle infestation during the 1990s. More than 80 percent of the riparian and wetland impacted watersheds within the national forest are on the Kenai Peninsula where human population and use is greater and the effects of the spruce beetle is more common. The results of the watershed condition classification rating for riparian and wetland conditions within the Chugach National Forest are displayed in table 82 and on map 24. Refer to the Aquatic Ecosystems-Riparian Areas and Wetlands Section in chapter 2 (Ecological Conditions and Trends) of the forest plan assessment for more details on the impacts and condition ratings for each watershed.

Table 82. Results of the watershed condition classification riparian and wetland condition ratings for the Chugach National Forest (Coleman et al. 2016)

Rating	Number of Watersheds
Good (Class 1) Functioning Properly	253
Fair (Class 2) Functioning at Risk	20
Poor (Class 3) Impaired Function	2

Despite the current good condition rating for the majority of the riparian and wetland areas within the national forest, impacts do exist. Riparian and wetland condition drivers and stressors within the Chugach National Forest include natural and human caused disturbances.

Placer mining within the national forest generally occurs within riparian areas. Placer mining activity can involve removing riparian vegetation and processing the gravel substrates found within these riparian areas. Placer mining activities have led to heavy sediment loads in stream channels, loss of vegetation and soil, and alteration of stream channel and flood plain function in some cases. Streams within the national forest particularly affected by placer mining activities include Resurrection Creek and its tributary Palmer Creek, Bear, Sixmile, Mills, Juneau, Canyon, Cooper, Bertha, Lynx, Silvertip, Gulch, Quartz, and Falls creeks (near Crown Point). Lower Resurrection Creek is impacted by historic and ongoing large scale placer mining activities. Although stream and riparian restoration was conducted on one mile of Resurrection Creek in 2005 and 2006, the vegetation in this reach will take a number of years before it reaches maturity and is able to function naturally. Similar impacts from historic mining have occurred on Cooper Creek.



Map 24. Chugach National Forest watersheds with riparian and wetland impacts. Analysis from the watershed condition class riparian and wetland condition rating rule set (Coleman et al. 2016)

Recreational gold panning and suction dredging activities also occur within riparian areas. These operations are only authorized to occur within active stream channels, unvegetated abandoned stream beds or unvegetated gravel bars. However, certain systems, such as Resurrection Creek and Six-mile Creek where recreational mining is encouraged (Huber and Kurtak 2010), are exhibiting mining that extends into the vegetated stream banks, causing damage to riparian function and integrity. For instance, in Resurrection Creek, the stream channel has widened up to 20 feet due to a loss of stream banks from these activities.

Past timber harvest on acquired lands in Prince William Sound has impacted riparian vegetation where riparian buffers were not adequate (areas on Knowles Head Peninsula and Montague Island). This riparian harvest has resulted in a reduction of large woody debris recruitment into streams, which affects channel form, nutrient inputs, cover, and habitat complexity, as well as riparian vegetation diversity. Habitat complexity and diversity is important for wildlife, birds, fish, and invertebrates.

Insects and disease have impacted and will continue to impact riparian and wetland resources of the Chugach National Forest. The spruce beetle infestation of the 1990s impacted numerous riparian spruce forests on the Kenai Peninsula and reduced streamside spruce cover. These impacts included loss of riparian vigor, reproduction, and growth, as well as changes in composition. The mortality of spruce resulted in short-term increases in large woody debris to streams. These areas now have long term limited large woody debris recruitment and loss of streamside shading. The recent spruce beetle activity in south central Alaska may result in renewed spruce mortality during the next 20 years across portions of the Kenai Peninsula. Areas that will be most affected will be those not previously affected. The spruce aphid, though less likely to result in tree mortality, may also affect coastal spruce riparian areas within the next few decades. Spruce bud blight has appeared on lands adjacent to the national forest and often leads to large portions of spruce mortality within stands. Lastly and likely the largest risk in the near future to riparian and wetland areas is alder canker. Alder canker leads to mortality of alder, frequently in large patches along floodplains and within 500 meters of streams. Loss and mortality of the alder will have nutrient impacts to watersheds. Refer to the Forest Insects and Diseases section for more detailed information on projected pathogens and insects that are most likely to influence vegetation composition, structure, and function over broad spatial areas for extended periods.

Roads and trails have impacted riparian and wetland areas where they are immediately adjacent to streams or water bodies. Their effects include contributions of road derived pollutants, introduction of invasive species, barriers to movement for both terrestrial and aquatic species and loss of wetland connectivity. Some, such as the Seward Highway and the Alaska Railroad, have changed the flow of water in and out of wetlands to the extent that they have converted some estuarine habitats into freshwater habitats resulting in changed riparian vegetation and wetland communities. Wetland damage, such as compaction, erosion, loss of vegetation, and creation of seedbeds for invasive species, has resulted from OHV use on unauthorized trails (user created), particularly on the Copper River Delta and on Hawkins and Hinchinbrook islands.

There are also several recreation developments that are within riparian areas. Recent floods (September 2012) and historic floods have eroded existing recreational developments (e.g., campsites, picnic areas, and outhouses) within or adjacent to riparian areas.

Watershed restoration projects during the last decade have included large scale stream and riparian restoration projects (i.e., Resurrection and Daves creeks) and riparian thinning projects (i.e., Hinchinbrook Island and Knowles Head). These projects have improved the functions of streams and riparian areas associated with impacts from past or historic land management and current activities. Continuing to restore these watersheds, riparian areas, and wetlands will sustain and improve integrity and provide resilience against future drivers and stressors. The primary drivers and stressors for riparian and wetland areas include increased population and/or national forest use, increased development, decreased salmon stocks, glacial retreat, earthquakes, fire, insects and disease, landslides, floods, and the anticipated overarching effects of climate change.

Impacts to riparian and wetland areas from increased population and/or national forest use could include increased placer mining, gravel extraction and development, increased water storage or diversions (hydroelectric facilities), new road construction, increased recreational use (particularly OHV use and angler developed trails), and the potential for increased introduction of invasive species (both terrestrial and aquatic) (Haufler et al. 2010).

Potential decreases in salmon stocks may also reduce the productivity of riparian ecosystems. Spawning Pacific salmon contribute marine derived nutrients to riparian ecosystems that fertilize and enhance riparian production (Bartz and Naiman 2005; Gende et al. 2007; Helfield and Naiman 2001; Monaghan and Milner 2008). A decrease in these ocean derived nutrients may decrease the health and vigor of riparian vegetation over time.

Earthquakes may also play a role as a system driver and stressor for wetlands by changing water table elevations. The 1964 earthquake profoundly affected wetlands across the Chugach National Forest. Tectonic subsidence in some areas, such as Cook Inlet and parts of eastern Prince William Sound, resulted in locally elevated ocean levels introducing saltwater to freshwater ecosystems. Conversely, in areas of tectonic uplift, such as the Copper River Delta and most of Prince William Sound, previous saltwater influenced wetlands converted to freshwater.

Climate is an important physical driver for watersheds and will have a strong influence on the future condition of watersheds and riparian and wetland ecosystems. Impacts to Chugach National Forest riparian and wetland areas from climate change may include changes in the timing and magnitude of flows, such as increased flood frequency and magnitude and the amount and timing of mean, peak and low flows, landslides, glacial retreat, losses of wetlands, an increase in fire potential, and potential increase in forest insects and disease (Fresco 2012; Haufler et al. 2010; Hayward et al. 2017; USDA 2014a; Wolken et al. 2011). Due to the complex topography, geomorphology, vegetational composition, and precipitation patterns coupled with the presence of glaciers across the Chugach National Forest, many of these affects will vary across geographic zones and from one watershed to another (Hayward et al. 2017; USDA 2014).

Projected increased temperatures from climate change may influence the frequency, extent, and severity of wildfires within the Chugach National Forest, particularly within the Kenai Peninsula Geographic Area (EPA 2016; Haufler et al. 2010; Wolken et al. 2011). Some studies on the Kenai Peninsula have also documented recent changes and accelerated losses of wetlands (drying habitats) associated with increased evapotranspiration as a direct result of increased mean summer temperatures since the 1970s (Berg et al. 2006; Berg et al. 2009; Klein et al. 2005).

Environmental Consequences

The indirect effects to riparian and wetland resources, are addressed under each alternative qualitatively. Each revision topic, highlighted in chapter 1 Need for Change, is addressed across the alternatives. Cumulative effects are addressed common to all alternatives.

Consequences Common to all Alternatives

Riparian and Wetland Integrity, Sustainability, and Resilience to Climate Change

A major driver of change to Chugach National Forest riparian and wetland conditions is climate change. The effects of climate change on riparian and wetland resources will remain the same under all of the alternatives. Changes in water quantity and water quality, wildfires, and insects and disease will remain the same in all alternatives. Other drivers of change, including invasive species, salmon stocks, and development, will also remain the same under all of the alternatives. Because 92 percent of Chugach National Forest watersheds exhibit Class 1 (good, functioning properly) riparian and wetland condition, they are considered to have high integrity and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities.

Riparian and Wetland Contributions to Cultural, Economic, and Social Sustainability

Chugach National Forest riparian and wetland resources will continue to contribute to the social, economic, and cultural sustainability of communities in the plan area for all of the alternatives. Impacts from future increased use and population on wetland and riparian resources will also remain the same for all of the alternatives.

Alternative A No Action

Alternative A would continue current management as described in the 2002 forest plan, including the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions, such as riparian and wetland restoration, would continue as resources are available. While adequate measures are provided for providing instream flow to maintain and support aquatic life and habitat, recreation and aesthetics, the natural flow conveyance of water and sediment, and other resources that depend on such flows on NFS lands, there is no strong direction in the 2002 forest plan for reserving in stream flow reservations and acquiring water rights.

The designated wilderness study area boundary and wilderness area recommendation would remain consistent with the 2002 forest plan. There are currently 4,372,657 acres open to mineral entry under alternative A (no action) if the recommended wilderness area is not acted upon and the current condition remains unchanged. There would be 2,985,147 acres open to mineral entry under alternative A in the event that the recommended wilderness area becomes a designated wilderness area. Upon designation, 1,387,510 additional acres of land would be withdrawn from mineral entry, subject to valid existing rights. Current short term and long term potential riparian and wetland stressors and impacts, such as changes in water quantity, water quality, and loss of riparian vegetation, associated with mineral development would remain the same.

Recreation opportunity spectrum classes and management areas would remain consistent with the 2002 forest plan. The current opportunities for summer and winter motorized and non-motorized activities and guided special uses would remain the same. Potential impacts to riparian and wetland conditions from snowmachines, helicopters, and ATVs would remain at current levels. Riparian and wetland condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would also remain the same. In general, all of these recreation effects are low except at points of concentrated use. Proper management, use of

BMPs, and adherence to standards and guidelines in the 2002 forest plan would continue to reduce potential recreational impacts to riparian and wetland conditions.

Alternative B

Alternative B, similar to alternative A, would continue current management as described in the 2002 forest plan. The alternative would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. While adequate measures are provided for providing instream flow to maintain and support aquatic life and habitat, recreation and aesthetics, the natural flow conveyance of water and sediment, and other resources that depend on such flows on NFS lands, there is no strong direction in this alternative for reserving in stream flow reservations and acquiring water rights.

Wilderness area recommendation, similar to alternative A, would remain consistent with the 2002 forest plan. Upon designation, the number of acres of land withdrawn from mineral entry would remain the same (1,387,510 acres). Potential riparian and wetland stressors and impacts, such as changes in water quantity, water quality, and loss of riparian vegetation, associated with mineral development would remain the same.

Recreation opportunity spectrum classes and management area changes from alternative A would potentially result in minor effects on riparian and wetland conditions. Most of these changes are focused on the Kenai Peninsula and reflect changes that incorporate the Kenai Winter Access Project Record of Decision (2007) management direction. Overall, there is a small decrease (less than 1 percent) in Semi-primitive opportunities for winter and summer motorized use. Potential impacts to riparian and wetland conditions from snowmachines, helicopters, and OHVs would decrease negligibly compared to alternative A. Riparian and wetland condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would remain the same as alternative A.

Alternative C

Alternative C, similar to alternatives A and B, would continue management direction providing for ecological sustainability. The alternative would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Similar to alternative B, plan components have been modified and added to provide more of an emphasis towards providing ecosystem resilience for changing conditions.

Wilderness area recommendation, upon designation, would result in a larger number of acres (1,819,700 acres) withdrawn from mineral entry than alternatives A and B. This increase in acres withdrawn from mineral activities under alternative C would reduce potential riparian and wetland stressors and impacts, such as potential changes in water quantity, water quality, and loss of riparian vegetation, associated with mineral development.

Recreation opportunity spectrum settings and management area changes and associated potential wetland and riparian condition effects vary from alternatives A and B. These variations will be explored by geographic area.

Within the Kenai Peninsula Geographic Area, alternative C offers a small increase (6 percent) in the primitive recreation class and backcountry management area. The backcountry management area and primitive recreation class indicate that there will be less people and smaller parties than in the alternatives A and B semi-primitive recreation classes. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to future limitations set by management on party size and number of permits. Thus, it is assumed that potential riparian and wetland condition impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly compared to alternatives A and B. Additionally, alternative C offers increased opportunities (16 percent) for winter recreational motorized use. Potential impacts to riparian and wetland conditions associated with snowmachines and helicopters use may increase. In general the environmental consequences would be minor except at points of concentrated use.

Alternative C offers an increase (28 percent) in the primitive recreation class within the Prince William Sound Geographic Area, primarily within the eastern portion. Primitive recreation classes indicate that there will be less people and smaller parties than in alternatives A and B semi-primitive recreation classes. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential riparian and wetland condition impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B. It is important to note that the Prince William Sound framework illustrated that outfitters and guide use accounts for only 10 percent of actual use. Thus, these small reductions in potential future special use permitting allocations may only result in nominal improvement in riparian and wetland ecosystems.

On the Copper River Delta, alternative C offers a decrease (25 percent) in the Primitive ROS class and increases in semi-primitive motorized use south of the Copper River Highway (5 percent) and semi-primitive winter motorized use north of the Scott and Sheridan glaciers (20 percent) compared to alternatives A and B. Potential impacts to wetland and riparian conditions from snowmachines, helicopters, OHVs and motor boats would increase compared to alternatives A and B. Additional impacts from recreation opportunity spectrum class changes include increased opportunities for larger and more frequent outfitters and guide special use party sizes. Larger and more frequent groups have a higher potential for impacting streams, riparian areas, and wetlands. In general, the environmental consequences to riparian and wetland conditions would be minor except at points of concentrated use. Proper management, use of BMPs, and adherence to standards and guidelines would reduce these impacts.

Alternative D

Alternative D, similar to all other alternatives, would continue management direction providing for ecological sustainability. All alternatives would continue watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available.

Similar to alternatives B and C, plan components have been modified and added to provide more of an emphasis towards providing ecosystem resilience for changing conditions.

Upon wilderness area designation, alternative D would have the largest number of acres withdrawn from mineral entry (1,884,200 acres). Alternative D would reduce potential riparian and wetland stressors and impacts associated with mineral development more than any other alternative.

Similar to alternative C, recreation opportunity spectrum classes and management area changes and associated potential water resources and watershed condition effects vary from alternatives A and B. The variations between D and C are very minor, only occur within the Prince William Sound Geographic Area, and are associated with the changes in the recommended wilderness area. Overall, alternative D offers an increase (less than 2 percent) in the primitive recreation class within Prince William Sound compared to alternative C. Alternative D has the largest percentage of the primitive recreation class of all of the alternatives. The primitive recreation class indicates that there will be less people and smaller parties than in the semi-primitive recreation class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential riparian and wetland condition impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B and decrease negligibly compared to alternative C. It is important to note that the Prince William Sound framework illustrated that outfitters and guide use accounts for only 10 percent of actual use. Thus, it is difficult to quantify the amount of riparian and wetland condition improvement that would occur from these small reductions in special use permitting allocations.

Cumulative Effects

Most watersheds within the national forest are in good condition and are functioning properly. Potential cumulative effects to watersheds and water resources resulting from past, current, and future management activities are based on the total amount of disturbance within the effects analysis area. Past management activities have been concentrated within certain watersheds. These are the watersheds where most activities under any alternative would occur. The additional effects of reasonably foreseeable major projects and the plans of adjacent land ownerships will be addressed qualitatively and will be common across all alternatives.

The effects and environmental consequences of reasonably foreseeable major projects and plans of adjacent land ownerships will be common across all alternatives. The largest foreseeable major projects and plans within the analysis area include the State of Alaska DNR/Copper River Basin Plan, the State of Alaska DNR/Prince William Sound Area Plan, the State of Alaska DNR/ Kenai Area Plan, foreseeable development on CAC lands, the Kenai Hydro LLC Grant Lake Hydroelectric project, the Sterling Highway re-route, the Seward Highway improvements, and associated activities on the Kenai National Wildlife Refuge, and the Wrangell St. Elias and Kenai Fiords National Parks. For the most part, all of the aforementioned plans and the adjacent land owners' management directions align with Forest Service management direction. Due to these alignments, measureable effects are negligible. The only discernable effects on watersheds and water resources within the analysis area would be from the Kenai Hydro LLC Grant Lake project, the Sterling Highway Re-route, the Seward Highway improvements, and foreseeable development of CAC lands.

Foreseeable direct adverse effects on riparian and wetland resources from the Kenai Hydro LLC Grant Lake project will be a result of the project's alteration of water quality, water quantity, hydrologic connectivity, and the loss of wetlands. The construction of the hydroelectric facility will result in altered water quantity and water quality in Grant Lake and Grant Creek. The variation from the natural hydrograph and the natural chemical and physical water quality characteristics may result in adverse impacts to riparian habitats along Grant Lake and Grant Creek. These impacts will last the duration of the life of the dam. Construction of the facility, pipeline and access road will also result in potential loss or degradation of wetland habitat. Implementation of BMPs will mitigate some of these effects.

Foreseeable effects to riparian and wetland habitats from the Sterling Highway Re-route project include long term direct and indirect effects on riparian and wetland habitats. Long term direct adverse effects include loss of wetlands and hydrologic connectivity due to construction and associated stream crossings of the new segment of highway. Long term indirect beneficial effects include potential improved water quality for the riparian areas along Kenai River due to the decreased risk and likelihood of accidents, spills and contaminants.

Foreseeable effects on riparian and wetland resources from the Seward Highway improvements project include long term direct adverse and beneficial effects. Long term direct adverse effects include loss of wetlands and hydrologic connectivity alteration due to road and trail construction and expansion. Long term direct beneficial effects include improved hydrologic connectivity for a few upgraded culverts.

Foreseeable effects to riparian and wetland resources from future developments on CAC lands are also possible, but it is difficult to quantify the magnitude and duration of these effects due to the unknown nature of the developments. However, it is anticipated that some of these developments may include construction of access roads and trails to inholdings; mineral extraction, including extraction from sub-surface estate lands owned by CAC; and timber harvest. Each of these activities has the potential to impact water quality, water quantity, hydrologic connectivity, and riparian and wetlands ecosystems.

Analytical Conclusions

The majority of riparian and wetland areas within the Chugach National Forest are in good condition and are functioning properly (Class 1). Impacts to riparian and wetland vegetation within the national forest are limited and localized. These impacts primarily occur along roads; in OHV use areas; in places where fuel wood, timber harvest, and large scale mining have occurred; in high recreational use areas (i.e., Russian River); and in areas affected by the spruce beetle infestation during the 1990s. More than 80 percent of the riparian/wetland impacted watersheds within the national forest are on the Kenai Peninsula where human population and use is greater and the effects of spruce beetle is more common.

All alternatives would continue management direction providing for ecological stability. All alternatives would continue the current program of watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions, such as riparian and wetland restoration, would continue as resources are available.

The effects of alternative B on riparian and wetland resources are very similar to alternative A except where changes in recreation opportunity spectrum settings were made to address the 2007 Kenai

Winter Access Project decision that changed access for winter motorized recreation. Potential impacts to riparian and wetland conditions from snowmachines, helicopters and OHVs would decrease negligibly compared to alternative A.

The effects of alternative C on riparian and wetland resources are very similar to alternatives A and B except where changes were made in the wilderness area recommendation and recreation opportunity spectrum classes. The alternative C wilderness area recommendation, upon designation, would have a larger number of acres withdrawn from mineral entry than alternatives A and B. This increase in the number of acres withdrawn from mineral activities under alternative C would reduce potential riparian and wetland stressors and impacts, such as potential changes in water quantity, water quality and loss of riparian vegetation, associated with mineral development. The alternative C recreation opportunity spectrum class changes vary by geographic area.

On the Kenai Peninsula and within Prince William Sound, the indirect effects of the increase in primitive and backcountry management settings of alternative C may result in a slight improvement in riparian and wetland resources compared to alternatives A and B. However, impacts to riparian and wetland resources associated with increased snowmachine and helicopter use on the Kenai Peninsula may increase slightly compared to alternatives A and B. On the Copper River Delta, indirect effects of the decrease in the primitive class and increase in the semi-motorized class would have the potential to impact riparian and wetland resources from increased snowmachine, helicopter, OHV, and motor boat use compared to alternatives A and B. In general, the environmental consequences to riparian and wetland resources in alternative C would be low except at points of concentrated use. Proper management, use of BMPs, and standards and guidelines would reduce these impacts.

The effects of alternative D on riparian and wetland resources are very similar to alternatives A, B, and C, except where changes were made in the wilderness area recommendation and the recreation opportunity spectrum classes. Alternative D, upon designation, would have the largest number of acres withdrawn from mineral entry. Alternative D would reduce potential riparian and wetland stressors and impacts associated with mineral development more than any alternative. Alternative D, similar to alternative C, recreation opportunity spectrum classes and management area changes and associated potential riparian and wetland resources effects has variations from alternatives A and B. The variations between D and C are very minor, only occur within the Prince William Sound and are associated with the changes in the area recommended for wilderness designation. Alternative D offers a slight increase in the primitive recreation class within Prince William Sound compared to alternative C. Alternative D has the largest percentage of the primitive recreation class of all of the alternatives. Primitive recreation classes indicate that there will be less people and smaller parties than semi-primitive recreation classes. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential riparian and wetland impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B and decrease negligibly compared to alternative C.

Overall, all of the alternatives have minimal environmental consequences to riparian and wetland resources. Ninety-two percent of Chugach National Forest riparian and wetland areas are in Class 1 condition (good, functioning properly). Healthy, properly functioning riparian and wetland areas generally exhibit strong integrity, are more resilient to stressors, have a greater capacity to adapt and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities.

Aquatic Ecosystems and Habitats

Introduction

The Chugach National Forest has a unique origin in that its precursor was established in 1892 as the Afognak Forest and Fish Culture Reserve. The unique feature of this original forest is that it was created primarily for the purposes of salmon conservation (Rakestraw 2002) and not forestry. In light of this unique feature, the national forest has been referred to as the original salmon forest. Although the national forest boundary has changed over time, the importance of salmon production has remained.

The national forest is a productive landscape that sustains abundant, healthy fish stocks for subsistence and personal use and commercial and sport fisheries. Maintaining the habitat diversity and connections among watersheds is essential to the continued productivity of the national forest's salmon fisheries. A highly productive marine environment adjacent to the national forest includes abundant marine mammals, marine fish, and shellfish.

Salmon or other members of the salmonid family, such as trout and char species, are found in most aquatic ecosystems within the national forest. Five Pacific salmon species are present in varying numbers and distributions, including: Chinook salmon (*Oncorhynchus tshawytscha)*, coho salmon (*Oncorhynchus kisutch),* sockeye salmon (*Oncorhynchus nerka)*, chum salmon (*Oncorhynchus keta)*, and pink salmon (*Oncorhynchus gorbuscha)*. Salmon are anadromous, meaning their life history includes a freshwater phase and a marine phase. The freshwater phase is dedicated to early life and reproduction and the marine phase provides rich food resources supporting rapid growth and transition to adulthood. All salmonid species depend on the freshwater environment to complete their life cycle. While access to freshwater is an absolute requirement, necessity of the marine environment is not as obligatory. For example, kokanee, the resident form of sockeye salmon, naturally occur in many land-locked lake systems. When introduced into novel freshwater environments, such as the Great Lakes, all five species of Pacific salmon have been demonstrated to complete their life cycle without a migration to the marine environment (Parsons 1973). Therefore, it appears that while salmon can adapt to the loss of the marine environment, they cannot survive if they are deprived of the freshwater environment.

In the case of southcentral Alaska and across the national forest from the Kenai Peninsula to Prince William Sound to the extensive delta and wetlands of the Copper River, much of this freshwater environment is represented by the many watersheds. Continued maintenance of these healthy watersheds' rivers, streams, riparian habitat, lakes, and wetlands help to produce viable and sustainable fish resources supporting subsistence and personal use and sport and commercial fisheries. The presence of salmon is one of the defining features of ecosystems within this national forest.

Methodology

Spatial Scale

The spatial scale is HUC 6 watersheds within the Chugach National Forest boundary.

Temporal Scale

This analysis is bounded in time by the foreseeable future period during which the effects of this plan implementation may persist as detectable. The plan timeframe is 15 years; however, trends are described for varying timescales.

Affected Environment

The national forest includes approximately 4,600 miles of known fish streams and over 110,000 acres of fish lakes ranging from a few acres to the approximately 14,000-acre Kenai Lake. Anadromous fish habitat includes 1,800 miles of documented anadromous streams and 48,100 acres of anadromous fish lakes. Almost 2,000 miles of smaller stream channels are suspected to contain anadromous populations but are not currently inventoried. Another 2,800 miles of stream provide resident fish habitat, with about 3,000 miles of smaller uninventoried streams. There are over 60,000 acres of resident fish lakes. Most of the national forest's streams and rivers empty into bays or estuaries, which are important during some life stages of anadromous fish species as well as for many saltwater fish species. Table 83 displays the documented miles of anadromous fish habitat by species and landscape area.

Table 83. Documented miles of fish habitat by species and geographic area

Species	Copper River Delta	Kenai Peninsula	Prince William Sound	National Forest Total
Chum salmon	84	109	231	424
Coho salmon	616	315	197	1127
Cutthroat	191	zero	34	225
Dolly Varden char	429	121	30	579
Chinook salmon	174	160	9	344
Pink salmon	150	161	590	901
Sockeye salmon	557	242	81	881

Eulachon (*Thaleichthys pacificus*) are pelagic schooling smelts that live in marine environments offshore of the national forest and spawn in freshwater within NFS lands. There are two major spawning populations within the national forest. These are found on the Twentymile River on the Kenai Peninsula and on the Copper River Delta.

Arctic grayling (*Thymallus arcticus*), though not native to the national forest, currently occur within the Kenai Peninsula and the Copper River Delta. These populations are the result of an earlier introduction of Arctic Grayling and have become self-sustaining populations. They occupy the Crescent Lake watershed on the Kenai Peninsula and 18 Mile Ponds on the Copper River Delta.

Most watersheds supporting fish resources within the national forest have minor or no water quality problems because of limited development, limited road access, and limited resource extraction (see Watershed and Water Resources section). Coleman et al. (2016), determined that the national forest includes 273 watersheds rated Class 1, two watersheds rated Class 2 and zero watersheds rated Class 3. No watersheds are known to have extensive water quality problems and all are very capable of supporting healthy populations of vegetation, aquatic organisms, fish and wildlife.

Social Economic

Commercial fishing is economically the largest national forest resource-related sector in southcentral Alaska. Fish habitat within the national forest plays a vital role in sustaining fisheries that support commercial fishing, sport fishing, subsistence fishing, and processing industries that account for large percentages of economic output in the study area.

The annual economic effect of salmon produced within the national forest in commercial fisheries is approximately 232 million dollars per year. For 2015, the State of Alaska reported that the southcentral Alaska region, which includes the Prince William Sound and Cook Inlet salmon fisheries and a halibut fleet, was one of only two regions to see an increase in jobs related to the fishing industry and had the second-highest employment.

The economic effect of recreational fisheries is more difficult to assess. Sport fishing is especially popular in Alaska and across the national forest. The Southwick Associates Inc. and W. J. Romberg (2008) report for 2007 indicated that there were 2.5 million days of sportfishing throughout Alaska, and 1.8 million or 72 percent of the total were sportfishing days occurring in southcentral Alaska.

Essential Fish Habitat

Current fisheries habitat conditions of the national forest are at or near levels of natural productivity. The management actions that could be detrimental to fish habitat have occurred only on limited numbers of streams affecting habitat mostly associated with roads and near communities.

Section 305(b)(2) of the Magnuson-Stevens Act requires all Federal agencies to consult with the Secretary of Commerce on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect essential fish habitat. This consultation is completed for site-specific projects with ground disturbing activity. The application of forestwide standards and guidelines and BMPs developed to meet soil protection, water quality standards, and fish habitat protection will help protect essential fish habitat within the national forest and adjacent estuarine and marine waters. Adoption of the forest plan does not specifically result in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the plan that could affect essential fish habitat would have a formal essential fish habitat developed. No formal essential fish habitat will be developed for the considered actions in this DEIS.

Fish are a major component of biodiversity of the national forest. The annual spawning migrations of anadromous fish (fish, such as salmon, spending part of their life in the ocean) are necessary for the function of many plant and animal communities. Anadromous fish provide significant resources to the national forest, with many birds and mammals consuming salmon eggs, fry, juveniles and decaying carcasses. Animals, such as black and brown bear and bald eagles, are dependent on spawning salmon or their carcasses for over winter survival.

Fish and the other aquatic resources within the national forest provide major subsistence and personal use, commercial and sport fisheries, and traditional and cultural values. Abundant rainfall, streams with glacial origins, and watersheds with high stream densities provide an unusual number and diversity of freshwater fish habitats. These abundant aquatic systems of the national forest provide spawning and rearing habitats for many of the fish produced in southcentral Alaska and Prince William Sound. Maintenance of these habitats, and associated high quality water, are focal points of State and Federal natural resource agencies, Alaska Native organizations, as well as user groups and the public.

Fish Streams

Channel typed streams have also been categorized by stream classes that describe stream values, such as whether anadromous or resident fish inhabit a particular stream. Class 1 streams are anadromous and high value resident fish streams, Class 2 streams are other resident fish streams, and Class 3 streams are managed for water quality and where appropriate, downstream aquatic resources. Fish habitat standards and guidelines are based in part on the stream class. Table 84 shows the miles of stream by channel type.

Table 84. Miles of Class 1, 2, and 3 streams[1]

Stream Class	Copper River Delta	Kenai Peninsula	Prince William Sound	National Forest Total
Class 1	1,991	521	765	3,277
Class 2	156	554	725	1,435
Class 3	566	1,211	2,223	4,000
Totals	2,713	2,286	3,713	8,712

1 - Does not equal totals in other tables due to some stream segments without stream class designation.

Channel Inventory and Stream Habitat Types by Landscape Area

All known perennial streams have been mapped and identified using the Alaska Region Stream Channel Type System. For a description of each channel type, see Alaska Regional Channel Type Field Guide (USDA 2014a). The channel types provide a system to estimate the amount and quality of fish habitat and can be used to predict their physical response and sensitivity to different management activities. Channel types have been categorized into distinctly different groups, called stream process groups." Table 85 displays the amount of the channel type process groups that occur throughout the national forest by landscape area.

Table 85. Miles of stream by process group and area

Process Group	Copper River Delta	Kenai Peninsula	Prince William Sound	National Forest Total
Alluvial fan	54	66	98	218
Estuarine	277	6	127	410
Flood plain	251	165	169	584
Glacial outwash	1,105	287	411	1,802
High gradient contained	566	1,211	2,223	4,000
Low gradient contained	zero	30	15	45
Moderate gradient contained	79	97	351	527
Moderate grad/mixed control	46	202	272	520
Palustrine	611	85	71	766
Totals	2,990	2,147	3,736	8,873

The Copper River Delta Geographic Area is characterized by large amounts of glacial outwash streams, Palustrine, and floodplain type streams. Mountain glacier melt water is the source of runoff to the Glacial Outwash streams. Consequently, these steams carry extremely high sediment loads and turbid water. Riparian areas are wide and may extend for several thousand feet on either side of the channel. These channels are accessible to anadromous fish in their lower reaches. Typically, they provide migration routes to salmon spawning in clear water tributaries. The fine sediment in the spawning beds normally limits spawning gravel quality. Sockeye salmon tend to select gravels where upwelling groundwater is present. Rearing habitat is generally limited to slough and side channel pools due to turbid water conditions.

The Palustrine streams are low gradient streams associated with bogs, marshes, wetlands, and lakes. These channels are shallowly incised, have fair flow containment, and flood flows usually overtop the stream banks and flow onto the adjacent landform, lessening downstream flooding and serving as a buffer during the major storms. Productivity of the channel is moderately tied to the riparian/terrestrial interaction. The Palustrine streams have high production capability for coho salmon. Spawning gravels are not abundant, and are usually more limited in overwinter habitat due to lack of large complex pools that provide quality winter habitat. The better rearing habitat, winter habitat is tied to undercut banks and large woody debris accumulations, as well as larger ponds and lake outlets.

High gradient contained stream channels dominate Kenai Peninsula watersheds. These channels generally have low fish habitat capability. The productive areas for fish habitat on the Kenai Peninsula are dominated by floodplain and moderate gradient with mixed control of streambanks channel types in the valley bottoms. These floodplains and channels have two-way interaction between the floodplain area and stream channels through bank erosion, channel migration and overflow, leaf fall, and blow down/tree fall. These channels receive moderate to high spawning use by all anadromous species. Coho salmon and Dolly Varden char use the available rearing areas of these channels extensively. Much of the better rearing habitat is associated with large woody debris accumulations, beaver dams, and off channel sloughs. Sockeye salmon production is associated with large lake systems found within the Kenai watershed, but they frequently use the flood plain and mixed control channels for spawning.

Watersheds in Prince William Sound are dominated by high gradient channels. Productive fish habitat is also dominated by the relatively small percentage of floodplain and mixed control habitat types. Unlike the Kenai Peninsula Geographic Area, estuarine channel type streams, though small in total miles, are extremely important within Prince William Sound. Sockeye salmon producing watersheds are limited in extent within Prince William Sound. Coghill Lake and Eshamy Lake are primary producers of sockeye salmon in Prince William Sound. These channels are always accessible to anadromous salmon and provide the primary area for pink and chum salmon spawning.

Channel Shape and Function

Most watersheds within the national forest have few or no unnatural modifications to channel shape and function. Impacts to channel shape and function typically occur in localized areas near the road system, where impacts from activities, such as mining, recreation, and roads, have altered riparian vegetation and stream channels. Natural changes in riparian condition and channel stability, for example from natural flooding events or glacial processes, are considered proper function in many watersheds within the national forest. Nine process groups (see table 85) for the three stream classes found within the national forest have been identified (USDA 2014a). These contain habitats with differing levels of productivity associated with both resident and anadromous fish resources. Those considered to be moderately productive for both resident and anadromous fish include lowlands and valley bottoms. Habitats considered highly productive for juvenile rearing are the peatland-bog wetlands and valley bottoms. The habitats considered highly productive for anadromous spawning habitat include estuaries and tidal deltas while the valley bottom and footslope habitats are considered to be moderately to highly productive for both resident and anadromous fish.

Flow Characteristics

Most watersheds within the national forest have no human impacts to water quantity in terms of diversions or reservoirs, and stream hydrographs are generally unaltered by human actions. Exceptions to this occur in a few localized areas near communities and on the road system.

Habitat fragmentation is not a large issue, largely due to the very limited number of roads within the national forest. The limited habitat fragmentation that does occur is a result of culvert passage issues, placer mining impacts, and dewatering.

Large woody debris is a very important component to many species of fish found in the lowland watersheds of the national forest. Large woody debris in stream channels may include trees, rootwads, and larger branches all capable of influencing channel morphology, sediment retention, structural diversity, gradient modification, nutrient production, and habitat. Watersheds that are primarily above timberline and that contain predominantly alpine, rock, snow, and ice environments have few or no streams, and large woody debris is not a component of these streams.

Another significant factor is a decreased supply of large woody debris (Doloff 1983). This may result in long term losses of fish habitat. Reduction in the amount of pools and the available hiding cover decreases the rearing habitat capability, particularly over wintering habitat, and decreases spawning success. Species diversity in the stream may be reduced and predation on fish increased. The less complex habitat also loses some of its ability to capture gravels and organic matter important to spawning and rearing fish. Also, the large woody debris provides a substrate for food production.

Stream Length

The amount of salmon producing habitat for a given stream is related to the stream’s length. Streams with many miles of habitat accessible to salmon, in general, produce more fish than short streams. Most streams within the national forest are relatively short (less than 10 miles) because of the steep mountain topography and the close proximity to the ocean. In Prince William Sound, it is common for salmon to have access only to the intertidal portion of the stream. However, even with these limitations, the production of salmon in this region is substantial. The Copper and Kenai rivers, on the other hand, are large systems with hundreds of miles of salmon bearing waters, much of which is outside of the national forest boundary.

Stream Gradient

Stream gradient, while relatively fixed, has a strong influence on fish production potential and species distribution. Very steep gradient streams are capable of constraining fish passage of some species and generally do not contain the pools necessary for juvenile rearing of salmon. Dolly Varden char, cutthroat trout, and rainbow trout can be found in streams that are quite steep and small. Streams that are moderate in gradient (greater than two to four percent) are generally not good habitat for chum and pink salmon, and more often are preferred by Chinook and coho salmon. All species can be found in lower gradient stream sections; however, pink and chum salmon tend to use these areas most.

Migration Barriers

Natural barriers to upstream migration of salmon, usually waterfalls, affect the distribution of aquatic species. The height of the falls and the timing of returning salmon with regard to flow conditions can have an impact on which anadromous species are able to use the production area above moderate sized barriers. For example, coho and Chinook salmon can negotiate falls in the range of eight to 10 feet high, while pink and chum salmon are likely blocked by any falls greater than four feet (Powers and Orsborn 1984).

Precipitation and Stream Flow

The amount of precipitation, when it falls, and whether it is mostly in the form of snow or rain has a strong influence on stream flow characteristics and stream temperature. Variations in precipitation and temperature are substantial across the national forest, as noted in Hayward et al. (2017), and this has a bearing on stream type. Within the national forest, these stream types may include: glacier driven, snow driven, rain driven, and groundwater driven. Variations in precipitation has the greatest potential to impact streams that are either snow or rain driven. Highest flows for snow driven streams occur during the period of spring snowmelt. Highest flows for rain dominated streams occur during the late summer months when rainfall amounts are typically the highest. The variability in the timing for spawning, incubation and post-emergence survival of newly hatched juvenile salmon (fry) will be influenced by the seasonal variations in rainfall amounts affecting the rain dominated streams. These hydrologic characteristics may also play a role in the suitability of a watershed for one species over another.

Water Turbidity

Streams with high turbidity generally represent suboptimal conditions for spawning and rearing conditions for salmon, char, and trout. Many streams within the national forest carry a heavy sediment load during the warmer portion of the year due to melting glaciers. This greatly reduces light penetration into the water column and impedes phytoplankton growth. This impact is transferred up the food chain and ultimately affects juvenile fish due to reduced food resources during their primary growing season. As a result, waters carrying a heavy glacial sediment load are less productive. Water turbidity from glaciers also affects the lakes that juvenile sockeye salmon rear in. Annual variations in the rate of glacial melt and associated lake turbidity can have dramatic year-to-year impacts on sockeye salmon production. It remains to be seen how vital these glacial valleys will be under the influence of climate change as they may become critical migratory corridors as conditions permit.

Spawning Gravel Quality

Heavily compacted or gravel laden with fine sediments is unfavorable for the incubation of salmon eggs. Freshly spawned eggs must survive for the next six to nine months in the same location before the young hatch and emerge in the spring. This is a critical stage in the life history, as the survival rate during this period from summer to fall spawning to spring emergence of fry is typically in the range of 10 percent (Bradford 1994). Lower survival rates are associated with streams having heavy silt loads, flooding, winter dewatering, and ice scouring. Heavy silt, whether from human-caused sources, such as road building, or natural ones, such as glaciers, can reduce inter-gravel water circulation and oxygen supply to the incubating eggs, causing them to suffocate. This can lower a population’s overall egg to fry survival rate and result in fewer salmon in the next generation.

Juvenile Rearing Habitat

Juvenile coho and Chinook salmon, as well as all char and trout, need stream habitats that will sustain them for one to four years. Watersheds with the largest portion of this required habitat will produce more fish than those watersheds that are mostly lacking such habitat. This specialized rearing habitat is complex and usually associated with pools, sloughs, wetlands and some type of structure or hiding cover, usually in the form of woody debris.

Biological Attributes

Estimating the total number of salmon in the Pacific Ocean is a complex problem because the production area includes watersheds from California northward to Alaska and across the Pacific to Russia and Japan. However, Ruggerone et al. (2010) analyzed salmon data and concluded that in recent years the average number of salmon in the Pacific Ocean was 634 million fish. Of those 634 million salmon estimated to occupy the North Pacific Ocean in an average year, at least 70 million are produced in watersheds that occur within the national forest based on data available from the Alaska Department of Fish and Game (Chilcote pers. comm. 2016).

Within the national forest, the largest production units are represented by the pink, chum, and sockeye salmon from Prince William Sound and the sockeye salmon for the Kenai River. These data have been collected over the years by the Alaska Department of Fish and Game and are available in a variety of annual reports (Begich and Pawluk 2011; Botz et al. 2013; Hochhalter et al. 2011; Shields and Dupuis 2012).

The number of salmon from these production areas for a five-year period ranged from 34.7 million salmon in 2009 to 106.4 million in 2013 with an average value of 66.7 million salmon. In a global context, this production represents from five to 17 percent of the total 634 million salmon estimated to be present in the entire Pacific Ocean. During the past five years, these national forest watersheds have produced an average of 11 percent of the global production of Pacific Ocean salmon. This means that at least one-ninth of the salmon in the Pacific Ocean begin life within national forest watersheds. However, it is important to note this should be considered a minimum estimate since secondary salmon production units within the national forest, such as Turnagain Arm and the Copper River Delta, have not been included in the analysis.

Kenai Peninsula Geographic Area

Fish produced within the Kenai River watershed (see map 25) dominate the fisheries in the Kenai Peninsula Geographic Area. The largest freshwater fisheries in Alaska for Chinook, sockeye, and coho salmon and rainbow trout all occur within the Kenai River watershed (Begich and Pawluk 2011). It is notable these fisheries are sustained entirely without supplementation from hatchery produced fish. The trends for these species range from strikingly downward for Chinook salmon to upward for other primary species. The increasing trend in catch of rainbow trout and Dolly Varden char has been particularly dramatic.

Sockeye salmon produced from the Kenai River watershed are the most important salmon species in this area for commercial fisheries. The estimated harvest of sockeye salmon in commercial fisheries has ranged from 1.7 million to 13.6 million fish (Shields and Dupuis 2012).

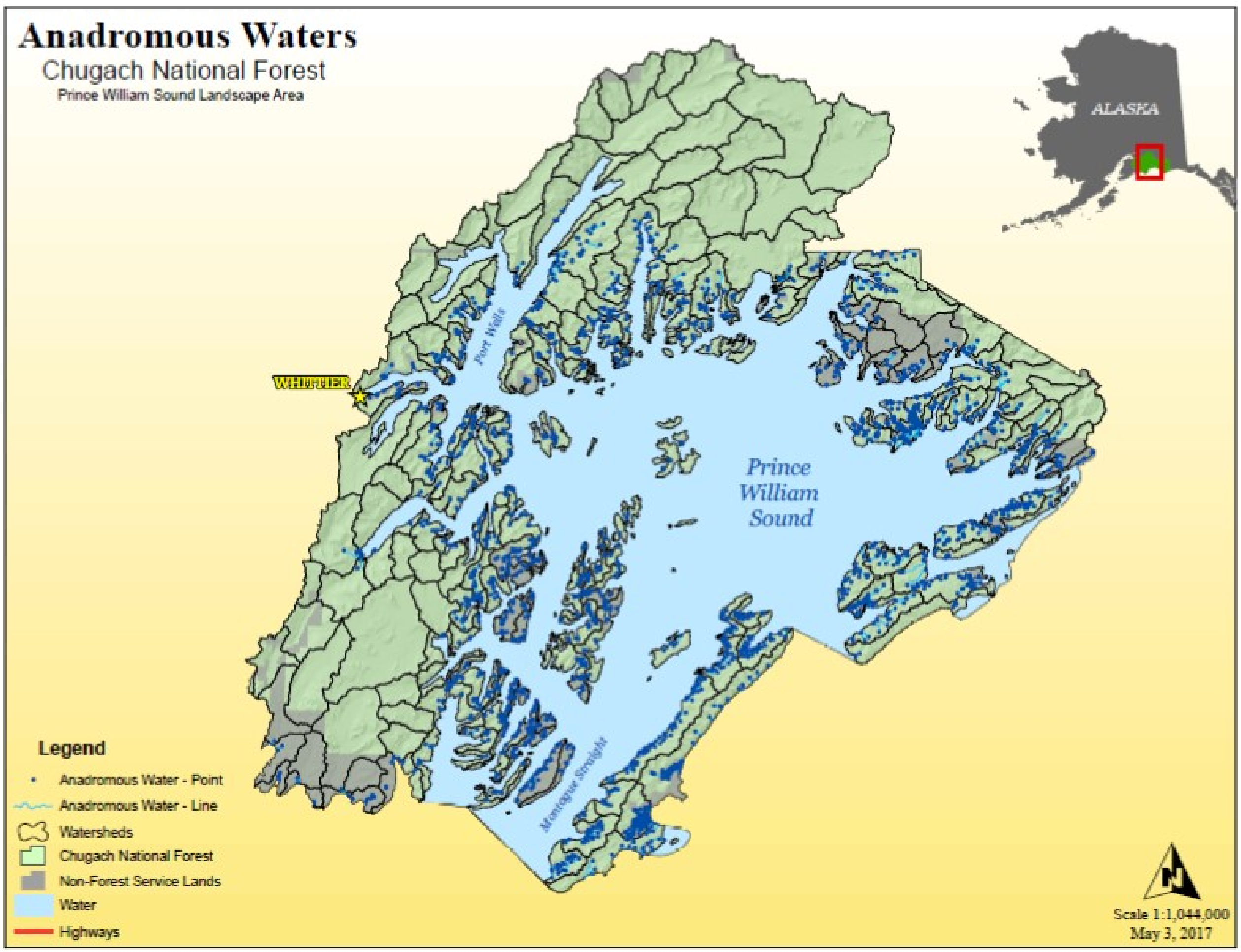
The singular eulachon fishery is on the Kenai Peninsula. This geographic area is located in the Twentymile River and the nearby upper Turnagain Arm. Spangler (2002) in his study of this population found that the duration of this particular run is longer than observed for runs returning to any other river on the Pacific coast. The harvest from 1995 to 2004 averaged 34,460 fish (Bosch 2010). Harvest decreased to 9,000 fish in 2005. Harvest has been increasing in recent years with approximately 29,000 fish harvested in 2009. The spawning levels of this species are not monitored, and the biology of the species is not well understood. However, eulachon are an important food source of the beluga whale, which is currently listed under the Endangered Species Act (ESA) (Hobbs et al. 2008).

Map 25. Anadromous waters in the Kenai Peninsula Geographic Area of the Chugach National Forest

Prince William Sound Geographic Area

In the anadromous waters of Prince William Sound (see map 26), pink and chum salmon are the primary species of importance. The total number of wild pink salmon (harvest plus escapement) returning to this area has averaged around 10 million fish since 1960. Since 1970, the total number of chum salmon returning to the same area has averaged 1 million fish. There is no indication that either species is increasing or decreasing. However, a large hatchery program for both species was established in the early 1990s. Hatchery fish from these programs now dominate the catch of salmon in Prince William Sound. Commercial fisheries catches have ranged up to 71.7 million fish over the last 20 years (Botz et al. 2013). Not all hatchery fish are caught or return to hatchery facilities. A portion of the hatchery fish stray into natural stream habitats used by wild fish. The effect of these stray hatchery fish may be harmful to the productivity and fitness of wild salmon in Prince William Sound (Brenner et al. 2012).

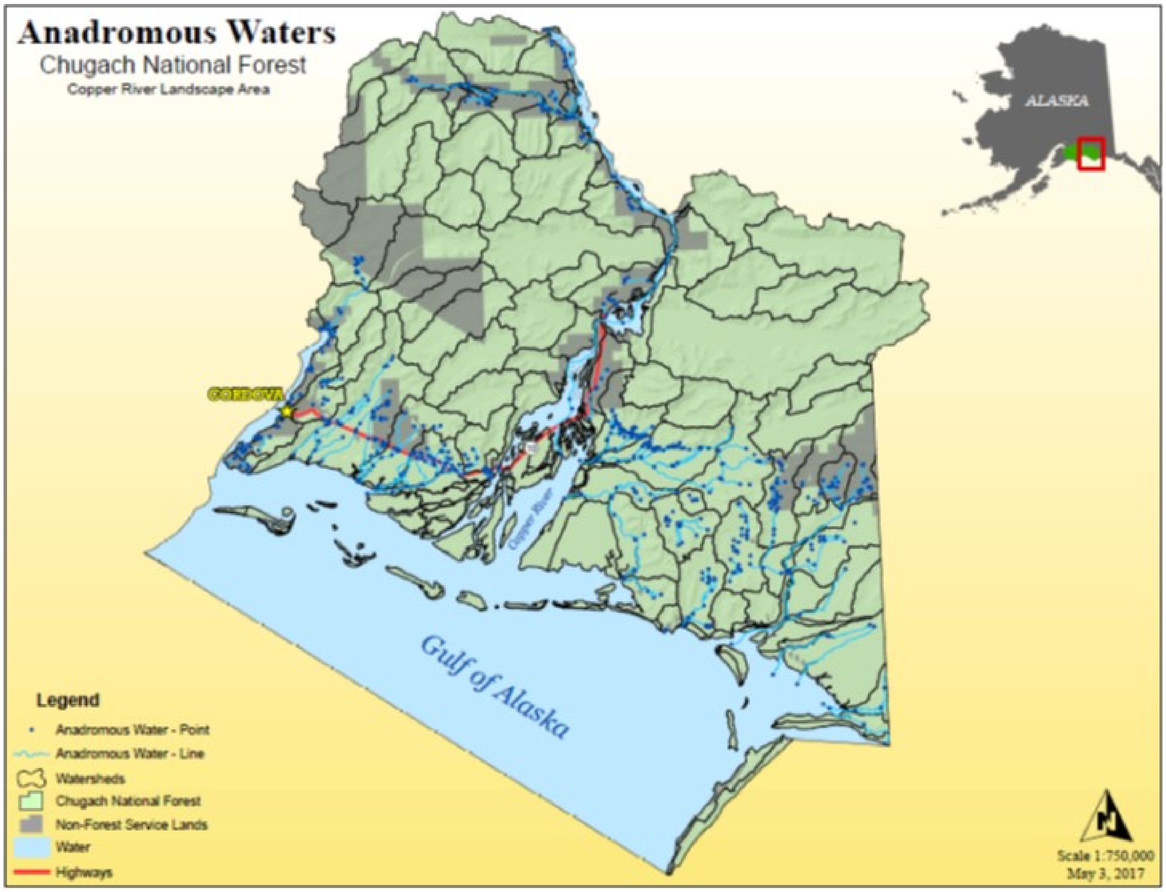
Only partial information is available for the other primary fish species in this region. These limited data indicate the trend for Prince William Sound Chinook salmon may be upward, neutral for coho salmon, and downward for sockeye salmon and Dolly Varden char. Based on data presented by Hochhalter et al. (2011), there is no trend evident for the catch of cutthroat trout in Prince William Sound.



Map 26. Anadromous waters in the Prince William Sound Geographic Area of the Chugach National Forest

Copper River Delta Geographic Area

In the Copper River Delta Geographic Area (see map 27), the primary species are coho and sockeye salmon. Unlike in Prince William Sound, pink and chum salmon are not common in this area. The trend for freshwater catch of coho salmon in this area is upward, while comparable information for sockeye salmon does not show any trend. Information on the other species is limited, but available data indicate the trend for Chinook salmon appears downward, while for Dolly Varden Char no trend was evident. Catch data for cutthroat trout (Hochhalter et al. 2011) also show a range of variation but no clear indication of a trend.



Map 27. Anadromous waters in the Copper River Delta Geographic Area of the Chugach National Forest

Salmon Species

Chinook salmon occur in moderate to large watersheds that have a diversity of rearing habitats for juvenile Chinook salmon. The habitat requirements are somewhat similar to coho salmon. In every location in the national forest where Chinook salmon are known to exist, coho salmon are also present. However, there are many more locations within the national forest where coho salmon occur and Chinook salmon are absent. The patchy occurrence of Chinook salmon among the many streams occupied by coho salmon is evidence that there are habitat differences that have thus far not been clearly identified. The following habitat and life history information for the five salmon species native to Alaska are taken from the Alaska Department of Fish and Game.

Chinook Salmon

Chinook salmon hatch in fresh water and rear in main-channel river areas for one year. The following spring, Chinook salmon turn into smolt and migrate to the salt water estuary. They then spend anywhere from one to five years feeding in the ocean, and return to spawn in fresh water. All Chinook salmon die after spawning.

Chinook salmon may become sexually mature from their second through seventh year, and as a result, fish in any spawning run may vary greatly in size. Females tend to be older than males at maturity.

Small Chinook salmon that mature after spending only one winter in the ocean are commonly referred to as jacks, and are typically male. Alaska streams normally receive a single run of Chinook salmon from May through July.

Chinook salmon do not feed during the freshwater spawning migration, so their condition deteriorates gradually during the spawning run as they use stored body materials for energy and gonad development.

Each female deposits between 3,000 and 14,000 eggs in several gravel nests, or redds, which she excavates in relatively deep, fast moving water. In Alaska, the eggs usually hatch in late winter or early spring, depending on time of spawning and water temperature. The newly hatched fish, called alevins, live in the gravel for several weeks until they gradually absorb the food in the attached yolk sac. These juveniles, called fry, wiggle up through the gravel by early spring.

Chinook juveniles divide into two types: ocean type and stream type. Ocean type Chinook salmon migrate to saltwater in their first year. Stream type spend one full year in fresh water before migrating to the ocean. In Alaska, most juvenile Chinook salmon remain in fresh water until the following spring when they migrate to the ocean as smolt in their second year of life.

Juvenile Chinook salmon in fresh water initially feed on plankton and later feed on insects. In the ocean, they eat a variety of organisms, including herring, pilchard, sandlance, squid, and crustaceans. Salmon grow rapidly in the ocean and often double their weight during a single summer season.

Fresh water streams and estuaries provide important habitat for spawning Chinook salmon, and they also serve as nursery grounds for developing eggs, fry, and juveniles. In North America, Chinook salmon range from the Monterey Bay area of California to the Chukchi Sea area of Alaska. In Alaska, they are abundant from the southeastern panhandle to the Yukon River. Major populations return to the Yukon, Kuskokwim, Nushagak, Susitna, Kenai, Copper, Alsek, Taku, and Stikine rivers with important runs also occurring in many smaller streams.

Coho Salmon

Stream habitat is essential to the life cycle of the coho salmon and often it is the larger streams having steeper gradients compared to those utilized by pink and chum salmon.

Coho salmon are also found in watersheds that contain lakes or lake-like habitat, often along with sockeye salmon. In these habitats, coho salmon are often found in large numbers, utilizing the lake habitat for juvenile rearing and overwintering.

The emergent coho salmon fry occupy shallow stream margins, and, as they grow, establish territories that they defend from other salmonids. Coho fry live in ponds, lakes, and pools within streams and rivers, usually among submerged, woody debris in quiet areas free of current. The coho salmon are extremely adaptable and occur in nearly all accessible bodies of fresh water, from large trans-boundary watersheds to small tributaries.

Coho salmon enter spawning streams from July to November, usually during periods of high runoff. The female digs a nest, called a redd, and deposits 2,400 to 4,500 eggs. As the eggs are deposited, they are fertilized with sperm, known as milt, from the male. The eggs develop during the winter, hatch in early spring, and the embryos remain in the gravel utilizing their egg yolk until they emerge in May or June. During the fall, juvenile coho salmon may travel miles before locating off-channel habitat where they pass the winter free of floods. Some fish leave fresh water in the spring and rear in brackish estuarine ponds and then migrate back into fresh water in the fall.

Coho salmon spend one to three winters in streams and may spend up to five winters in lakes before migrating to the sea as smolt. Time spent at sea varies. Some males (called jacks) mature and return after only six months at sea at a length of about 12 inches, while most fish stay 18 months before returning as full size adults.

In freshwater, coho salmon fry feed voraciously on a wide range of aquatic insects and plankton. They also consume eggs deposited by adult spawning salmon. At sea, their diet consists mainly of fish and squid.

Little is known about the ocean migrations of coho salmon.

Sockeye Salmon

Sockeye salmon are typically found in watersheds that contain lakes or lake-like habitat, which is generally a requirement for more productive sockeye salmon spawning and juvenile rearing. Coho salmon are also typically found in these habitats, often in large numbers, utilizing the lake habitat for juvenile rearing and overwintering. Pink and chum salmon are less common and frequently absent, especially where they occur in the eastern Prince William Sound. It is likely there are cryptic, yet to be discovered, characteristics of these habitats that make them less favorable to pink and chum salmon.

Fresh water lakes, streams and estuaries provide important habitat for spawning and rearing sockeye salmon. On the west coast of North America, sockeye salmon range from the Klamath River in Oregon to Point Hope in northwestern Alaska.

Sockeye salmon spend one to four years in fresh water and one to three years in the ocean.

In Alaska, most sockeye salmon return to spawn in June and July in freshwater drainages that contain one or more lakes. Spawning itself usually occurs in rivers, streams, and upwelling areas along lake beaches. During this time 2,000 to 5,000 eggs are deposited in one or more redds, which the female digs with her tail over several days. Males and females both die within a few weeks after spawning.

Eggs hatch during the winter, and the young alevins remain in the gravel, living off their yolk sacs until the spring when they emerge from the gravel as fry and move to rearing areas. In systems with lakes, juveniles usually spend one to three years in fresh water, feeding on zooplankton and small crustaceans, before migrating to the ocean in the spring as smolts. However, in systems without lakes, many juveniles migrate to the ocean soon after emerging from the gravel.

Smolts weigh only a few ounces upon entering salt water, but they grow quickly during their one to three years in the ocean, feeding on plankton, insects, small crustaceans, and occasionally squid and small fish. Alaska sockeye salmon travel thousands of miles during this time, drifting in the counter-clockwise current of the Alaska Gyre in the Gulf of Alaska. Eventually they return to spawn in the same freshwater system where they were hatched.

Chum Salmon

Chum salmon are found in streams that are usually small, with a short spawning reach, often including a sizable portion within the intertidal zone. Typically these streams contain adequate spawning gravel and a sufficient water supply to facilitate the incubation of eggs during the winter months. Another characteristic feature is that the streams have very little habitat for older aged juvenile salmon. Consequently, coho and Chinook salmon, which need this type of juvenile habitat, are uncommon in these streams. The density of adult pink and chum salmon during the spawning season is typically very high. The habitats favoring pink and chum salmon are prevalent across much of Prince William Sound.

Chum salmon have the widest distribution of any of the Pacific salmon. They range throughout Alaska, but are scarce north of Kotzebue Sound. While at sea, most of Alaska's chum salmon remain in the eastern Chukchi and Bering seas and the Gulf of Alaska.

Chum salmon usually spawn at the mouth, or in the lower sections, of rivers, although in Alaska's largest river systems, some travel great distances (up to 2,000 miles to the upper Yukon River in Canada) upriver to spawn. After hatching, juvenile chum salmon spend a short time (days to weeks) in freshwater before migrating to the ocean. Once in the ocean, juvenile chum salmon remain near shore, particularly in shallow eelgrass beds, for the first several months before dispersing into the open ocean.

Chum salmon usually spawn in the fall. They can be found in two distinct races based on spawning-run timing: the earlier-running race is referred to as summer chum salmon, and the later-running race is called fall chum salmon. Small to medium, slow-flowing, spring-fed side channels are often their preferred spawning habitat, but they spawn in a wide variety of habitats, including large muddy rivers, cold, clear headwater streams, and in the mouths of rivers below the high-tide line. A female chum salmon excavates depressions (redds) in the gravel and deposits her eggs as one or more males simultaneously releases its sperm resulting in fertilization. The female then covers the fertilized eggs with gravel and guards the redd until she eventually becomes too weak to hold position in the stream.

Chum salmon embryos hatch from eggs after three to four months, depending on water temperature. Hatchlings (alevin) remain in the gravel while continuing to absorb nutrients from the egg yolk for an additional 60 to 90 days before emerging. They begin their migration to the sea within days or weeks.

At sea, juvenile chum salmon spend several months near shore then disperse into the open ocean. They grow rapidly in the ocean, reaching 12 or more pounds over the next 3 to 4 years, with the most rapid growth taking place during their final year at sea.

Pink Salmon

Pink salmon are found in streams that are usually small, with a short spawning reach that often includes a sizable portion within the intertidal zone. Typically, these streams contain adequate spawning gravel and a sufficient water supply to facilitate the incubation of eggs during the winter months. Another characteristic feature is that the streams have very little habitat for older aged juvenile salmon. Consequently, coho and Chinook salmon, which need this type of juvenile habitat, are uncommon in these streams. The density of adult pink and chum salmon during the spawning season is typically very high. The habitats favoring pink and chum salmon are prevalent across much of Prince William Sound.

Pink salmon are found throughout the coastal waters of the North Pacific Ocean, Arctic Ocean, and nearby seas.

In Alaska, pink salmon are widely distributed along the coast, with only a few in the Copper River Delta and none in the upper Copper River drainage.

Pink salmon have the shortest lifespan of all the Pacific salmon found in North America. They mature and complete their entire life cycle in two years. This predictable two-year life cycle has created genetically distinct odd-year and even-year populations of pink salmon.

Pink salmon generally spawn in small rivers near the coast, and in estuaries near the mouths of rivers. Most pink salmon do not travel farther than 40 miles up a river to spawn.

The female picks a suitable nesting place and constructs a nest in the river bed by turning on her side and vigorously flexing her body and tail, digging a shallow hole. As she settles into the hole to deposit her eggs, a male joins her to fertilize them. Males develop the enormous hump on their back, and an enlarged head with big teeth that they use in fights with other males. A female may dig and lay eggs in up to four nests, covering her previous nests as she digs new ones. A group of nests is known as a redd. A female stays and defends her redd until she dies, usually within two weeks. Males leave to try and fertilize other eggs.

The eggs incubate over winter and hatch in late winter or early spring. The young salmon fry, or alevin, live under the gravel feeding off the yolk sac attached to their belly and continue to grow until they are large enough to emerge from the gravel on the bottom of the river. They then swim to the ocean and gather in schools and remain in estuaries and along the beaches where they begin feeding on plankton, larval fishes, and occasional aquatic insects. After 18 months of feeding and growing in saltwater, they reach maturity and return to the river where they were born to spawn between late June and mid-October.

Watersheds within the national forest with pink and chum salmon populations are the most common (254 watersheds). Habitats containing sockeye and coho salmon populations are the most common in the Copper River Delta Geographic Area, representing 43 percent of the stream systems. Prince William Sound is dominated by the pink and chum salmon habitats, representing 51 percent of the stream systems found on the sound. The Chinook salmon and Dolly Varden char habitats are the most common for the Kenai Peninsula Geographic Area, together representing 64 percent of the stream systems. The Chinook salmon habitat preferences are the least common with only 24 stream systems identified across the entire national forest.

Marine Survival Cycles

Marine survival of juvenile salmon fluctuates widely. Perhaps more than any other factor, it is the survival rate during the marine phase of a salmon's life history that best predicts the subsequent run size, catch, and level of marine derived nutrients that are infused back into the freshwater aquatic ecosystem. Survival rates, usually expressed as juvenile to returning adult survival, are difficult to obtain for wild populations. However, where such data exist, they have been found to correlate well with cyclic patterns of salmon abundance (Mantua 2009; Mantua et al. 1997).

Marine-derived Nutrients

Salmon have a major influence on the productivity and integrity of aquatic ecosystems in Alaska, as well as a being contributors to the integrity of terrestrial ecosystems. Their presence provides a nutrient subsidy that is critical to maintain the productivity of the ecosystem (Hicks et al. 2005). This influence comes from a boost of nutrients from decomposing salmon carcasses in freshwater systems. The carcasses are supplied each year after the spawning season is over when the salmon die and decompose. This seasonal boost of nutrients increases stream productivity significantly and benefits the capacity of the system to produce all forms of aquatic life, including fish. Without this annual nutrient supply, the productivity of these systems would be much less, a factor of high significance, especially for species likes Chinook, coho, and sockeye salmon, for which a substantial part of their life history occurs in freshwater. Salmon eggs, flesh, and fry are very important food resources in the aquatic system, while also contributing to the terrestrial ecosystem, both in terms of wildlife and riparian vegetation.

Table 86. Common name, scientific name, and general distribution of fish produced within the Chugach National Forest

Common Name	Scientific Name	Distribution
Chinook salmon	*Oncorhynchus tshawytscha*	Across the national forest
Coho salmon	*Oncorhynchus kisutch*	Across the national forest
Sockeye salmon	*Oncorhynchus nerka*	Across the national forest
Chum salmon	*Oncorhynchus keta*	Across the national forest
Pink salmon	*Oncorhynchus gorbuscha*	Across the national forest
Steelhead trout	*Oncorhynchus mykiss (anadromous form)*	Eastern national forest (Copper and Martin rivers) and Turnagain Arm Tributaries
Cutthroat trout	*Oncorhynchus clarki*	Scattered Across Prince William Sound and Copper River Delta
Rainbow trout	*Oncorhynchus mykiss*	Kenai Peninsula, Copper and Martin Rivers
Dolly Varden char	*Salvelinus malma*	Across the national forest
Arctic char	*Salvelinus alpinus*	Cooper Lake, Swanson River, and likely in small alpine lakes
Lake trout	*Salvelinus namaycush*	Kenai Lake
Arctic grayling	*Thoymallus arcticus*	Crescent and Grayling Lakes (introduced species)
Round whitefish	*Prosopium cylindraceum*	Kenai Peninsula, Copper River
Humpback whitefish	*Coregonus oidschian*	Copper River
Eulachon	*Thaleichthys pacificus*	Turnagain Arm, Copper River Delta
Burbot	*Lota lota*	Juneau Lake (single location)
Coast Range sculpin	*Cottus aleuticus*	Likely across the national forest
Prickly sculpin	*Cottus asper*	Likely across the national forest
Slimy sculpin	*Cottus cognatus*	Likely across the national forest
Threespine stickleback	*Gasterosteus aculeatus*	Across the national forest , often anadromous
Ninespine stickleback	*Pungitius pungitius*	Kenai Peninsula, infrequent
Pacific lamprey	*Entosphenus tridentata*	Copper and Kenai rivers

Species Diversity

Interactions among different naturally occurring species has an influence on the function of ecosystems and the productivity of individual species. At this time, these interactions with the NFS lands are poorly understood, changes in the relative number and distribution of these species provide an important indicator of ecosystem disturbance.

There are at least 19 fish species that occupy at least a portion of the national forest (see table 86). In terms of abundance, economic value, cultural significance, and ecological importance, the five species of Pacific salmon play the primary role. However, there are six additional anadromous species that occupy national forest waters and are also part of the indigenous ecosystem, including: steelhead trout, sea-run cutthroat trout, sea-run Dolly Varden char, eulachon, Pacific lamprey, and threespine stickleback. As described in table 86, some of these species are widespread and others have a very limited distribution. For example, eulachon return in large numbers to specific basins (e.g., Twentymile River and the Copper River).

The national forest also contains a number of fish species that spend their entire life in freshwater (see table 86). These include: Dolly Varden char (resident form), rainbow trout (resident form), cutthroat trout (resident form), Arctic char, humpback whitefish, round whitefish, ninespine stickleback, and three sculpin species.

Climate Change

Salmon and their associated ecosystems are sensitive to climatic variations and the possible effects are many and complex (Bryant, 2009, Chilcote et al. 2017, Schoen et al 2017). Climate change will alter the ecological conditions with warmer temperatures, changes in rain, snow and ice melt resulting in changes in stream hydrology, and changes in marine conditions that will affect salmon. In the recent past, periods of colder ocean temperature have been less favorable to survival of Alaska salmon than when ocean temperatures were warmer (Mantua, 2009) but the consequences of long-term, directional change are less certain.

The net effect of climate change on both freshwater and marine systems may cause a shift in the current mix of aquatic ecosystems present in the national forest (Abdul-Aziz, Mantua, and Myers, 2011) Chilcote et al. 2017) and on the abundance of salmon. Based on climate scenarios for the next 60 years, the snowpack for watersheds at lower elevations are projected to decline because of warmer temperatures. Reductions in snowpack at lower elevations are expected to alter the timing and amount of runoff in 61 of 720 watersheds (Chilcote et al. 2017). These watersheds are expected to transition from streamflow patterns characteristic of snow-dominated toward patterns expected for rain-dominated systems resulting in changing stream conditions. The changes in hydrographs and associated environmental transformation will likely harm some salmon populations while benefiting others (Schoen et al. 2017). It may result in the expansion of certain species that are now relatively uncommon, such as Steelhead and Cutthroat Trout (Chilcote et al. 2017).

The degree to which salmon are able to cope with changes brought about by a warming climate is in part dependent on the variability in salmon stocks in the region, the variation in ecological conditions within drainage systems, and the access salmon have to the inherent environmental heterogeneity through hydrologic connectivity (Reed et al. 2011, Schoen et al. 2017). Currently, freshwater systems on the Chugach National Forest are largely intact. Watershed complexity ranges from small streams and ponds to large rivers and lakes and is complimented by a diversity of hydrologic and thermal regimes associated with different water supplies (e.g., glacial, snow-dominated, transitional, spring-fed) (Chilcote et al. 2017)). This habitat diversity, in turn, supports a high level of population and life history diversity that contributes to the resilience of the region’s salmon and the fisheries that rely on them (Schindler et al. 2010. Chilcote et al. 2017).

Environmental Consequences

The indirect effects to fish resources are directly related to the condition of the watersheds and water resources. These indirect effects will be addressed under each alternative qualitatively. The cumulative effects to fish resources related to the watersheds and water resources will be described as common across all alternatives.

Consequences Common to All Alternatives

Fisheries

Salmon, char, and trout are all caught in commercial, sport, personal use, and subsistence fisheries. As a result, a portion of each year's production is removed from the population prior to spawning. Although salmon populations are robust and it can be demonstrated numerically they are able to sustain high fishery impact rates, it is not clear what the long term ecological impact may be of fewer salmon carcasses on the spawning grounds as a result of these fisheries. Effectively, the annual infusion of marine derived nutrients into most aquatic ecosystems has been reduced (Schindler et al. 2003).

The ecological character of most anadromous streams is likely different today than in historical times before the start of large-scale salmon fisheries. Evidence for this change is provided by Rogers et al. (2013) in their reconstruction of salmon population numbers over the past 500 years based on the evaluation of stable nitrogen isotopes in sediments from 20 lakes in western Alaska. In the 400 years before 1900, salmon populations fluctuated independently from each other in a non-synchronous pattern. However, virtually all spawning populations declined after 1900, which coincides with the start of large-scale fisheries. The authors infer that these fisheries have reduced the infusion of salmon derived nutrients into the freshwater aquatic ecosystem by 60 percent relative to the historical baseline from 1500 to 1900.

There are a number of commercial fish species harvested in the waters of southcentral Alaska. According to 2016 Alaska Department of Fish and Game harvest statistics, the Prince William Sound inseason harvest estimates for five species of salmon amounted to 11,963 Chinook salmon, 1,936,591 sockeye salmon, 476,273 coho salmon, 8,755,832 pink salmon, and 2,488,583 chum salmon.

Other commercial harvests include herring, groundfish, and shellfish. The sport harvest within these same waters has also risen dramatically, increasing significantly in the waters within and adjacent to the national forest.

Hatchery Influence on Wild Salmon

Hatchery fish are common in Prince William Sound and the lower Kenai Peninsula. A number of studies on coho salmon, Chinook salmon, and steelhead trout have demonstrated that hatchery and wild fish spawning under natural conditions differ considerably in their relative ability to produce surviving offspring (Araki et al. 2008; Buhle et al. 2009; Chilcote 2003; Leider et al. 1990). Chilcote et al. (2011) estimated that a naturally spawning population composed entirely of hatchery fish would have approximately one-tenth the reproduction rate as a population composed entirely of wild fish. Such differences between hatchery and wild fish have not been demonstrated for salmon populations that occur within the national forest, although Hilborn and Eggers (2000) concluded that hatchery pink salmon have replaced rather than supported wild pink salmon populations reproductively in Prince William Sound.

Alaska private non-profit corporations operate the hatcheries in Alaska. Both the Main Bay Hatchery and the Cannery Creek Hatchery are located in Prince William Sound within the Glacier Ranger District. The Main Bay Hatchery is a state-owned hatchery built in 1981 by the Alaska Department of Fish and Game Fisheries Rehabilitation, Enhancement and Development Division as a chum salmon hatchery and is approximately 40 miles southeast of Whittier. Prince William Sound Aquaculture Corporation manages and operates the facility for Alaska Department of Fish and Game. The Cannery Creek Hatchery is a state-owned hatchery built in 1978 by the Alaska Department of Fish and Game

Fisheries Rehabilitation, Enhancement and Development Division as a pink and chum salmon hatchery. It is in the Unakwik Inlet in Prince William Sound, approximately 40 miles east of Whittier. This facility is also managed and operated by Prince William Sound Aquaculture Corporation for the Alaska Department of Fish and Game. The infrastructure's contribution to social, economic, and ecological sustainability is found in the economic impact of the Prince William Sound Aquaculture Corporation 2012 document (McDowell Group 2012).

Prince William Sound hatchery-produced salmon that were commercially harvested in 2016 amounted to approximately 9.4 million fish at an estimated exvessel value of $28 million (Stopha 2017). This value roughly breaks down to 65,000 sockeye salmon, 31,000 coho salmon and 9,500 pink salmon. Sockeye salmon contributed the most hatchery fish to the sport, personal use, and subsistence fisheries in Prince William Sound. Minor hatchery augmentation occurs on the national forest portion of the Kenai Peninsula.

Fish Pass Structures and Impoundments

Eight operating fish pass structures on NFS lands have been built in Prince William Sound streams with the objective of increasing production of wild salmon. These fish pass structures give salmon access to new habitat for production. The additional salmon produced as a result of these fish pass structures have likely contributed to commercial, sport, personal use, and subsistence fisheries. The fish pass structures may also enhance the production of wild salmon in addition to the hatchery programs that primarily increase the production of hatchery fish. The effects on pre-existing resident forms of wild char and trout living above the migration barrier is of interest. The Forest Service measured relative numbers of cutthroat trout in Canoe Creek before a fish pass structures was constructed and then again 10 years after construction, and found no appreciable difference (Hodges pers. comm. 2015). These fish pass structures were constructed at natural, pre-existing barriers (usually waterfalls) that historically had been impassable to upstream migrating salmon. Some of the fish pass structures are a result of mitigation for streams that were not barriered until the 1949 Queen Charlotte Islands earthquake (Martin pers. comm. 2015).

Invasive Species

Invasive species can pose a serious risk to aquatic ecosystems. In terms of fish, the primary threats to southcentral Alaska are northern pike (*Esox Lucius*) and Atlantic salmon (*Salmo salar*). Northern pike are not native to the national forest, but indigenous populations do exist in Alaska. Northern pike have been found in lakes on the western portion of the Kenai Peninsula, but none have yet been reported on the national forest. Atlantic salmon, likely escapees from commercial pen-rearing hatchery operations in British Columbia, have been recovered in the marine environment near Cordova and warrant observation. Atlantic salmon do not seem to be able to establish self-sustaining natural populations in the streams draining into the Pacific Ocean. There are several streams on the east coast of Vancouver Island in British Columbia where natural populations of Atlantic salmon have become established (McGinnity et al. 2009; Volpe et al. 2000). Invasive invertebrates and fish pathogens also pose a threat to national forest aquatic ecosystems, although at this time there is no evidence that any contact has occurred.

The spread of *Elodea* spp. (waterweed), a highly invasive aquatic plant, is an emerging issue in Alaska and within the national forest. *Elodea canadensis* has been found in a number of lakes and sloughs on the Copper River Delta. Recent surveys have found it spreading to new lakes and known populations are spreading. The ecology and long term effects of *Elodea canadensis* on the Copper River Delta are not well understood and are being investigated. Outside its native range, this plant has often degraded water quality, impeded boat traffic, reduced dissolved oxygen, and impacted native fisheries. (Carey et al. 2016).

Vegetation

Vegetation, and particularly riparian vegetation, regulates the exchange of nutrients and organic material from upland forests and grasslands to streams. Vegetated riparian areas are particularly dynamic portions of the landscape. These areas are shaped by disturbances characteristic of upland ecosystems, such as fire and wind throw, as well as by disturbance processes unique to aquatic systems, such as channel erosion, peak flow, deposition by floods, and debris flows. Riparian areas are widely considered to be critical habitat for fish and aquatic insects. Maintaining the integrity of the vegetation is particularly important for these riparian-dependent species.

Generally, vegetation management projects would be expected to improve fish and aquatic insect habitat and would not specifically result in any actions that could affect essential fish habitat. Any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Wildlife

Generally, wildlife management projects would be expected to improve or have no effect on fish and aquatic insect habitat. Prescribed burning effects on fish habitat are similar to those described under the Fire Management section. Anticipated wildlife management does not specifically result in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Oil Spills

In 1989 the *Exxon Valdez* ran aground and 11 million gallons of crude oil were spilled into Prince William Sound. This had a catastrophic effect on the marine ecology and food webs that salmon depend on. It also affected the intertidal zone of many streams in Prince William Sound where a large portion of the pink salmon and chum salmon spawn. Most salmon populations are thought to have recovered from this event, although the ecological affect is still evident.

Since 1989, shipping procedures and oil spill response measures have been implemented to reduce the likelihood of a spill and in the event of another spill help contain the scale of affect. However, oil tankers continue to travel Prince William Sound and the chance of another large oil spill has not been eliminated. In addition, there remain impacts from the spills from coastal villages, towns, and recreational and commercial vessels.

Subsistence

All the rural communities in and adjacent to the national forest reported harvesting fish, with salmon ranking as the most important group of species. These fisheries have traditionally focused on nearshore species, such as salmon, herring, and shellfish (molluscan and crustacean), as well as a few demersal or groundfish species, such as cod, halibut, and rockfish. Within the national forest, much of the harvest of fish for food takes place under various sets of State and Federal regulations. In freshwater, salmon, trout, and char are harvested in accordance with both State sport regulations (all Alaska residents, see State Regulations (http://www.adfg.alaska.gov/index.cfm?adfg=residentfishing.main)) and Federal subsistence fishing regulations (only qualified rural residents with a customary and traditional use determination).

The two most important Federal subsistence fisheries that take place within the national forest are the dipnet fishery at the Russian River Falls and a freshwater fishery on the Copper River Delta. These subsistence fisheries, which have high value for local residents, account for small amounts of fish relative to the commercial fisheries.

Road Construction

Road construction and use may be the greatest potential sediment source over both the short term and long term. Roads constructed in riparian areas can constrict floodplains and channels resulting in changes to channel morphology and fish habitat (Furniss et al. 1991). Road construction on steep mountain and hillslope landforms commonly found on the Kenai Peninsula increases the likelihood of landslides, which transport large quantities of sediment and woody debris. The rate of failure would be dependent on storm events. Upon reaching streams, the material can block or cause channel shifts, alter existing habitat structures, fill in pool rearing habitats, and increase fine sediment in spawning gravel. These changes would likely decrease the habitat capability to produce fish.

Roads can also be viewed as causing risk to fish movement, primarily due to culverts being used on moderate to high gradient streams. At highest risk are stream-rearing fish, particularly cutthroat trout and Dolly Varden char, which occupy the smaller headwater streams during some parts of their lives. In general, resident species are not as sedentary as previously thought (Trotter 1989). High quality spawning habitat may be some distance from high quality rearing or over wintering habitat of lakes, ponds, or pools of large rivers. Juveniles of other stream-rearing fish such, as coho salmon, are often highly mobile during their freshwater stage, moving seasonally between stream reaches, so they are also at risk. Survival often is dependent on this seasonal movement (Bustard and Narver 1975). Restrictions in upstream movement could have impact to overall habitat capability.

It is not expected that road construction will specifically result in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Timber Harvest

Timber harvest activities may increase risk to fish resources. The risks of these effects are proportionate to the intensity of the management treatments, the juxtaposition to the riparian areas, and the sensitivity of the harvest area to increased erosion. Of particular concern is the protection of riparian areas, including flood plains, areas of riparian vegetation, and certain wetlands associated with riparian systems. Commercial timber harvest is not permitted in riparian areas. However, non-commercial harvest and other tree removal is permitted in some riparian areas.

Also of concern is the amount of protection afforded steeper channels (often not fish-bearing) in the headwaters areas. It is important to maintain the natural function of these steeper channels, including the V-notches. Forested leave strips are considered to be an important measure to insure protection of headwater areas (Murphy and Koski 1989).

However, there is risk of unanticipated stream habitat effects, such as accelerated numbers of landslides over background levels, blow down of riparian buffers, and the cumulative effects of many small and individually insignificant actions affecting fish habitat capability. Harvest activities may increase erosion and siltation of streams and reduce large woody debris input to streams as a result of riparian vegetation disturbance.

There is potential for reduction of key habitat components for juvenile coho salmon with regard to disturbance of off channel habitat and low gradient tributaries. Management influence on off-channel habitat usually consists of bank disturbance, small logging debris loading of these habitats, and sedimentation or disturbance from upstream activities that are not mapped before timber harvest. Mitigating these potential effects by avoiding or minimizing timber harvest activities in riparian areas is felt to be the key means of minimizing impacts to fisheries habitat from logging (Chamberlin 1982; Dolloff 1987; Johnson et al. 1986; Murphy et al. 1986).

Timber harvest within riparian areas may lead to increases in primary productivity and secondary productivity. Increases in summer water temperatures created by reduced canopy closure from timber harvest or other vegetation removal projects may also increase algae growth. Other possible outcomes to increased sunlight/increased algae growth are increased water temperature and a decreased solubility of oxygen in the water. This has been documented to result in increased adult fish respiration causing fish mortality in heavily logged watersheds. These can lead to increases in summer salmonid carrying capacity. For stream-rearing fish, both resident and anadromous, the amount of overwinter habitat is considered critical.

Very little timber harvest occurs within the national forest. Most of the recent logging occurred in the 1990s and that on private lands within the national forest boundary. The greatest demand is for personal use sawtimber and fuelwood. Details are provided in the Forest Products section of this DEIS.

Given the low intensity of harvest, no fundamental changes in watershed processes affecting fish habitat are expected. It is not expected that timber management will specifically result in any actions that could affect Essential Fish Habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Fire

Fire can have both positive and negative effects on fish and their aquatic habitat. Fire can release important elements, such as nitrogen and phosphorous, into the aquatic systems. These increases are temporary and usually dissipate after re-vegetation occurs. There is speculation that such increases could increase the productivity of the steams during this period. Alaskan streams are relatively sterile. Thus, productivity increases in plants and animals that provide food sources may lead to increases in numbers of fish.

Key physical components of a fully functioning aquatic ecosystem include complex habitats consisting of floodplains, banks, channel structure (i.e., pools and riffles), and subsurface waters. These are created and maintained by upslope disturbance processes, including fire, that supply nutrients, woody debris, and water. Large intense fires may lead to changes in these upslope processes. These wildland fires can have short-term detrimental effects, particularly to certain fragile soil and channel types, in the form of increased sedimentation, channel degradation, and changes in stream temperature regimes.

Over time (500 years or more), streams within the Kenai watershed were and are clearly disturbance-dependent systems. To maintain aquatic viability throughout a large drainage basin, it is necessary to maintain features of the natural disturbance regime. Fire is a factor in the natural disturbance regime on Kenai Peninsula forested watersheds.

The use of prescribed fire to reduce fuels and manage vegetation would directly benefit aquatic habitat, while concurrently reducing the risk of large catastrophic wildfires that could, at least in the short term, damage aquatic systems. It is not expected that fire management will specifically result in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Lands and Special Use Management

Dams and water diversions can have significant effects on aquatic and riparian habitat and fish migration by changing channel dimensions, altering aquatic and riparian habitat, and obstructing fish migration. The degree of these effects is currently unknown.

As permits are amended, renewed, or issued, the Forest Service will analyze environmental effects to determine if additional mitigation measures or new terms and conditions are required. It is not expected that lands and special use management will specifically result in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Minerals

Mining and fossil fuels extraction can affect fish and aquatic habitat. Mining can be a significant source of bedload sediment or toxic heavy metals introduced into streams. Other risks include altered stream flows and channels, acid-mine drainage, toxic substance spills, and altered temperatures. Normally, water is needed in mining operations, and this depletion of streams or underground aquifers may also adversely affect fish habitat.

There have been significant mining operations in the past history of the national forest. Mineral extraction currently affects a small, though currently unknown, percentage of stream habitats within the national forest. More details are provided in the Minerals section of this DEIS.

Hard rock mining operations proposed within the national forest include a variety of resource protection stipulations and requirements. These operations are carefully monitored to ensure compliance with the terms of the mine operating plan or lease agreement. Anticipated minerals management projects are not expected to specifically result in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Recreation

The relation between recreation and salmon aquatic habitat is complex. It represents a relation between habitat and the people. The indirect effect of overuse of streamside zones by recreational users is difficult to judge. The criteria to judge the potential effects of recreation of aquatic habitat are the amount and number of recreational visitor days and the degree of access. Sport fishing is a major recreational activity within the national forest, but a variety of other recreational uses, such as motorized vehicle use, boating, hiking, and horseback riding, could damage riparian and aquatic habitats. Some of the activities are dependent on the aquatic environment and have potentially more impact on fish habitat. Fishing, particularly at areas where returning adult salmon congregate, may create localized impacts. Such sites are currently found on the Russian River and Quartz Creek, and impacted sites are increasing as recreation use increases.

Recreational use can affect aquatic habitat in many ways. The most obvious ways within the national forest is through the loss of streamside riparian vegetation and changes in the upland soils. Riparian zones are transitional areas that lie between the river channel and the upland. They provide important fish habitat and hydrologic functions by controlling floods and erosion. The riparian vegetation functions as a buffer and filter system between upland development and the river, maintaining water quality by absorbing nutrients, accumulating and stabilizing sediments, and removing pollutants from upland development. These areas are also where a major part of the national forest sport fishing and other recreational activities are concentrated. The trampling of soils by anglers, hikers or others using the riparian areas can result in soil compaction, reduction in organic matter, and root exposure. User developed trails may also result in collection of surface water, with rutting and erosion. Loss of soils can lead to sediments entering salmon habitat and result in a reduction in spawning and rearing habitat, negatively affecting spawning gravel quality, or filling in the pools, or loss of undercut banks (Furniss et al. 1991).

Riparian zones, floodplains, and alluvial landforms are probably the most sensitive areas to recreational developments and use. In their review, Clark and Gibbons (1991) found that even light recreational use could impact riparian vegetation causing mortality of the overstory, loss of tree vigor, root kill, and loss of ground cover. They also indicate that keeping roads and trails away from sensitive areas is important in controlling impacts. Baxter et al. (1999) have suggested that alluvial, or floodplain sections of streams are the most critical and sensitive reaches of watersheds. Gunderson (1968) found that floodplain development altered the stream morphology and fish populations. On the Kenai Peninsula, the intensive use of the floodplain has resulted in a decline of Chinook salmon habitat capability. Before extensive bank restoration activities started in 1996, the lower Russian River experienced significant loss of stream bank stability due to recreational angler trampling, but comprehensive rehabilitation efforts on these areas since that time have resulted in an improvement of habitat quality (Griglak 2000).

Access can also play a critical role in determining potential impacts on aquatic habitat by either hindering or facilitating recreational use of the streams and lakes. As previously described, roads may have a detrimental impact on salmon habitat (Furniss et al. 1991). Clark and Gibbons (1991) suggest that access management is critical to protecting the quality of fish habitat. In their review, Clark and Gibbons (1991) state that if roads and trails are kept some distance away from the stream channels, detrimental impacts to habitat may be kept at a minimum. The standards and guidelines for the forest plan call for keeping roads and trails out of riparian areas, with incursions into riparian habitat only where necessary to cross from one side of the valley to another, or to direct recreational users to specific spots, such as viewing spots or angler access.

Recreational gold panning that is allowed also has the potential to impact spawning habitats. Some use of motorized suction dredges is allowed within all alternatives. Griffith and Andrews (1981) found that suction dredging stream gravels resulted in destruction of salmonid embryos and alevins within the affected spawning substrate. Roberts and White (1992) indicate that the eggs of alevins are most vulnerable during the second part of their incubation within stream gravels. Harvey and Lisle (1998) in their review of the potential impacts of suction dredging on fish habitat indicated that the impacts go beyond the direct impacts to incubating salmon eggs. Dredging of stream banks can have long lasting effects on stream channel stability. Dredging within the riffle crests could destabilize spawning sites and reduce the number of aquatic invertebrates. Also, fine sediments are mobilized and may be cast over spawning substrates. Juvenile and adult salmonid are not affected, as they are sufficiently mobile to not be directly impacted.

While there are some potential impacts due to recreational gold panning, the amount of mining anticipated has small impacts within the national forest. In response to these potential effects, the standards and guidelines for recreational gold panning include timing restrictions to protect the eggs and alevins in the gravels. The size of dredge equipment is also regulated to limit the amount of gravel that can be processed. The dredging of banks within the active stream channel is prohibited.

Intensive recreational fishing sites are not expected to change much. Access decisions may have implications on how people use an area, and subsequently on how much streamside disturbance would occur. As the distance from access points increases, the use of salmon and trout streams decreases. The location of roads and trails near streams could have indirect impacts on aquatic habitat. Damage to streams from anglers trampling banks may be mitigated by restrictive angling regulations.

Recreation management does not anticipate specifically resulting in any actions that could affect essential fish habitat, and any action that would be taken following adoption of the forest plan that could affect essential fish habitat would have a formal essential fish habitat designation.

Alternative A No Action

Alternative A would continue current management as described in the 2002 forest plan. This alternative would continue the current program of fish resource management and watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. While adequate measures are provided for providing instream flow to maintain and support fish resources, other aquatic life and habitat, recreation and aesthetics, the natural flow conveyance of water and sediment, and other resources that depend on such flows on NFS lands, there is no strong direction for reserving in steam flow reservations and acquiring water rights.

The alternative A (no-action) designated wilderness study area boundary and wilderness area recommendation would remain consistent with the 2002 forest plan. There are currently 4,372,657 acres open to mineral entry under alternative A (no-action) if the recommended wilderness area is not designated and the current condition remains unchanged. There would be 2,985,147 acres open to mineral entry under alternative A in the event that the recommended wilderness area becomes designated. Upon designation, 1,387,510 acres of land would be withdrawn from mineral entry, subject to valid existing rights. Under alternative A, current short term and long term potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development would retain the same footprint with little effect on fish resources. Additionally, potential short term and long term water quality environmental consequences, such as sedimentation, erosion, and contamination, associated with mineral development would remain the same within the national forest.

For alternative A, recreation opportunity spectrum classes and management prescription areas would remain consistent with the 2002 forest plan. The current opportunities for summer and winter motorized and non-motorized activities and guided special uses would remain the same. Potential impacts to fish resources, water quality and overall watershed conditions from snowmachines, helicopters, and ATVs would remain at current levels. Fish resources, water quality and overall watershed condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would also remain the same. In general, all of these recreation effects are short term and low except at points of concentrated use. Proper management, use of BMPs, and standards and guidelines outlined in the 2002 forest plan would continue to reduce potential recreational impacts to water resources and overall watershed conditions that support fish resources.

Alternative B

Alternative B, similar to alternative A, would continue management direction providing for ecological sustainability. The alternative would continue the current program of fish resource management, watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Plan components have been modified and added to provide more of an emphasis on providing ecosystem resilience for changing conditions.

The alternative B wilderness area recommendation, similar to alternative A, would remain consistent with the 2002 forest plan. Upon designation, the number of acres withdrawn from mineral entry would remain the same (1,387,510 acres). The footprint of the potential water quantity stressors and impacts, such as withdrawals and diversions, associated with mineral development would remain the same. Additionally, the footprint of potential water quality stressors and impacts on fish resources, such as sedimentation, erosion, and contamination, associated with mineral development would remain the same.

For alternative B, recreation opportunity spectrum classes and management prescription area changes from alternative A have potential minor effects on water resources and watershed conditions and affected fish resources. Most of these changes are focused on the Kenai Peninsula and reflect changes that incorporate the Kenai Winter Access Project Record of Decision (2007) management direction. Overall, there is a small decrease (less than 1 percent) in Semi-primitive ROS class opportunities for winter and summer motorized use. Potential impacts to water resources and overall watershed conditions from snowmachines, helicopters, and OHVs would decrease negligibly compared to alternative A. Fish resources should not be affected. Water quality and overall watershed condition impacts associated with opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would remain the same as alternative A.

Alternative C

Alternative C, similar to alternatives A and B, would continue management direction providing for ecological sustainability. This alternative would continue the current program of fish resource management and watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Similar to alternative B, plan components have been modified and added to provide more of an emphasis on and a more proactive approach to providing ecosystem resilience for changing conditions.

The alternative C wilderness area recommendation, upon designation, would have a larger number of acres withdrawn from mineral entry than alternatives A and B (1,819,700 acres). This increase in the number of acres withdrawn from mineral activities under alternative C would reduce the acreage of potential water quantity stressors and impacts affecting fish resources, such as withdrawals and diversions, associated with mineral development. Additionally, potential fish resource and water quality stressors and impacts, such as sedimentation, erosion, or contamination, associated with mineral development would also be reduced.

For alternative C, recreation opportunity spectrum classes and management prescription area changes and associated potential water resources and watershed condition effects vary from alternatives A and B. These variations will be explored by geographic area.

Overall, within the Kenai Peninsula Geographic Area, alternative C offers a small increase (6 percent) in the primitive recreation class and backcountry management area. The backcountry management area and primitive recreation class indicate that there will be less people and smaller parties than for the alternatives A and B semi-primitive recreation class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to future limitations set by management on party size and number of permits. Thus, it is assumed that the effects on fish resources and the potential water quality and overall watershed condition impacts associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly compared to alternatives A and B. Additionally, alternative C offers increased opportunities (16 percent) for winter recreational motorized use. Potential impacts to fish resources, water quality, and overall watershed conditions associated with snowmachines and helicopters use may increase. In general, the environmental consequences would be low except at points of concentrated use.

Overall, alternative C offers an increase (28 percent) in the primitive recreation class within the Prince William Sound Geographic Area, primarily within the eastern portion. The primitive recreation class indicates that there will be less people and smaller parties than in the alternatives A and B semi-primitive recreation class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential for impacts to fish resources, water quality, and overall watershed condition associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic, would decrease slightly within eastern Prince William Sound compared to alternatives A and B. It is important to note that the Prince William Sound framework illustrated that outfitters and guide use only accounts for 10 percent of actual use. Thus, these small reductions in potential future special use permitting allocations may have nominal improvement in watershed conditions, which should have positive effects on fish resources.

Overall, alternative C, on the Copper River Delta, offers a decrease (25 percent) in the primitive recreation class and increases in semi-primitive motorized use south of the Copper River Highway (5 percent) and semi-primitive winter motorized use north of the Scott and Sheridan glaciers (20 percent) compared to alternatives A and B. Potential impacts to fish resources, water resources, and overall watershed conditions from snowmachines, helicopters, OHVs, and motor boats would increase compared to alternatives A and B. Additional impacts from recreation opportunity spectrum class changes include increased opportunities for larger and more frequent outfitters and guide special use party sizes. Larger and more frequent groups have a higher potential for impacting streams, riparian areas, and water resources and for affecting fish resources. In general, the environmental consequences to fish resources, water resources, and overall watershed conditions would be low except at points of concentrated use. Proper management, use of BMPs, and standards and guidelines would reduce these impacts.

Alternative D

Alternative D, similar to all alternatives would continue management direction providing for ecological sustainability. All alternatives would continue the current program of fish resource management, watershed restoration to promote healthy watersheds, stable stream channels, and the biological and physical health and function of riparian management areas. Implementation of BMPs for the prevention of sediment delivery to stream channels and other non-point pollution sources would continue to be a priority for all management activities. Improvement of aquatic habitat conditions would continue as resources are available. Plan components, similar to alternatives B and C, have been modified and added to provide more of an emphasis on providing ecosystem resilience for changing conditions.

Alternative D, upon designation, would have the largest number of acres withdrawn from mineral entry (1,884,200 acres). Alternative D would reduce the footprint of potential water quantity stressors and impacts on fish resources, such as withdrawals and diversions, associated with mineral development more than any other alternative. Additionally, it would reduce the effects on fish resources and the potential water quality stressors and impacts associated with mineral development more than any other alternative.

For alternative D, similar to alternative C, recreation opportunity spectrum classes and management prescription area changes and associated potential fish resources, water resources, and watershed condition effects vary from alternatives A and B. The variations between D and C are very minor, only occur within the Prince William Sound area, and are associated with the changes in the recommended wilderness area. Overall, alternative D offers an increase (less than 2 percent) in the primitive recreation class within the Prince William Sound Geographic Area compared to alternative C. Alternative D would have the largest percentage of the primitive recreation class of all of the alternatives. The primitive recreation class indicates that there will be less people and smaller parties than in the semi-primitive recreation class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that the impacts on fish resources, potential water quality, and overall watershed condition associated with future opportunities for non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic would decrease slightly within eastern Prince William Sound compared to alternatives A and B and decrease negligibly compared to alternative C. It is important to note that the Prince William Sound framework illustrated that outfitters and guide use only accounts for 10 percent of actual use. Thus, it is difficult to quantify the amount of fish resource, water resource, and watershed condition improvement that would occur from these small reductions in potential future special use permitting allocations.

Cumulative Effects

Fish resources across the national forest are in good condition, largely due to watersheds in good condition and functioning properly. Potential cumulative effects to fish resources, watersheds, and water resources resulting from past, current, and future management are based on the total amount of disturbance within the effects analysis area described earlier. Past management activities have been concentrated within certain watersheds affecting certain fish populations. These are the watersheds where most activities would occur under any alternative. The additional effects of reasonably foreseeable major projects and the plans of adjacent land ownerships will be addressed qualitatively and will be common across all alternatives.

The largest foreseeable major projects and plans within the analysis area include the State of Alaska DNR/Copper River Basin Plan, the State of Alaska DNR/Prince William Sound Area Plan, the State of Alaska DNR/ Kenai Area Plan, foreseeable development on CAC lands, the Kenai Hydro LLC Grant Lake Hydroelectric project, the Sterling Highway re-route, the Seward Highway improvements, and associated activities on the Kenai National Wildlife Refuge, and the Wrangell St. Elias, and Kenai Fiords National Parks. For the most part all of the aforementioned plans and the adjacent land owners' management directions align with Forest Service management direction. Due to these alignments, measureable effects are negligible. The only discernable effects on fish resources watersheds and water resources within the analysis area will be from the Kenai Hydro LLC Grant Lake project, the Sterling Highway re-route, the Seward Highway improvements, and foreseeable development of CAC lands.

Foreseeable direct effects on fish resources, watersheds, and water resources from the Kenai Hydro LLC Grant Lake project include short term and long term adverse impacts to fish resources as a result of water quality, water quantity, and overall watershed conditions. The construction of the hydroelectric facility will result in altered water quantity in Grant Lake and Grant Creek. The fluctuating water levels will be different from the natural hydrograph and may result in potential impacts to fish habitat, riparian habitats, and hydrologic connectivity on tributaries entering Grant Lake. These impacts will last the duration of the life of the dam. Water quality impacts from the project will be both chemical and physical and short term, (construction phase) and long term (life of the dam) in nature. Implementation of BMPs will mitigate some of these effects. The cumulative effects on overall watershed condition from this project has a moderate to high potential to move one HUC 6 (Grant Lake-Grant Creek) watershed from a Class 1 condition into a Class 2 condition due to alterations in water quality, water quantity, fish habitat, riparian vegetation, and the presence of new roads and trails.

Foreseeable effects on fish resources, watersheds, and water resources from the Sterling Highway re-route project include short term direct effects and long term direct and indirect effects on water quality and overall watershed condition. Short term direct effects include minor adverse effects to water quality related to construction. Implementation of BMPs should mitigate some of these effects. Long-term direct adverse effects include loss of wetlands and hydrologic connectivity. Long-term indirect beneficial effects include potential improved water quality for the Kenai River due to the decreased risk and likelihood of accidents, spills, and contaminants. The overall cumulative effects on watershed condition class from this project may result in a few degraded watershed condition class attribute ratings due to the increased road miles and loss of wetlands from the re-route. These downgraded attributes have a low potential of changing one HUC 6 (Kenai Lake) watershed condition classification rating from a Class 1 to a Class 2.

Foreseeable effects on fish resources, watersheds, and water resources from the Seward highway improvements project include minor short term adverse effects, long term indirect and direct adverse effects, long term beneficial effects to water quality, and overall watershed condition. Short term direct effects include minor adverse effects to water quality possibly affecting fish resources related to construction. Implementation of BMPs should mitigate some of these effects. Long term direct adverse effects include loss of wetlands and hydrologic connectivity alteration due to the expansion of the highway and parking lots. Long term indirect effects include increased winter snowmachine access and summer motorized boat access from improved parking areas along Placer and Twentymile rivers. Increased motorized access has the potential for impacts to water quality from petroleum containments and increased erosion from boat wakes, trampling, and general increased use. Long term beneficial effects of the project include improved aquatic organism passage and hydrologic connectivity for a few culverts, which will be very beneficial to fish resources. The overall cumulative effects on watershed condition class from this project may result in a few degraded watershed condition class attribute ratings due to the increased road and trail miles and loss of wetlands from the expansion; however, it is unlikely that there would be any changes to any watershed condition class ratings.

Foreseeable effects on fish resources, watersheds, and water resources from future developments on CAC lands are also possible; however, it is difficult to quantify the magnitude and duration of these effects due to the unknown nature of the developments. However, it is anticipated that some of these developments may include construction of access roads and trails to inholdings, mineral extraction, including extraction from subsurface estate lands owned by CAC, and timber harvest. Each of these activities has the potential to impact fish resources, water quality, water quantity, and overall watershed conditions due to erosion, hydrologic connectivity alteration, and loss of wetlands.

Analytical Conclusions

Chugach National Forest fish resources, water resources, and watersheds will continue to contribute to sustainability of the diverse aquatic habitats and the social, economic, and cultural integrity of communities in the plan area under all of the alternatives. The likely increase in future water use, both consumptive and non-consumptive, and impacts from climate change on those uses will also remain the same under all alternatives.

For all alternatives, cumulative effects to the aquatic habitats, species, and activities affecting salmon and the aquatic species associated with them will be minimal and without significant changes to the natural distributions and functions in nearly all streams and lakes within the national forest. In addition, there are very few human impacts on NFS lands affecting the presence of aquatic life and fish resources.

Terrestrial Ecosystems

Introduction

This section describes the current condition and projected long term trends for terrestrial ecosystems across the Chugach National Forest. The environmental consequences as they affect terrestrial ecosystems are evaluated for the no-action alternative and the three action alternatives. Specific vegetation resources described and evaluated herein include vegetation type and abundance, ecosystem conditions and trends, and drivers and stressors.

Methodology

Spatial Scale

The climate of the Chugach National Forest is influenced by both maritime and continental climate patterns, which drive the distribution of ecosystems across the national forest. The three geographic areas of the national forest correspond roughly with the major climate divisions across the region, with the Kenai Peninsula Geographic Area occupying the sub-boreal and transitional region, and Prince William Sound and Copper River Delta occupying the coastal rainforest region. The divisions within the coastal rainforest are further delineated by the geographic areas, with Copper River Delta representing the Gulf of Alaska and the more protected Sound represented by the Prince William Sound Geographic Area. For these reasons, the three geographic areas within the Chugach National Forest were used as the spatial scale for the assessment of the affected environment (see the Geographic Areas map in the map package). Indirect and cumulative effects of the proposed alternatives were assessed by geographic area where applicable, otherwise the spatial scale was the boundary of the national forest.

Temporal Scale

The effects analysis considered those impacts that are expected within the plan timeframe.

The assessment of the affected environment considered both current conditions and short and long term trends. Short term trends are those trends expected to affect terrestrial vegetation over the next 15 years (plan timeframe), and long term trends extend 50 years into the future, which is the temporal scale used in the climate change assessment (Hayward et al. 2017). The natural or expected range of variation was described in the context of long term vegetation history dating back to the end of the last glacial maximum.

Measurement Indicators

Attributes and indicators used to evaluate vegetation condition and trend as described in the affected environment are listed in table 87.

Table 87. Attributes and indicators used to evaluate vegetation condition and trend

Attribute	Indicator	Metric or Method Used in Evaluation
Vegetation type	Forest, shrub (tall/low and dwarf), wetland by geographic area	Acres and percent area by vegetation type by geographic area Status and trend (climate assessment)
Invasive species	Invasive plant species	Number of occurrences (terrestrial) Area (aquatic)
Forest health	Insects and disease	Area (aerial surveys and road surveys) Literature review
Disturbance regimes	Natural range of variation	Literature review
Rare or uncommon ecosystems	Coastal wetlands, Barrier Islands	Status and trend (AKNHP)

Attributes and indicators used to evaluate the indirect effects of the alternatives and plan actions are listed in table 88.

Table 88. Attributes and indicators used to evaluate the indirect effects of the alternatives and plan actions

Attribute	Indicator
Recommended Wilderness Area	Percentage of wilderness study area recommended by alternative
Recreation Opportunity Spectrum	Percentage of primitive, semi-primitive non-motorized, semi-primitive non-motorized (winter motorized allowed), semi-primitive motorized, roaded natural, and roaded recreation class by alternative
Terrestrial Invasive Species	Potential for transport and establishment of invasive species as influenced by percentage of recreation opportunity spectrum class and recommended wilderness

Affected Environment

The forest plan assessment (USDA 2014a) and climate change assessment (Hayward et al. 2017) evaluate ecosystem status, condition and trend, and the effects of future climate change on select ecosystems within the plan area. In this section, the results of these assessments are reviewed with a focus on key ecosystems, including those that are expected to change or are currently changing, those that provide key wildlife habitat, and ecosystems that are considered uncommon or rare. An overview of the climate and physical setting for the region sets the stage for the current distribution and pattern of vegetation communities within the plan area. The condition and trend of the dominant ecosystems within each geographic area are described, followed by an overview ecological integrity in the context of the natural range of variation and projected future conditions.

Human uses, natural disturbance cycles, and drivers and stressors are some of the factors included in the affected environment and natural range of variation sections. Human impacts include mining, logging, hunting, fishing, gathering, human caused-fires, recreation, roads, railroads, trails, and other infrastructure. Disturbance cycles and drivers include lightning-caused fires, tectonic activity, glacial recession, climate trends, and native insects and diseases. Stressors include non-native insects and diseases, invasive species, pollution (such as the 1989 oil spill), and the interaction of climate with stressors or disturbances.

Climate and Physical Setting

Climate strongly influences plant species distributions at broad spatial scales, while disturbance patterns, and soil conditions control distributions at the local level (GBIF 2015; Hayward et al. 2017; Pearson and Dawson 2003). The climate of Chugach National Forest is influenced by both maritime and continental climate patterns. Mountain ranges extending north-south and east-west result in complex weather patterns that drive precipitation and temperature gradients across the region. Storm tracks tend to travel in a counterclockwise direction from the Gulf of Alaska into Prince William Sound crossing the Kenai Mountain Range from east to west resulting in a strong precipitation gradient on the leeward side of the range (Hayward et al. 2017). Temperature patterns also vary across the region from a maritime climate in the Gulf of Alaska to a more continental climate on the west side of the Kenai Mountains. These climate gradients result in different vegetation and disturbance cycles across the geographic areas of the Chugach National Forest.

The climate of the Kenai Mountains geographic area is transitional between maritime and continental. This region has warmer summer temperatures, colder winter temperatures, and less precipitation than the maritime region. The area falls within the sub-continental boreal climate regime (Jorgenson and Meidinger 2015; Rivas-Martinez and Sánchez-Mata 2011), though owing to its location on the boundary with the maritime climate zone, it also shows some similarity with the maritime region, particularly in the Girdwood, Portage, Placer, and 20-Mile Valleys, near Seward, and in the upper elevations along the eastern border of the Kenai Peninsula Geographic Area.

A maritime climate characterizes the region east of the Kenai Mountains, including the Prince William Sound and Copper River Delta geographic areas. Cool summers and relatively mild winters with heavy precipitation falling as snow in the higher elevations characterize the north pacific maritime climate. The forests of this region represent the northern extent of the temperate rainforest (Alaback 1991). While both of these areas are in the maritime climate zone, the Copper River Delta area has colder winter temperatures owing to strong continental winds, which flow out of the Copper River Canyon in the winter. The inland portion of Copper River Delta also receives slightly less precipitation than Prince William Sound.

Vegetation History

The landscape of the Chugach National Forest is shaped by glaciation and tectonic movement (Hayward et al. 2017). As a consequence of these ongoing physical dynamics related to climate change and tectonic uplift and subsidence, the landscape is undergoing significant directional and cyclic change. The vast majority of the national forest was under ice at the last glacial maximum. Nunataks appear to have occurred on Knight, Montague, and Hinchinbrook Islands, resulting in isolated terrestrial refugia in Prince William Sound (Heusser 1983). These sites would not have supported trees and likely few shrub species persisted. The western Kenai Peninsula, which is in the snow shadow of the Kenai Mountains, appears to have maintained several large biological refugia, including sites in the northwest Kenai Mountains, the upland between Skilak and Tustumena lakes, and in the Caribou Hills north of Homer (Reger et al. 2007). Other refugia in the Copper River basin and Talkeetna Mountains, along with low passes in the Alaska Range, provided sources for species to establish in newly exposed terrestrial habitat as ice receded. Hence, the current vegetation represents the outcome of glacial retreat followed by species recolonization.

The region spans the contact between the North American and Pacific plates, and mega-earthquakes, such as the 9.2 magnitude earthquake of 1964, result in the lateral and vertical shift of land at the contact. While the impacts to vegetation are generally only seen in low elevations in coastal and near-coastal environments, the effects can be dramatic in these areas. The 1964 earthquake profoundly affected coastal vegetation across the Chugach National Forest. Tectonic subsidence in some areas, including Cook Inlet, the coastal regions around Whittier and Seward, and parts of northwestern Prince William Sound, resulted in saltwater inundation into freshwater ecosystems and coastal forests. Conversely, in areas of tectonic uplift, such as the Copper River Delta and most of Prince William Sound, previously saltwater influenced wetlands converted to freshwater, and large areas of wetlands were drained. Wetlands in these affected areas of uplift and subsidence were changed instantaneously and will be adapting for the next several hundred years (USDA 2014a).

The vegetation currently occurring in the region is different from the past and resulted from directional change that began with the exposure of land following the last glacial maximum. Abiotic drivers, including glaciation and tectonic movements, interacting with climate and the historical legacy of species colonization have resulted in the current vegetation pattern that exists on the national forest today (Hayward et al. 2017).

Human activities in the past influenced the distribution of vegetation across the Chugach National Forest. Over thousands of years, Alaska Native people occupied southcentral Alaska and practiced a sophisticated subsistence culture across the region, harvesting sea mammals, fish, and a broad range of terrestrial plants and animals. Across the Kenai Peninsula, subsistence practices were more riverine adapted, while in the coastal areas of Prince William Sound, subsistence practices were adapted to the marine environment (see the Cultural Resources and Terrestrial Wildlife and Habitats sections for more information). Beginning with Russian exploration in the late 1700s, human influence on ecosystems in the region changed in type and increased. Commercial fur trade led to increased harvest of indigenous mammals, while fur farming introduced exotic mammals, such as blue fox, to islands and coastal areas on the mainland. Mining brought thousands of people through Prince William Sound and southcentral Alaska. In 1898 over 3,000 people moved through the Copper River region, and by 1907, Prince William Sound had experienced a mineral boom with large copper mines at Ellamar, Latouche, Port Fidalgo, and Knight Islands. The town of Cordova was founded at the terminus of the Copper River and Northwest Railway, which transported copper from the Kennecott Mine to the north. The town of Valdez was initially populated with gold prospectors who were either exploring the region or travelling up the Copper River to interior Alaska.

The Kenai Peninsula also experienced a population boom from 1888 to 1900 after gold was discovered in the Cook Inlet region. The towns of Sunrise and Hope sprang up to service the placer mining industry, and although the gold rush in this part of Alaska was comparatively brief, it laid the foundation for economic development of the region. The increased population and the need for goods and services led to the development of new transportation routes, including the construction of the Alaska Railroad, which began in Seward in 1903. By 1909 the railroad extended north to Turnagain Arm, and by 1923 the railroad was completed to the interior city of Fairbanks, at which point Seward became an important port city for Alaska. Evidence of tie-hacking from the railroad construction period can still be seen in some forests of the Kenai Peninsula in the form of old stumps left after selected trees were removed to be used as railroad ties. During this period, human-caused fires burned large tracts of land on the Kenai Peninsula. The legacy of these fires is still visible on the landscape in the form of mature birch and aspen stands in areas that were burned during the early 1900s (Potkin 1997).

This history provides context for interpreting the current vegetation pattern and future trends in the context of the natural range of variation and the implications of climate change. This section seeks to explore the status and trend for terrestrial ecosystems, with attention to key ecosystems and also those that are currently changing or are projected to change under conditions of climate warming and increased human use.

Vegetation Condition and Trend

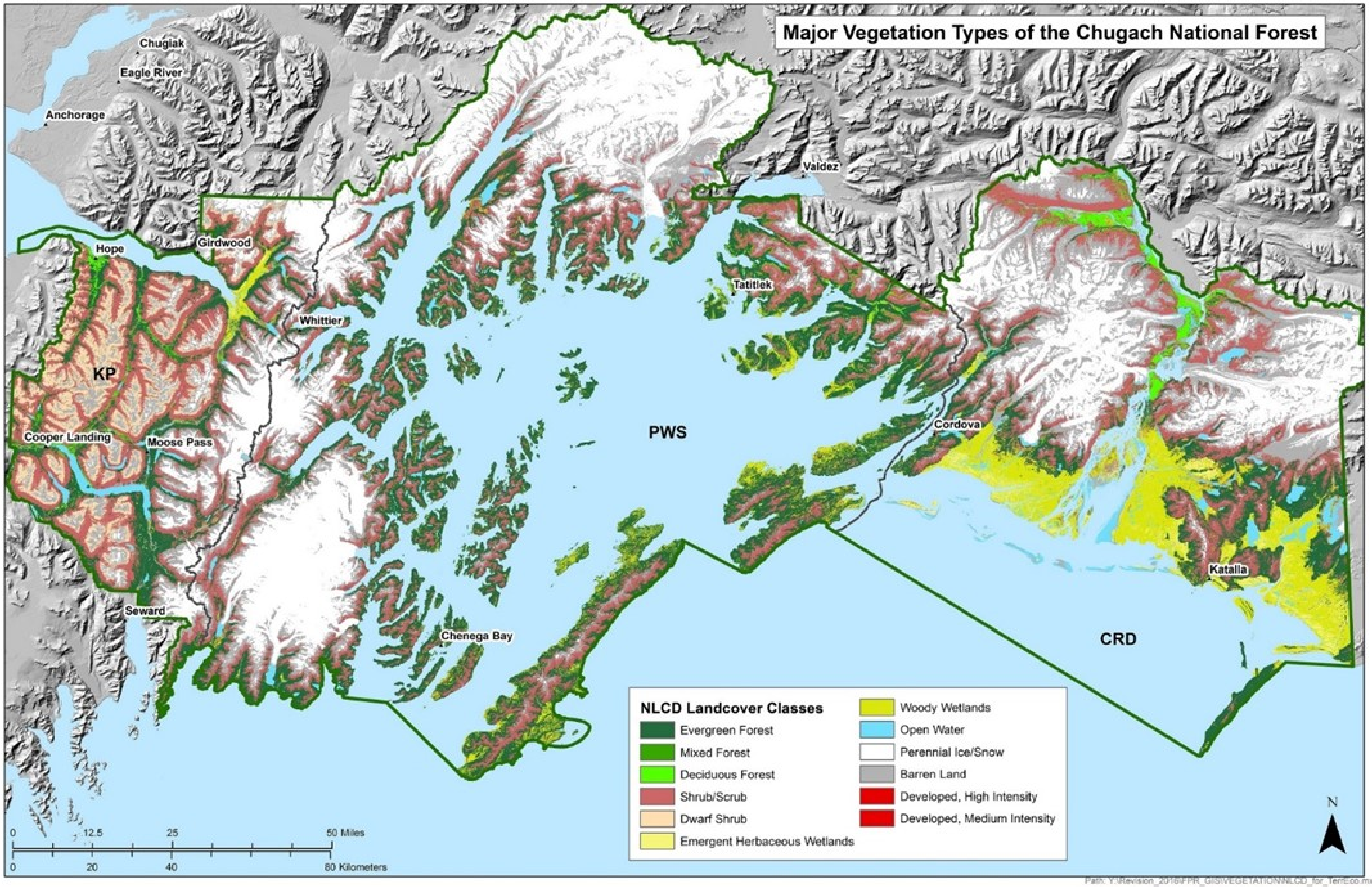
The broad scale vegetation pattern across the Chugach National Forest was interpreted using the landcover map produced as part of the National Landcover Database (landcover database) (see map 28). This map is currently the best available source for describing vegetation across the national forest (DeVelice 2012a; Homer et al. 2015). Accuracy of the National Landcover Database vegetation classes in the coastal rainforest region of southcentral and southeast Alaska, which includes the Chugach National Forest, was estimated at 88 percent (Selkowitz and Stehman 2011).

Within the Chugach National Forest, forested lands account for 22.7 percent of the terrestrial landscape and extend from sea level to treeline, which typically occurs between 1,500 and 2,500 feet depending on region and aspect. Wetlands account for 7.4 percent of the landscape, and shrublands, including alpine dwarf shrub tundra and low and tall shrublands, account for 23.8 percent of the landscape. Forty-three percent of the terrestrial landscape is unvegetated; these barren classes include glaciers, perennial snow, and rock (see table 89). The vegetation pattern varies across the geographic areas of the national forest. Permanent ice and snow occupy less of the Kenai Peninsula than the other two geographic areas, and as a result, shrublands and alpine tundra occupy a greater proportion of the upper elevation composition. In Prince William Sound, glaciers and ice caps occupy the upper elevations with multiple glaciers terminating at tidewater in the head of fiords. The lower elevations of Prince William Sound are characterized by a complex shoreline and islands fringed by coastal forests. The Copper River Delta is characterized by a vast wetland system exposed directly to the Gulf of Alaska, but similar to Prince William Sound, glaciers and ice caps dominate the upper elevations of the area.

Because vegetation pattern and process vary distinctly across the plan area, in the following sections, vegetation condition is described in terms of dominant disturbance processes and dominant forest, shrub, and wetland vegetation type for each geographic area.

Table 89. Acreage by aggregated National Landcover Database classes within the boundary of the Chugach National Forest, including lands of other ownership

Landcover Class	Acres	Percent Area	Percent of Kenai Peninsula Geographic Region	Percent of Prince William Sound Geographic Region	Percent of Copper River Delta Geographic Region
Forest					
Deciduous forest	82,893	1.3	1.4	0.8	2.0
Evergreen forest	1,339,204	21.2	15.9	28.9	13.0
Mixed forest	11,570	0.2	0.9	zero	zero
Forest subtotal	1,433,667	22.7	18.2	29.7	15.0
Shrubland					
Alpine dwarf shrub	177,598	2.8	14.1	zero	zero
Shrub/scrub	1,327,527	21.0	30.0	20.1	16.8
Shrubland subtotal	1,505,125	23.8	44.1	20.1	16.8
Wetlands					
Woody wetlands	390,058	6.2	1.1	3.5	13.4
Emergent herbaceous wetlands	77,617	1.2	0.5	0.1	3.4
Wetland subtotal	467,675	7.4	1.6	3.6	16.8
Mesic/Dry Herbaceous					
Mesic/dry herbaceous	17,597	0.3	0.1	0.3	0.4
Non-vegetated					
Open water		1.8	2.6	1.8	4.2
Perennial ice/snow	1,685,463	26.7	16.5	32.0	25.1
Developed	4,735	0.1	0.2	zero	0.1
Barren land	1,028,616	16.3	16.6	12.6	21.6
Non-vegetated subtotal	2,891,429	45.8	35.9	46.4	51.0
Totals	6,255,717	100	100	100	100



Map 28. Major vegetation types within the boundary of the Chugach National Forest, including lands of other ownerships

Across the national forest, wetland classes mapped through the National Wetlands Inventory show 22.8 percent of the area in a wetland class, compared to 16.8 percent wetland in the National Landcover Database.

Table 90 shows the area for each wetland system mapped by the National Wetlands Inventory for the national forest and by geographic region. The discrepancy between the two maps is most likely a result of different classification standards applied to wetlands and also different map resolutions used to develop each product. The National Landcover Database is based on 30-m LandSat imagery and the National Wetlands Inventory is interpreted using high resolution stereo imagery. The National Landcover Database used a more restrictive interpretation of wetlands than the National Wetlands Inventory, particularly in the woody wetlands class. As a result of these different mapping and classification approaches, it is likely that wetland area is under-represented in the National Landcover Database vegetation map. While wetland area differs between the National Landcover Database and the National Wetlands Inventory, the pattern of wetland distribution across the geographic areas is similar between the two maps, with the least wetland area in the Kenai Peninsula and the most in the Copper River Delta.

Table 90. Chugach National Forest wetland area and percentage by national wetlands inventory class

National Wetlands Inventory Wetland System	Total Wetland Acres	Total Percent Area	Percent of Kenai Peninsula Geographic Region	Percent of Prince William Sound Geographic Region	Percent of Copper River Delta Geographic Region
Estuarine	358,042	5.7	1.8	1.4	2.5
Lacustrine	95,524	1.5	0.5	0.5	0.6
Palustrine	762,941	12.1	0.6	5.8	5.6
Riverine	192,054	3.0	0.1	0.1	2.8
Marine	32,498	0.5	zero	0.2	0.4
Totals	1,441,059	22.8	3.0	7.9	11.9

Landcover classes mapped in the National Landcover Database and wetland classes mapped in the National Wetlands Inventory give a general view of vegetation structure and landscape pattern but provide little information about plant composition and landscape processes. Because vegetation composition and dynamics differ across the national forest, the major ecosystems are described for each geographic area with descriptions of dominant vegetation and disturbance dynamics. Detailed descriptions of vegetation communities and successional dynamics can be found in the plant community classifications for the Chugach National Forest (DeVelice et al. 1999; Boggs 2000) and also in the national classification standards (NatureServe 2008; USNVC 2016).

Vegetation Condition Kenai Peninsula Geographic Area

The Kenai Peninsula Geographic Area is situated at the intersection of the sub-boreal and maritime climate regimes and forest vegetation reflects this transitional nature. Dominant trees include Lutz spruce (*Picea X lutzii*), a hybrid that occurs where the ranges of Sitka and white spruce overlap, Alaska paper birch (*Betula neoalaskana*), a common tree across the Alaskan boreal, and mountain hemlock (*Tsuga mertensiana*), a species that is not typically present in the boreal, but occurs commonly in maritime regions. Elevations across the Kenai Peninsula Geographic Area range from sea level along Turnagain Arm to over 5,500 feet along the crest of the Kenai Mountains. Treeline occurs between 1,800 and 2,500 feet (where not impeded by snow avalanches), and alpine vegetation becomes sparse above 3,500 feet. Complex mountain topography combined with a relatively narrow band of forest vegetation restricted to the lower slopes and valley bottoms results in a landscape pattern that is frequently dissected and fragmented. Vegetation pattern is further fragmented in steep mountainous terrain prone to frequent snow avalanches.

Disturbance Processes of the Kenai Peninsula Geographic Area

Like the rest of the national forest, the landscape of the Kenai Peninsula Geographic Area is shaped by glaciation. The distribution of vegetation types, age classes, and patch sizes is further influenced by fire, insect infestations, blowdown, snow avalanches, flooding, and human disturbance.

Although lightning and natural fires have historically been infrequent, wildfire plays an important role in the disturbance regime of this area. Under the natural fire regime, fires were infrequent but large. Estimates of the mean fire-return interval range from 600 to 800 years (Potkin 1997; Berg and Anderson 2006). Human caused fires that burned during the last century left a lasting impact on the present vegetation pattern. About 1,400 fires burned a combined 75,000 acres within the Kenai Peninsula Geographic Area from 1914 to 1997 (Potkin 1997) creating areas of early successional plant communities, many of which are currently large stands of deciduous forests (see Fire History section).

The vegetation pattern on many mountain sideslopes of the Kenai Peninsula Geographic Area is controlled by frequent snow avalanches. Many steep slopes otherwise capable of supporting forest vegetation are maintained in shrubland and herbaceous states by periodic snow avalanches that prevent forests from developing.

Spruce bark beetle (*Dendroctonus rufipennis*) infestations are a major natural disturbance of spruce forests in the sub-boreal region. Spruce bark beetles typically attack larger, slow-growing spruce, but infestations periodically escalate to epidemic levels when forest and climatic conditions are favorable for beetle expansion. During epidemic level infestations, beetles are less selective and may attack and kill a wider range of spruce trees. Beetle infestations that thin stands and produce a growth release in surviving trees occur on average every 50 years in white and Lutz spruce forests on the Kenai Peninsula (Berg and Anderson 2006; Berg et al. 2006). Spruce bark beetle outbreaks that produce a more substantial thinning occur at longer intervals, with the last two severe infestations occurring in the 1870s/1880s and from 1987 to 2000 (Berg and Anderson 2006; Berg et al. 2006). The beetle infestation that began in 1987 on the Kenai Peninsula killed over 1.3 million acres of spruce trees (USDA 2002), but, while the damage was extensive, this level of outbreak appears to be representative of past mortality events and indicates that beetles represent an important part of the ecological history of this region (Hayward et al. 2017). The two dominant forest cover types in the Kenai Mountains are mountain hemlock and mountain hemlock-spruce (USDA 2002). After the infestation had declined, the area occupied by mountain hemlock forest had increased 22 percent and the area occupied by mountain hemlock-spruce decreased 28 percent (Boucher and Mead 2006). The spruce mortality (46 percent reduction in white and Lutz spruce basal area) within the mountain hemlock-spruce forests of the Kenai Mountains resulted in a transition in basal area dominance from white and Lutz spruce in 1987 to mountain hemlock in 2000 (Boucher and Mead 2006). The spruce mortality in this region essentially accelerated succession toward late-seral mountain hemlock stands.

Hardwood defoliators, such as geometrid and autumnal moths, leaf miners, and leaf rollers, periodically erupt and can damage deciduous trees and shrubs across large areas. These types of infestations are a normal part of the disturbance cycle in the boreal forest; however, longer growing seasons and warmer winters could contribute to increasing severity and frequency of insect infestations in the future (Malmstrom and Raffa 2000).

Many endemic pathogens, such as root decay and stem decay, exist at background levels and can damage vegetation in individual patches or stands, but several recent pathogens have emerged that have the potential to change vegetation across broad spatial scales (see the Forest Insects and Diseases section) (USDA 2017).

In forests impacted by the spruce bark beetle infestation, particularly those accessible via the road system and near communities, management activities designed to mitigate the risk of wildfire and enhance moose habitat have reduced the amount of dead spruce and encouraged the growth of deciduous forests of birch and aspen. Additional human uses, including fuelwood, timber sales, and placer mining, have a small footprint along the road corridor (see the Drivers and Stressors section and the Affected Environment Vegetation History section for a description of historic human disturbances).

Sub-boreal Forests of the Kenai Peninsula

Spruce-hardwood forests composed of Lutz spruce and Alaska paper birch, Kenai birch (*Betula papyrifera* var. *kenaica*), aspen (*Populus tremuloides*), or Scouler willow (*Salix scouleriana*) are the dominant, low elevation forest types on well-drained upland terrain across the Kenai Peninsula Geographic Area. Deciduous trees or spruce may be dominant depending on seral stage and disturbance history. Common plants in the forest understory include rusty menziesia (*Menziesia ferruginea*), lowbush cranberry (*Vaccinium vitis-idaea*), crowberry (*Empetrum nigrum*), wood fern (*Drypoteris expansa*), bluejoint reedgrass (*Calamagrostis canadensis*), and feathermosses (*Pleurozium schreberi* and *Hylocomium splendens*).

Stands of black cottonwood (*Populus balsamifera* ssp. *trichocarpa*) occur along floodplains with Lutz spruce occurring on older terraces. Common understory plants in riparian corridors include Sitka alder, feltleaf willow (*Salix alaxensis*), devil's club (*Oplopanax horridus*), or bluejoint reedgrass (*Calamagrostis canadensis*).

Black spruce (*Picea mariana*) is a minor forest type in the Kenai Mountains; it occurs at low elevations on gently sloping northerly aspects or flats. This type is associated with cold sites and poorly drained soils.

In mid-elevations, forests of mountain hemlock and Lutz spruce become more common, particularly on northerly aspects. Understory shrubs typically include rusty menziesia and early blueberry (*Vaccinium ovalifolium*).

In upper elevations near treeline, dense stands of slow growing mountain hemlock and patches of stunted krumholtz mountain hemlock intermixed with alpine tundra become common, particularly on northerly aspects in areas with late-lying snow pack. Mountain hemlock is adapted to cool moist climates and these treeline forests are similar in composition and structure to those occurring in the maritime geographic areas (Prince William Sound and Copper River Delta).

The forest types listed above are included within the National Landcover Database mixed, conifer, or deciduous forest classes, which account for 18.2 percent of the terrestrial area of the Kenai Peninsula Geographic Area.

Sub-boreal Shrublands of the Kenai Peninsula

Extensive thickets of Sitka alder (*Alnus viridis* ssp. *sinuata*) occur on mountain sideslopes above treeline and on steep sideslopes prone to snow avalanche. At the elevation limit of alder, these thickets transition to a mosaic of shrublands and herbaceous meadows with such species as tall fireweed (*Chamerion angustifolium*), bluejoint reedgrass (*Calamagrostis canadensis*), northern geranium (*Geranium erianthum*), and lady fern (*Athyrium filix-femina*). Willow thickets are common on a variety of landscapes throughout the Kenai Peninsula Geographic Area, generally occurring in small patches or along riparian corridors. Barclay willow (*Salix barclayi*) is one of the most widespread species occurring on riparian corridors, side slopes, footslopes, and rounded mountains. Feltleaf willow is also common, but its distribution is limited to riparian corridors and floodplains. Scrub birch (*Betula glandulosa* and *B. nana*) is a minor yet widespread low shrub type within the geographic area. These shrub types correspond to the National Landcover Database shrub/scrub class, which accounts for 30 percent of the Kenai Peninsula Geographic Area.

Dwarf shrub tundra occurs in the alpine above the low and tall shrub zones. In the sub-boreal region, crowberry is often the dominant dwarf shrub (DeVelice et al. 1999). Mountain-avens (*Dryas octopetala*) often occupies dry exposed sites while partridgefoot (*Luetkea pectinata*) and Alaska bellheather (*Harrimanella stelleriana*) typically occur on sites with late-lying snowbeds. Species diversity is often high in alpine sites owing to abundant microsite differentiation and exposed soils from ongoing disturbance, such as rock fall, cryoturbation, and wind erosion. Common alpine plants include lowbush cranberry (*Vaccinium vitis-idea*), bog blueberry (*Vaccinium uliginosum*), pincushion plant (*Diapensia lapponica*), alpine azalea (*Loiseleuria procumbens*), arctic willow (*Salix arctica*), alpine sweetgrass (*Anthoxanthum monticola*), smallawned sedge (*Carex microchaeta*), narcissus anemone (*Anemone narcissiflora*), blackish oxytrope (*Oxytropis nigrescens*), least willow (*Salix rotundifolia*), several species of native fescue (*Festuca* spp.) and bluegrass (*Poa* spp.), and a variety of forage lichens (*Cladina* spp., e.g.) and turf mosses (*Polytrichum* spp., e.g.). These shrub classes are included in the National Landcover Database dwarf shrub class, which accounts for 14.1 percent of the area of the Kenai Peninsula Geographic Area.

Sub-boreal Wetlands of the Kenai Peninsula

Wetlands are relatively uncommon in the Kenai Peninsula geographic region, with the exception of the Portage, Placer, and Twenty-mile drainages at the head of Turnagain Arm. Wetland types in this region include tidally influenced marshes dominated by Lyngbye's sedge (*Carex lyngbyei*) and freshwater marshes dominated by Sitka sedge (*Carex aquatilis* var. *dives*) or beaked sedge (*Carex rostrata*); rich fens with marsh fivefinger (*Comarum palustre*), buckbean (*Menyanthes trifoliata*), and swamp horsetail (*Equisetum fluviatile*); and low shrub wetlands dominated by sweet gale (*Myrica gale*) often in association with willows, such as undergreen willow (*Salix commutata*) or Barclay's willow.

Peatlands, defined as wetlands with 40 centimeter organic matter accumulation at the soil surface, occur infrequently in the Kenai Peninsula Geographic Area, often in depressions with restricted drainage and along pond margins. The peatland types are typically dominated by sedges and cottongrass with dwarf shrubs in the understory and a ground layer dominated by the peat-forming sphagnum mosses (*Sphagnum* spp.). Common graminoids include tufted clubrush (*Trichophorum caespitosum*), few-flowered sedge (*Carex pauciflora*), many-flowered sedge (*Carex pluriflora*), and cottongrass (*Eriophorum angustifolium*). Typical peatland dwarf shrubs are bog rosemary (*Andromeda polifolia*), bog cranberry (*Vaccinium oxycoccos*), and dwarf birch (*Betula nana*).

Herbaceous wetlands correspond to the National Landcover Database emergent wetlands, and wetlands with a shrub or tree component correspond to the National Landcover Database woody wetlands.

Vegetation Condition Prince William Sound Geographic Area

Prince William Sound is situated within the coastal temperate rainforest and represents the northern extent of this biome (Alaback 1991). The area is characterized by forested islands and a complex coastline of fiords and rocky headlands. Tidewater glaciers originating from large icefields occupy the head of many of the bays and fiords. Elevations range from sea level along the extensive coastline to over 13,000 feet at the summit of Mount Marcus Baker, the highest peak in the Chugach Mountains. Forests are typically restricted to elevations below 1,500 feet and are composed of Sitka spruce (*Picea sitchensis*), mountain hemlock, and western hemlock (*Tsuga heterophylla*).

Disturbance Processes of the Prince William Sound

One of the most notable disturbance processes in Prince William Sound Geographic Area is ongoing glacial recession, most pronounced at lower elevations. This trend of glacial retreat was initiated at the end of the last glacial maximum, and retreat is expected to continue at rates equivalent to or higher than current rates (Hayward et al. 2016). Ongoing glacial retreat is exposing new terrain and allowing the expansion of early seral shrub and herbaceous communities into previously non-vegetated areas.

The region receives abundant winter snowfall, particularly in higher elevations. On mountain sideslopes, frequent snow avalanches prevent forests from developing on steep slopes; these areas are occupied by shrubland and herbaceous vegetation tolerant of frequent disturbance.

Additional disturbances in the coastal rainforest include windthrow, exposure to salt spray and storm surge, mass wasting and soil creep, flooding along riparian corridors, periodic insect infestations, and chronic pathogens, such as red ring rot (*Phellinus pini*) and red belt fungus (*Fomes pinicola*). Many disturbances cause small patches of mortality that perpetuate old-growth gap dynamics. Fire is extremely rare in the coastal rainforest.

Current human disturbances are less evident in Prince William Sound Geographic Area than on the Kenai Peninsula, as much of Prince William Sound is within the College Fiord-Nellie Juan Wilderness Study Area. Personal use fuelwood and historic logging are some of the current and past human disturbances (see the Affected Environment Vegetation History section for a description of historic human disturbances). The oil spill of 1989 that spilled at least 10,800,000 gallons of crude oil from the *Exxon Valdez*, resulted in the stranding of oil on an estimated 2,100 kilometers of shoreline in western Prince William Sound, along the north Gulf of Alaska coast, and westward past Kodiak Island (see the drivers and stressor section and also the Aquatic Ecosystems and Habitats and Terrestrial Wildlife and Habitats sections for more information about the impacts of the oil spill).

Pacific Maritime Forests of Prince William Sound

Sitka spruce forests often form a narrow band along the coastal regions of the temperate rainforest. This forest type is characteristic of coastal headlands and ancient beach ridges. Sites dominated by Sitka spruce are usually tied to disturbance, such as slope instability, water movement (either downhill through the soil or in open streams), exposure to salt spray, or windthrow (DeMeo et al. 1992; Martin et al. 1995). Sitka spruce also occurs as a mid-successional stage on recently deglaciated terrain.

Western hemlock-Sitka spruce is the most common forest type throughout the Prince William Sound Geographic Area (Barrett and Christensen 2011). Here at the northern extent of the coastal rainforest (Alaback 1991), mountain hemlock is often an important component of the canopy even at low elevations. Western hemlock reaches its western and northern range limit in Prince William Sound (Heusser 1983); but mountain hemlock extends along the eastern Kenai Peninsula coastline through Kenai Fiords, and also occurs in isolated patches across Cook Inlet (Viereck and Little 2007). Range limits of both species are likely still expanding slowly into suitable climate settings. Common understory species of western hemlock-Sitka spruce forests include early blueberry, devil's club, Pacific reedgrass (*Calamagrostis nutkaensis*), threeleaf foamflower (*Tiarella trifoliata*), false lily of the valley (*Maianthemum dilatatum*), skunk cabbage, ferns, and gooseneck mosses (*Rhytidiadelphus* spp.).

Alaska yellow-cedar (*Callitropsis nootkatensis*) occurs in isolated parts of Prince William Sound, and these forests represent the northern extent of this tree species. Stands typically occur as mixed-canopy forests with either mountain or western hemlock. Yellow-cedar forests on poorly-drained sites in southeast Alaska have experienced widespread mortality and decline in the past century linked to winter root injury related to cold damage from decreased snowpack (Hennon et al. 2006; Hennon et al. 2012). Mortality is expressed in a narrow, low-elevation band from sea level to 500 feet (Hennon et al. 2012). Yellow-cedar roots are shallower and less cold tolerant than those of other associated conifers and are therefore more vulnerable to injury from superficial soil freezing. It is suspected that the persistence of snow beyond the last hard spring freeze protects yellow-cedar from root injury. Thus, lower snowpack explains the broad spatial distribution of yellow-cedar decline and heightened mortality in the warmer areas of its range. Yellow-cedar in Prince William Sound has not shown evidence of decline seen in southeast Alaska (Barret and Pattison 2016; Hennon et al. 2016). Common understory shrubs of yellow-cedar forests in Prince William Sound include early blueberry (*Vaccinium ovalifolium*), copperbush (*Elliottia pyroliflora*), rusty menziesia (*Menziesia ferruginea*), and Steller's cassiope (*Harrimanella stelleriana*). Deer cabbage (*Nephrophyllidium crista-galli*) is the most common herbaceous species.

In upper elevations, mountain hemlock becomes the dominant canopy tree growing in dense closed-canopied stands. At treeline, stunted krumholtz forests interspersed with alpine heathers, such as Steller's cassiope, crowberry and Aleutian mountain heath (*Phyllodoce aleutica*), are common.

These coniferous forest types are included within the National Landcover Database evergreen forest class, which accounts for 29 percent of the terrestrial landscape within Prince William Sound (see table 89).

Black cottonwood occurs as a minor forest component along riparian corridors and outwash plains and is also a pioneer species on recently deglaciated terrain. In the maritime regions of the Chugach National Forest, this forest type is the equivalent to the National Landcover Database deciduous forest classes, which accounts for one percent of the terrestrial landscape within Prince William Sound.

Pacific Maritime Shrublands of Prince William Sound

The most abundant tall shrubs in Prince William Sound are Sitka alder and salmonberry (*Rubus spectabilis*), which commonly occupy avalanche chutes and beach fringe areas. Alder is also an important pioneer species on recently deglaciated surfaces. A variety of willows including feltleaf willow, Barclay's willow, and Sitka willow (*Salix sitchensis*), occur along riparian corridors and beach fringes. Copperbush (*Elliottia pyroliflora*) is a common low shrub that often occurs at near treeline below alpine dwarf shrub heaths. These low and tall shrub types correspond to the National

Landcover Database shrub/scrub class, which accounts for 20.1 percent of the terrestrial landscape of Prince William Sound.

Alpine heath, dominated largely by dwarf ericaceous shrubs, occurs above treeline and on exposed ridges at lower elevations. Common species include yellow mountain heather (*Phyllodoce aleutica*), crowberry, partridgefoot, Alaska bellheather, bog blueberry, and dwarf bilberry (*Vaccinium cespitosum*). This alpine dwarf shrub type is uncommon in Prince William Sound and was not captured in the National Landcover Database vegetation map.

Pacific Maritime Freshwater Wetlands of the Prince William Sound

Freshwater marshes and wet meadows, relatively uncommon in Prince William Sound, are limited to areas with suitable floodplain or basin topography with a permanent water source throughout all or most of the year. These ecosystems are often dominated by emergent wetland sedges, such as Sitka sedge or beaked sedge, and other common herbaceous species include swamp horsetail, buckbean, and marsh five-finger.

Peatlands (also called muskegs) are common across Prince William Sound. High rainfall, cool summer temperatures, and restricted drainage create ideal conditions for peatland development. These wetland ecosystems are typically dominated by sedges and cottongrass with dwarf shrubs in the understory and a ground layer dominated by peat-forming sphagnum mosses. Common graminoids include tufted clubrush, fewflower sedge, manyflowered sedge, and cottongrass. Typical peatland dwarf shrubs include bog rosemary, bog cranberry, and crowberry. Other common species include deer cabbage and calthaleaf avens (*Geum calthifolium*). Peatlands often occur in a mosaic with stunted mountain hemlock trees.

Herbaceous wetlands correspond to the National Landcover Database emergent wetlands, and wetlands with a shrub or tree component correspond to the National Landcover Database woody wetlands. The combined wetland area in Prince William Sound as mapped by the National Landcover Database is 3.6 percent of the terrestrial landscape.

Pacific Maritime Coastal Ecosystems

The shoreline of Prince William Sound is dominated by gravel and cobble beaches, rocky shorelines, and headlands. Other coastal ecosystems include coastal wetlands, sandy beaches and beach meadows, which are all are relatively uncommon within the geographic area.

The abundant rocky shorelines and gravel beaches of Prince William Sound are typically unvegetated or sparsely vegetated. A steep storm berm often forms along the upper portion of gravel and cobble beaches exposed to wave action, and a narrow band of vegetation composed of herbaceous species with varying degrees of tolerance for salt spray and wind abrasion often occupies the berm. Common species found on gravel and cobble substrates include beach rye (*Leymus mollis*), beach pea (*Lathyrus japonicus* var. *maritimus*), beach greens (*Honckenya peploides*), oyster tongue (*Mertensia maritima*), beach lovage (*Ligusticum scoticum*), villous cinquefoil (*Potentilla villosa*), and Nootka lupine (*Lupinus nootkatensis*).

Sandy beaches and beach meadows form most frequently on low gradient sites that have an abundant source of sediment, usually delivered by glacially fed rivers. Processes that define the system include sand deposition, wind and water erosion, long shore transport, and overwash from storm surges. Salt tolerant herbaceous species, such as beach greens and oyster tongue, often occur just above mean high tide. Beach rye and beach pea occupy sites further above the high tideline, but these sites still may experience storm surges. Further removed from the ocean, a variety of herbaceous communities may develop. Species composition is variable but may include any of the following: beach rye, meadow barley (*Hordeum brachyantherum*), eminent bluegrass (*Poa eminens*), red fescue (*Festuca rubra*) tufted, hairgrass (*Deschampsia cespitosa*), bluejoint reedgrass, tall fireweed, Sitka burnet (*Sanguisorba canadensis*), northern yarrow (*Achillea millefolium* var. *borealis*), seacoast angelica (*Angelica lucida*), kneeling angelica (*Angelica genuflexa*), beach lovage, cow parsnip (*Heracleum maximum*), seaside ragwort (*Senecio pseudoarnica*), Nootka lupine, and beach strawberry (*Fragaria chiloensis*).

Coastal wetlands, including tidal marshes and tide flats, form in low-gradient areas with sediment input that are protected from wave action, such as lagoons and estuaries. These are highly productive ecosystems provide essential habitat for shorebirds, waterfowl, and coastal fisheries. Tidal marshes in southern Alaska are often dominated by near monotypic stands of Lyngbye's sedge. Other species may include Pacific silverweed (*Argentina egedii*) and tufted hairgrass. Frequently inundated tide flats on the seaward edge of coastal marshes may feature any of the following species: alkaligrass (*Puccinellia* spp.), glasswort (*Salicornia* spp.), seaside arrowgrass (*Triglochin maritima*), goose tongue (*Plantago maritima*), scurvy grass (*Cochlearia officinalis*), Canadian sandspurry (*Spergularia canadensis*), beach greens, or sea milkwort (*Glaux maritima*). Tidal marshes are widely distributed along the Gulf of Alaska coast but they occupy a relatively small area along the rocky coastline. Owing to their landscape position, tidal marshes are highly susceptible to damage from development, oil spills, sea level rise, and earthquake induced slides and tsunamis. These ecosystems are recognized by the Alaska Natural Heritage Program as ecosystems of conservation concern with a State conservation status rank of S4 (apparently secure but uncommon within the state; may be a long term conservation concern) (Boggs et al. 2016).

(All of the coastal vegetation types described above also occur in the Copper River Delta; however, the distribution pattern differs: within the Copper River Delta, rocky coastlines are relatively uncommon, while coastal wetlands and sandy shorelines are abundant.)

Vegetation Condition Copper River Delta Geographic Area

Like Prince William Sound, the Copper River Delta Geographic Area is part of the temperate rainforest biome (Alaback 1991), but the landscape pattern differs from that of Prince William Sound. The region is directly exposed to the Gulf of Alaska and is also influenced by the climate of interior Alaska via cold air drainage through the Copper River corridor during winter months. The Copper River is one of the four rivers in southern Alaska that bisect the coastal mountain ranges that separate the interior climate from the coastal maritime climate (Boggs 2000).

The most distinctive and important features of the Copper River Delta are the vast and highly productive outwash plains, floodplains, tidal marshes, and uplifted marsh ecosystems associated with the Copper River and several smaller river systems that feed into the coastal plain. At the mouth of the Copper River Delta, a string of barrier islands extends along the length and forms a protected lagoon between the islands and mainland.

This landscape pattern is reflected in the proportion of different vegetation types within the geographic area; for example, forests make up only 15 percent of the terrestrial landscape, compared to 30 percent in Prince William Sound, but wetlands (as mapped in the National Landcover Database) account for 16.8 percent of the area compared to 3.6 percent in Prince William Sound. Upland forest and shrub vegetation types and disturbance dynamics within the coastal mountains are similar to those described for the Prince William Sound Geographic Area and are not duplicated here (see

Prince William Sound Forest and Shrublands descriptions). In the more inland regions of the Copper River Delta Geographic Area, the climate is somewhat influenced by the continental interior, and the upland forest pattern and type differ slightly from Prince William Sound. For example, treeline extends to over 2,500 feet, and spruce forests may be dominated by either Sitka or Lutz spruce. The following sections describe the disturbance processes and vegetation patterns unique to the delta portion of the Copper River Delta Geographic Area.

Disturbance Processes of the Copper River Delta

The Copper River Delta is a highly dynamic environment because of periodic tectonic uplift and ongoing fluvial processes, including erosion and deposition of sediments on outwash plains, floodplains, and estuaries. The tremendous sediment load delivered by the glacially fed Copper River is responsible for the creation and maintenance of the ecosystems of the Copper River Delta, including a series of barrier islands and spits at the mouth of the Copper River Delta maintained by strong coastal currents (Boggs 2000). Earthquakes are a periodic disturbance within the region, occurring on average every 600 years (Plafker et al. 1992). Tectonic uplift abruptly raises portions of the Copper River Delta above the influence of saltwater initiating immediate changes in hydrology. The episodic uplift is eventually compensated for by regional subsidence (Brocher et al. 2014). The 1964 earthquake uplifted the area by six to 12 feet (Reimnitz 1966) and triggered ongoing shifts in vegetation composition and structure. Boggs (2000) described disturbance processes on the Copper River Delta following the 1964 earthquake as follows:

> Before1964, much of the delta was covered by brackish marshes dominated by sedges (Carex spp.) and mixed grass/forb communities (Crow 1968, Potyondy and others 1975, Trainer 1959). The earthquake lifted these marshes above the tidal influence, initiating massive changes in vegetation composition and structure. Some tidal marsh communities described as common in previous studies (Crow 1968, Potyondy and others 1975) are now rare or absent on the landscape. Many pre-1964 tidal mudflats were elevated sufficiently that they are now developing brackish marshes.

Currently, the uplifted marsh consists of freshwater ponds, levees, old tidal slough channels, and freshwater streams. Prior to the uplift, the marsh was intermittently flooded by extremely high tides (Boggs 2000; Cooper 2007; Thilenius 1990). After the earthquake, hydrologic changes to uplifted marshes gradually reduced the soil salinity and allowed for the establishment of shrubs and trees including alder, willow, and spruce (Crow 1971). The uplift caused extensive changes to vegetation pattern and disturbance dynamics, shifting the saltwater-influenced boundary by as much as nine miles in some locations (Boggs 2000; Reimnitz 1966; Thilenius 1990). Currently, the uplifted marsh is only tidally affected in creeks that drain the surface. Prior to the earthquake, beaver distribution was restricted to the outwash plain portion of the delta because suitable habitat was not available within the marsh environment; however, increases in woody vegetation after the earthquake created more favorable habitat and beaver distribution expanded from the outwash plain to the uplifted marsh (Cooper 2007). Beaver activity continues to have an impact on vegetation pattern in the uplifted marsh through flooding, removal of woody vegetation, dam building, and eventual dam failure. Beavers have a major effect on the development and maintenance of rich fens (Boggs 2000), and their activity influences succession by increasing the amount of ponded surface water in the uplifted marsh and interrupting succession toward peatlands or forested vegetation types (Cooper 2007).

The outwash plain of the Copper River Delta is a freshwater ecosystem composed of glacial and alluvial outwash, braided glacial rivers, streams, ponds, alluvial terraces, and sand and gravel bars that are the direct result of erosion and deposition of sediment (Cooper 2007; Davidson 1998). The disturbance dynamics of the outwash plain were not substantially altered by the earthquake, and thus successional patterns and processes have remained largely unchanged since the uplift and reflect vegetation dynamics typical of glacial outwash plains (Boggs 2000).

At the Copper River Delta front, extensive tidal marshes and mudflats are maintained by frequent saltwater inundation. Mudflats uplifted by the earthquake are continuing to develop into tidal marshes. Complex patterns of sloughs and levees bisect these coastal wetlands and create a mosaic of vegetation types. Offshore, barrier islands are maintained by sediment input and strong ocean currents along the Gulf of Alaska.

Current and past human caused disturbances within the region include personal use fuelwood collection, moose habitat enhancement, and historic logging and mining (see the Affected Environment Vegetation History section for a description of historic human disturbances).

The dominant vegetation types that currently occupy the complex landscapes of the Copper River Delta plain are described in the following sections.

Pacific Maritime Wetlands and Uplifted Marsh of the Copper River Delta

Wetlands of the Copper River Delta represent the largest contiguous wetland on the Pacific coast of North America (Thilenius 1990) and make up more than half of the wetland area within the Chugach National Forest (see table 89 and table 90). Throughout the North Pacific, coastal wetlands have a relatively limited extent owing to the rocky nature of much of the coastline.

Tidal marshes throughout the Copper River Delta are dominated by Lyngbye's sedge, though other species, including Pacific silverweed, alkali buttercup (*Ranunculus cymbalaria*), seaside arrowgrass, and Mackenzie's sedge (*Carex mackenziei*), may be present. Tide flats occur on the seaward side of tidal marshes, and species occupying these sites are tolerant of daily inundation by saltwater. Tide flats in the Copper River Delta are typically sparsely vegetated with alkali grass (*Puccinellia pumila* and *P. nutkaensis*) (Boggs 2000). The current distribution of tidal marshes and flats developed on sediments uplifted during the 1964 earthquake.

On the uplifted marsh, numerous remnant tidal marsh species, such as Lyngbye's sedge and marsh pea (*Lathyrus palustris*), persist in what have now become freshwater systems. Other common freshwater wetland types include marshes composed of Sitka sedge, beaked sedge, and russet sedge (*Carex saxatilis*); rich fens composed of marsh fivefinger, buckbean, and swamp horsetail; and aquatic beds with burred (*Sparganium* spp.) and yellow pond-lily (*Nuphar lutea* ssp. *polysepala*). Wet shrublands (typically fens) dominated by sweet gale or Barclay willow with wet sedges in the understory are also common on the uplifted marsh (Boggs 2000).

In addition to the marsh and fen ecosystems described previously, the uplifted marsh also contains well developed peatlands that have formed in the poorly drained depressions between levees. Peatland vegetation includes many-flowered sedge, cottongrass, Sitka sedge, and Sphagnum moss. Dwarf shrubs, including bog cranberry, bog rosemary, and crowberry, are often present but not usually abundant (Boggs 2000).

Along the levees of the uplifted marsh, woody vegetation, such as Sitka alder, willow, and Sitka spruce, has established in areas that have become sufficiently well drained to support shrubs and trees (Boggs 2000).

Pacific Maritime Outwash Plain of the Copper River Delta

Well drained terraces of the outwash plain and floodplain support forests composed of black cottonwood or Sitka spruce, with coniferous forests only becoming dominant in later seral stages. Shrublands of Sitka alder and willow (Barclay or Sitka) dominate early seral stages of succession and can also be abundant in the understory in mid-seral forests. In late seral stages of spruce forest development, early blueberry and devils club become common (Boggs 2000).

On poorly drained terraces of the distal outwash plain wet levees and ponded basins characterize the landscape. Wet levees support Sitka alder, Barclay willow, and bluejoint reedgrass, and, in later seral stages, sweet gale and sedges. Interlevee wetlands support aquatic bed, marsh, fen, and peatland vegetation types (Boggs 2000).

Pacific Maritime Barrier Islands, Beaches, and Spits of the Copper River Delta

Barrier islands at the mouth of the Copper River Delta are maintained by sediment input from the Copper River and shaped by strong ocean currents (Boggs 2000). Along the Gulf of Alaska coast, barrier islands are uncommon (Hayes and Ruby 1994; Boggs 2000; Boggs et al. 2016; DeVelice et al. 2007), occupying less than one percent of the coastline, compared to roughly 10 percent of the continental coastline worldwide (Stutz and Pilkey 2011). The barrier islands of the Copper River Delta represent the most extensive and well developed system along the Gulf of Alaska coast. The 1964 earthquake uplifted barrier islands and associated tidal flats by as much as 10 feet. As a result of this uplift, barrier islands have grown in length, and on the inland side of the islands, tidal marshes became uplifted marshes and mud flats developed into tidal marshes.

Sandy beaches on the exposed gulf side of the islands transition to sand dunes with herbaceous and shrub communities interspersed with slacks dominated by low herbaceous vegetation and wetlands. Pioneer species, such as beach rye, colonize exposed sand and serve to stabilize the dunes with roots that penetrate over three feet to water (Boggs 2000; DeVelice et al. 2007). Species and plant association diversity increases with dune stability. Common herbaceous species on the dunes include tall fireweed, beach strawberry, beach rye, northern yarrow, and Nootka lupine. Common shrubs colonizing the more stable portions of the dunes include Sitka alder, Barclay willow, dune willow (*Salix hookeriana*), and feltleaf willow. On the inland side of the barrier islands, vegetation grades to tidal marshes and tide flats.

Barrier islands provide important habitat for marine mammals and birds owing to their separation from terrestrial predators on the mainland. Islands at the mouth of the Copper River provide haulouts for harbor seals, stopover feeding grounds for migrating shorebirds, and habitat for a variety of bird species. Because of their rarity and their susceptibility to damage from oil spills and human use, these ecosystems have been assigned a conservation status rank of S4 by the Alaska Natural Heritage Program, indicating that they are apparently secure, and there is no expected decline in their condition in the short or long term (Boggs et al. 2016). (See the Terrestrial Wildlife and Ecosystems and Subsistence Resources sections for more information about wildlife habitat and subsistence uses on barrier islands.)

Drivers and Stressors

Natural Disturbance

Terrestrial ecosystem patterns across the Chugach National Forest are primarily the result of natural processes. As noted in the forest plan assessment (USDA 2014a), significant natural disturbances occurring in the past and expected to continue in the future include natural fire ignited by lightning, native insect and disease outbreaks (see Forest Insects and Disease section), earthquakes, volcanic ash fall, snow avalanches, landslides, windthrow of trees, glacial action, flooding, and beaver activity. Patterns of natural disturbance vary across the region and the dominant disturbance processes are described by geographic area earlier in this section.

Human-caused Disturbance

Human-caused impacts across the plan area include the developed footprint of roads, trails, railroads, recreation sites, utilities, airstrips, and cabins along with activities such as, placer mining, hunting, fishing, gathering, recreational uses, personal use fuelwood collection, limited commercial timber harvest, and human caused fires, particularly within the Kenai Peninsula Geographic Area. Most of the current and ongoing human impact occurs on the Kenai Peninsula, which has several small communities, two major highways, a network of trails, and a railroad. Because most of the roads are situated in valley bottoms, the majority of the impacts are concentrated in forests occupying lower slopes and valley bottoms.

The largest amount of ongoing vegetation treatment within the Chugach National Forest is hazardous fuel reduction on the Kenai Peninsula where an average of 875 acres has been treated annually from 2004 through 2013. Treatments consist of removal, thinning, pruning, piling, and burning especially in WUI, high use areas, and along transportation routes. Wildlife habitat improvement for moose winter range is another major activity. Between 1977 and 1997 nearly 10,000 acres were treated using prescribed fire within the Kenai Peninsula Geographic Area (Boucher 2003). More recent moose habitat enhancement activities have focused on creating early successional habitat through thinning, timber harvest, and hydro ax treatments. Forest vegetation establishment and improvement and invasive plant treatment projects also occur within the national forest.

Very little timber harvest occurs within the Chugach National Forest. Most of the recent logging occurred in the 1990s on private lands within the national forest boundary. Some of those logged lands are now NFS lands, such as logged tracts of land on the Knowles Head Peninsula in Prince William Sound. These previously logged areas within Prince William Sound are currently under management prescriptions designed to restore forests to old growth conditions.

The 1989 oil spill in the Prince William Sound area has had a long lasting impact on resources in the affected area. At least 10,800,000 gallons of crude oil spilled from the *Exxon Valdez*, resulting in the stranding of oil on an estimated 2,100 kilometers of shoreline in western Prince William Sound, along the north Gulf of Alaska coast, and westward past Kodiak Island. Extensive cleanup efforts from 1989 through 1991 and natural wave action on the shoreline removed much of the stranded oil. It was expected that remaining oil would be reduced to negligible amounts soon thereafter; however, observations indicated that oil remained in intertidal sediments of some beaches eight years after the spill, some of it only lightly weathered. Several resources have not yet fully recovered from the spill and lingering oil remains below the surface in many intertidal areas. Restoration and monitoring activities aimed at improving resources affected by the spill are ongoing.

Invasive Species

A species is considered to be invasive if it meets two criteria: (1) it is non-native to the ecosystem under consideration and (2) its introduction causes, or is likely to cause, economic or environmental harm or harm to human health (Executive Order 13112). Invasive species can endanger native species and threaten ecosystem services and resources, including clean water, recreational opportunities, sustained production of wood products, fish and wildlife habitat, and human health and safety (USDA 2013). Adverse effects from invasive species can be exacerbated by interactions with fire, native pests, weather events, human actions, and environmental change. Estimated damage from invasive species worldwide totals more than 1.4 trillion dollars per year (Pimentel et al. 2001).

Non-native Insects and Diseases

Non-native insects and diseases are a growing problem within Alaska and across the Chugach National Forest. Status and trends of these organisms are described in the Forest Insects and Diseases section of this DEIS.

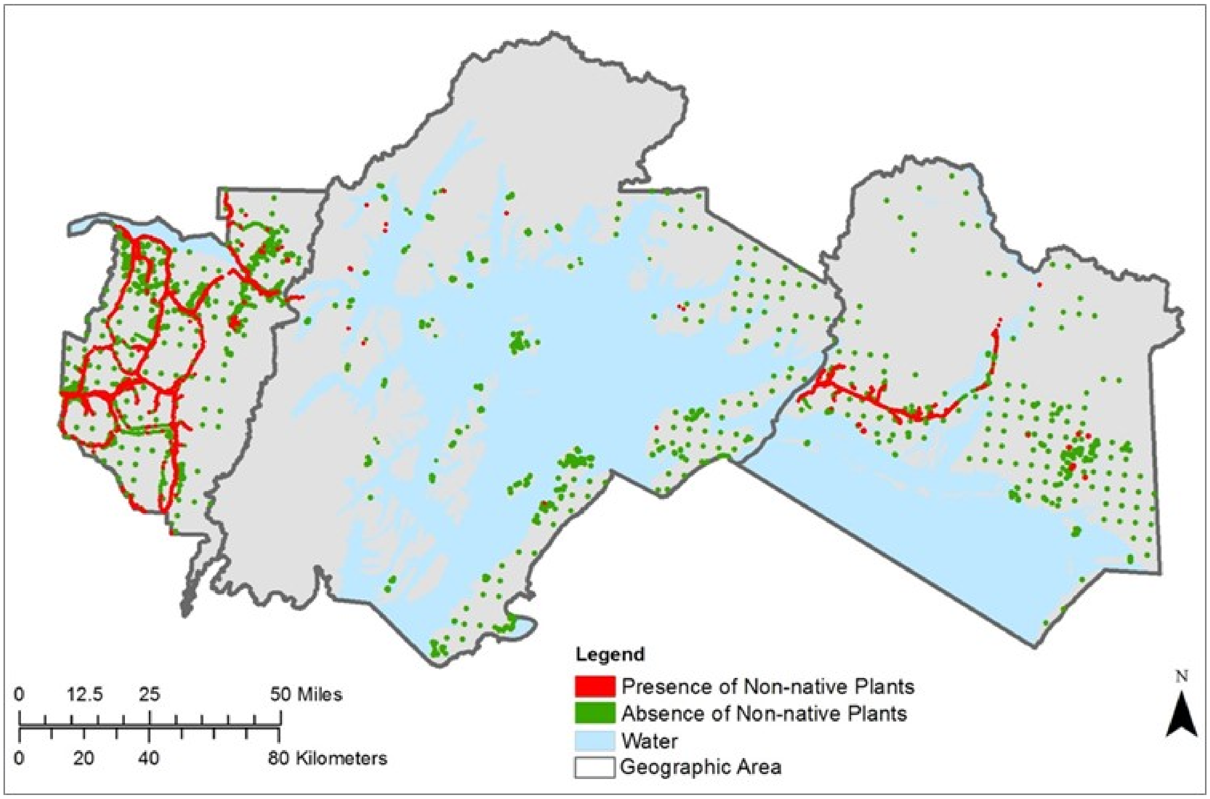
Terrestrial Invasive Plants

Most non-native terrestrial plant occurrences within the national forest are in areas of intensive human-caused disturbance. Non-native plants have been found on about 71 percent of the sites sampled on road edges, facilities, trailheads, mineral material sites, trails, and shorelines of the Chugach National Forest (based on Natural Resource Information System Threatened, Endangered, Sensitive Plants – (NRIS TESP)Invasive Species data; see table 91). In contrast, about one percent of backcountry sites sampled have non-native plants present (based on Chugach National Forest ecology plot and Forest Inventory and Analysis (FIA) data (see table 91)). About 86 percent of occurrences of terrestrial non-native plants within the national forest are on the Kenai Peninsula (based on combined NRIS TESP-Invasive Species data, Chugach National Forest ecology plot data, and FIA data; see table 91 and map 29).

Table 91. Summary of non-native terrestrial plant species occurrences within the boundary of the Chugach National Forest based on data from the Natural Resource Information System Threatened, Endangered, Sensitive Plants -Invasive Species, FIA data, and the Chugach National Forest Ecology Program vegetation plot databases

Data Variable	Kenai Peninsula Geographic Area	Prince William Sound Geographic Area	Copper River Delta Geographic Area	National Forest Totals
All Data				
Occurrence records	9,362	70	1,424	10,856
Non-occurrence records	1,748	705	835	3,288
Sum	11,110	775	2,259	14,144
Percent of forestwide occurrences	86.2%	0.6%	13.1%	100%
Front Country Sites				
Occurrence sites	1,260	25	309	1,594
Non-occurrence sites	481	25	155	661
Sum	1,741	50	464	2,255
Percent of sum	72.4%	50.0%	66.6%	70.7%
Backcountry Sites				
Occurrence sites	7	zero	20	27
Non-occurrence sites	1,267	680	680	2,627
Sum	1,274	680	700	2,654
Percent of sum	0.5%	zero	2.9%	1.0%
Number of Species				
Non-native species	85	22	43	93
Highly invasive species	10	5*	6	12

*All five occurrences of highly invasive species in Prince William Sound are in the Whittier area.



Map 29. Terrestrial non-native plant species occurrence (red dots) and non-occurrence (green dots) records currently documented within the Chugach National Forest. The Kenai Peninsula, Prince William Sound, and Copper River Delta geographic areas are also displayed (left to right, respectively).

Table 92. Non-native plant species currently documented within the Chugach National Forest with invasiveness ranks of 70 and above (highly invasive)

Scientific Name	Common Name	Rank	Quantity[1]	Area
Bromus tectorum	Cheat grass	78	5	Portage
Cirsium arvense	Canada thistle	76	6	Girdwood
Elodea spp.	Waterweed	79	21	Copper River Delta
Hieracium aurantiacum	Orange hawkweed	79	16	Kenai Peninsula and Cordova
Lupinus polyphyllus	Bigleaf lupine	71	36	Kenai Peninsula, Whittier, and Copper River Delta[2]
Melilotus alba	White sweetclover	81	32	Kenai Peninsula, Whittier, and Cordova
Phalaris arundinacea	Reed canarygrass	83	31	Kenai Peninsula, Whittier, and Copper River Delta
Polygonum x bohemicum	Bohemian knotweed	87	zero	Cordova
Prunus padus	European bird cherry	74	1	Kenai Peninsula (near Hope)
Rosa rugose	Rugosa rose	72	1	Whittier
Sochus arvensis	Perennial sowthistle	73	1	Kenai Peninsula (Hope Y); eradicated from site
Vicia cracca	Bird vetch	73	35	Kenai Peninsula and Whittier

Source: AKNHP 2013

1 - Number of populations reported in NRIS TESP-Invasive Species out of 10,828 non-native plant species occurrence records within the boundary of the Chugach National Forest.

2 - Bigleaf lupine may be native in some locations within the Chugach National Forest.

Non-native plants within Alaska have been given an invasiveness rank on a scale of zero to 100 (Carlson et al. 2008). Species ranked 70 or greater on this scale are considered to be highly invasive. Of the 93 non-native plant species currently documented within the boundary of the Chugach National Forest, 12 are considered highly invasive (see table 92). Of the 5.4 million acres of NFS lands, the total area of infestation of highly invasive terrestrial plants is estimated at less than 1,000 acres (DeVelice et al. 2012).

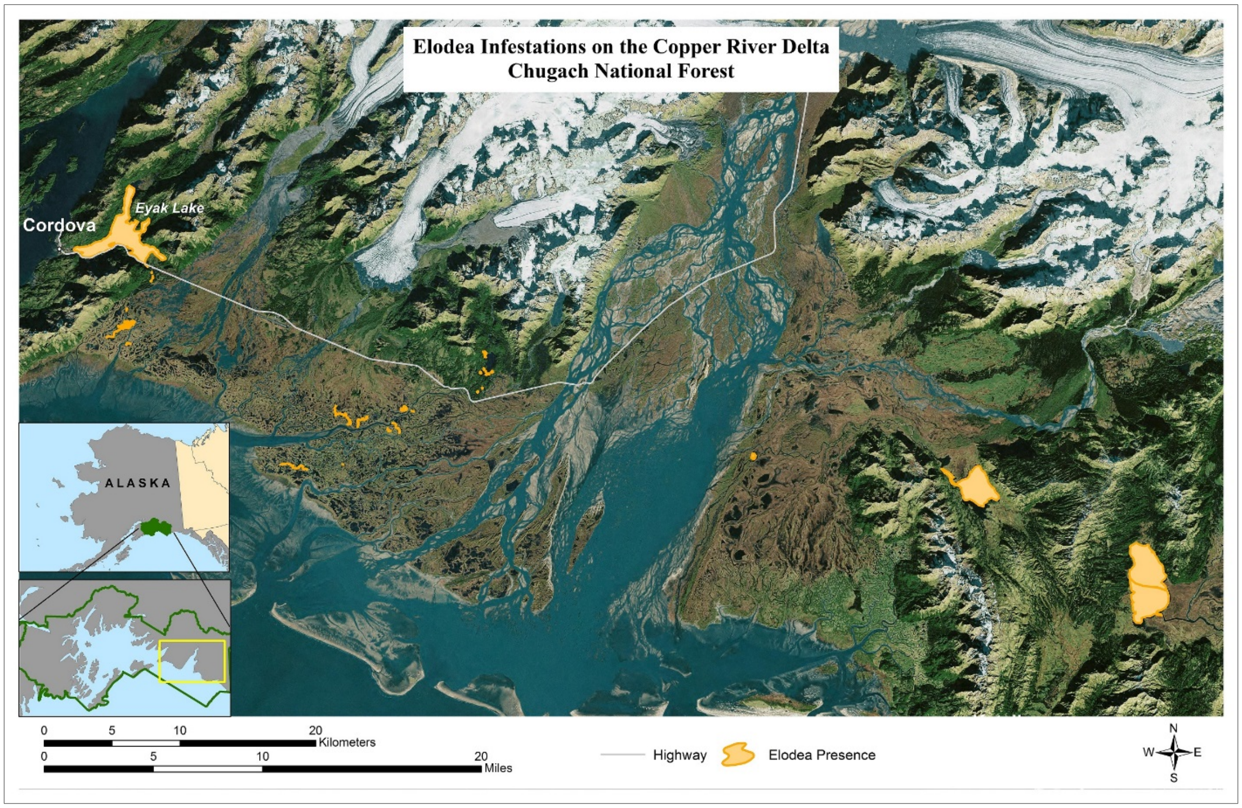
Because terrestrial invasive plants have relatively limited distributions within the Chugach National Forest, managers are in a unique position to prevent the introduction and spread of invasive plants and to eradicate small populations before they spread. However, effects of changing climate, increasing levels of disturbance (both natural and human-caused), and increasing tourism and population growth make the national forest vulnerable to the introduction and spread of invasive plants.

Aquatic Invasive Plants

Elodea spp. (waterweed), a fish tank plant, is the first known aquatic invasive plant in Alaska. It was first documented on the Copper River Delta in 1982, and these infestations are the oldest and most widespread in the state. Since then, infestations have been discovered in several water bodies in Anchorage, Fairbanks, and the Kenai Peninsula. Outside its native range, it has often compromised water quality, grown so abundantly that boat traffic is hindered, reduced dissolved oxygen, and negatively impacted native fisheries. Further, only a plant fragment is needed to infest a water body because it reproduces vegetatively. Once established, it can easily be spread by float planes traveling between freshwater lakes across the State. Recognizing the threat, in March 2014, the Alaska Department of Natural Resources issued a statewide quarantine for both *Elodea canadensis* and *E. nuttallii*. The State of Alaska is in the process of developing a statewide strategic plan with the goal to eradicate these species.

Recent invasive species surveys across the Copper River Delta reveal that the plant has spread to new lakes and known populations have grown in size (see map 30). Several treatment methods for eradicating *Elodea* spp. have been tried, including mechanical and physical removal, but the only effective eradication method has been herbicide application. From 2014 to 2016 managers at the Kenai National Wildlife Refuge have been treating infestations of *Elodea* spp. on three lakes within the refuge using the aquatic herbicide, fluridone.

Within the Copper River Delta, the Forest Service has initiated a small-scale treatment of ponds containing *Elodea* spp. with the intention of determining the feasibility of eradicating this species across the Copper River Delta and evaluating the impacts to fish, native aquatic plants, and macroinvertebrates. If left untreated, the infestation in Eyak Lake near Cordova, which is a common float plane landings site, could remain a source population for Anchorage lakes and also remote lakes in Prince William Sound, such as Eshamy and Coghill Lakes.



Map 30. *Elodea canadensis* infestation on the Copper River Delta

Short-term Vegetation Trends (15 years)

In the short term (15 years), natural disturbance events including, fire, floods, windstorms, landslides, avalanches, and insects and disease outbreaks, will continue to influence the composition and structure of vegetation communities within the national forest. Human caused disturbances, such as fuel reduction, timber harvest, fuelwood harvest, and wildlife habitat enhancement, will also continue affect forest composition and structure. With the exception of prescribed fire, vegetation management activities will largely take place within the roaded corridor. Natural disturbance will be the predominant process across the remainder of the national forest. In the absence of major disturbance events, the majority of forested cover types are expected to move through natural succession toward later seral stages.

Within the Kenai Peninsula Geographic Area, mature birch and aspen stands may be replaced by Lutz spruce and hemlock where these conifers currently occur in the stand understory. Coniferous forest is expected to maintain itself or expand slightly as conifers replace deciduous trees through natural succession and treeline expansion upward into alpine tundra. Alder and willow shrublands could expand slightly into upper elevations as the shrubline continues to advance into alpine tundra. However, consistent and directional changes associated with treeline and shrubline advance may not be detectable over the 15-year plan timeframe.

In Prince William Sound, Sitka spruce and mixed hemlock-spruce cover types are expected to maintain themselves. Barring large-scale disturbances, succession would continue to move vegetation toward later seral stages. With rapid glacial retreat occurring in low elevation settings, the area of recently deglaciated terrain is expected to expand, particularly in areas such as Columbia Bay. Early successional species will gradually colonize newly exposed terrain.

In the Copper River Delta Geographic Area, Sitka spruce and mixed hemlock-spruce cover types are expected to maintain themselves in upland settings. In areas uplifted by the 1964 earthquake, such as the uplifted marsh landscape, succession is expected to proceed with trees and shrubs continuing to establish along stringers and levees uplifted above the influence of salt water. On the floodplain of the Copper River, vegetation composition is expected to be maintained through frequent flooding. Changes associated with glacial retreat are expected to be similar to those described for Prince William Sound.

Long-term Vegetation Trend (50 years)

Terrestrial ecosystems within the Chugach National Forest are expected to exhibit variable ecological response to climate change (Hayward et al. 2017). Models examining potential changes in the distribution of vegetation types suggest that coastal temperate rainforest will retain most of its current distribution and potentially expand, while alpine tundra is likely to decline as forests and shrublands move upward in elevation. However, the dynamics of vegetation change will lag behind the shift in climate and a range of ecological factors will interact with current vegetation, soils, and disturbance processes.

The influence of both fire and insects on forest and shrub communities is likely to change as a result of directional climate change. Although fire will remain rare in the coastal rainforest, the flammability of vegetation and the potential for fire is likely to increase in the sub-boreal region, including the Kenai Peninsula geographic area. Longer growing seasons and warmer winter temperatures could also facilitate more frequent infestations of defoliating insects and bark beetles. The direct effects of climatic warming on vegetation shifts may be less dramatic than effects mediated by herbivores and fire (Niemela et al. 2001); however, the scale and timing of these types of events is difficult to predict.

These broad trends will have differential impacts across the sub-boreal and maritime regions of the national forest. For example, changes to alpine vegetation are likely to be more pronounced in the sub-boreal region (Kenai Peninsula Geographic Area), while changes resulting from glacial recession are likely to be more evident in the maritime region (Prince William Sound and Copper River Delta geographic areas). The impacts of insects and diseases will differ by region as well. In the following sections, the projected changes in vegetation over the next 50 years is examined across the different geographic areas of the Chugach National Forest based on both the results of the climate change assessment and the understanding of succession and disturbance dynamics.

Kenai Peninsula Geographic Area Projected Vegetation Change

Treeline and Shrubline

The gradual decline in the spatial extent of alpine tundra likely represents the most important projected change in ecosystem conditions across the plan area. The recently completed climate change assessment (Hayward et al. 2017) estimated that the area within a suitable climate envelope for alpine tundra will decline by 87 percent by 2060 and that alpine tundra will be replaced at the ecotone by trees and tall shrubs. Within the Chugach National Forest, the greatest area of alpine tundra (classed as dwarf shrub) occurs in the Kenai Mountains, occupying 14.1 percent of the geographic area (see table 89). This vegetation type provides important foraging habitat for Dall sheep and caribou populations in the western portion of the Kenai Mountains and mountain goat in the eastern portion of the range. Alpine tundra also contains habitat for Eschscholtz’s little nightmare

(*Aphragmus eschscholtzianus*), a sensitive plant and proposed species of conservation concern within the plan area, known in the Alaska Region from only one location in the Kenai Mountains.

Observed trends in the upward migration of trees and shrubs into alpine tundra support results predicted in the climate change assessment. In a study that examined recent vegetation change near treeline in the western Chugach and Kenai mountains during a 40-year period, Dial et al. (2016) found that the encroachment of tall woody vegetation into alpine tundra matched the observed warming trend, and tall shrub encroachment into alpine tundra was proceeding more rapidly than treeline advance. In the Kenai Mountains, tall shrub advance was estimated at a rate of 7.5 feet per year, while treeline advance was proceeding at a rate of 3.6 feet per year.

Flammability, Fuel loads, Insects, and Diseases

Warming temperatures are projected to lead to earlier snow melt in the spring, which will extend the season of high fire risk that occurs during the snow-free period before new vegetation begins to emerge (green up). Changes in vegetation linked to damage from insects and disease could compound the temperature related fire risk by increasing hazardous fuel loads. Spruce mortality caused by the spruce bark beetle increased dramatically in southcentral Alaska in 2016, and mortality is at the highest level observed since 1999 (see Forest Insects and Diseases section; USDA 2017). Most of the recent mortality occurred to the north and west of the plan area, but a new area of infestation was observed in the Kenai Mountains along the border between the Chugach National Forest and Kenai National Wildlife Refuge. It is uncertain what the future impact of the spruce bark beetle will be in the Kenai Peninsula Geographic Area, but it is likely that mature Lutz spruce trees that escaped the previous infestation will be at risk. Young trees avoided by the beetle during the previous infestation have matured and could also become vulnerable in the coming decades. In addition to available host trees, a conducive climate is needed to facilitate an infestation. A run of warmer than average summer temperatures can stress host trees and accelerate beetle life cycles creating prime conditions for a severe infestation. Warmer temperatures could lead to conditions in which infestations become more likely.

Additional damage to forests could come from two recently detected pathogens affecting aspen and spruce: a newly documented, and as yet unidentified, aspen canker called running canker and spruce bud blight, caused by the fungal pathogen *Gemmamyces piceae*. All species of spruce are affected, and because this fungus is capable of growth and reproduction in cold temperatures, it is expected to continue its spread into native forests in the coming decades (see Forest Insects and Disease section; USDA 2017).

Extensive dieback and mortality of alder shrublands has been documented across southcentral Alaska between 2000 and 2016 (see map 6 Forest Insects and Diseases section; USDA 2007; USDA 2017). Alder canker, a general term including several pathogenic fungi, has been identified as a causal agent, though in some cases the causes may involve a complex of biotic and abiotic influences, including insect defoliators and drought stress. In addition to being one of the most dominant vegetation types in southcentral Alaska, alder shrublands play a significant role in nitrogen (N) inputs to the ecosystem both by N fixation and by producing an N-rich leaf litter. N inputs enhance primary productivity in both terrestrial and aquatic environments, particularly in N-limited systems here (Devotta 2008; Hu et al. 2001; Ruess et al. 2006; Shaftel et al. 2010; Callahan et al. 2017). Loss or reduction of alder on a landscape scale would have profound impacts on total nitrogen inputs and site productivity. Alder is generally considered a low flammability shrub, but grasslands that occur in a mosaic with alder thickets are highly flammable during the snow-free season before green-up. The expansion of grasslands in the wake of alder dieback and mortality could cause an increase in the flammability of affected areas during the high risk season.

In sub-boreal region, it is possible that the direct effects of climatic warming on vegetation shifts may be less dramatic than effects mediated by herbivores and fire (Niemela et al. 2001). Insects, such as bark beetles and defoliators, can cause rapid changes in vegetation composition and structure that, in turn, can result in rapid changes to fuel loads and vegetation flammability. With projected warming temperatures, these scenarios will become more likely, but the scale and timing of insect infestations is difficult to predict.

Invasive Plants

Relative to the other two geographic areas, the Kenai Peninsula Geographic Area has a large network of roads and trails and is a popular destination for residents and visitors alike (USDA 2014a). Because of the visitation rate and amount of infrastructure, this geographic area has more occurrences of invasive species than the less developed geographic areas (see table 91 Invasive Species, this section). With a projected increase in recreational use, the likelihood of invasive species introduction and spread will increase, as will the risk of introduction of previously undocumented invasive species. The Forest Service currently monitors invasive plant introductions and actively works to eradicate highly invasive plant populations. It is likely that the amount of effort required to mitigate the spread of noxious weeds will continue to increase going forward.

Prince William Sound Geographic Area Projected Vegetation Change

Temperature and Precipitation

In the next 50 years, the coastal rainforest is projected to retain most of its current distribution and potentially expand (Hayward et al. 2017). Within this biome, however, significant changes in temperature and precipitation are projected. As is the case across the Chugach National Forest, winter temperatures are expected to increase more than summer temperatures. In coastal and near coastal areas, the average January temperature is currently slightly above freezing; however, in the next 50 years, the average January temperature is expected to rise to 40° F. Precipitation is projected to increase across the region, but with increasing temperatures, there will be a higher proportion of precipitation falling as rain in lower elevations (below 3,000 feet) where the average winter temperatures are projected to be well above freezing, resulting in a longer snow free period. At higher elevations where winter temperatures are predicted to remain below freezing, a deeper snowpack is predicted (Hayward et al. 2017).

Glacial Recession

Glaciers within the Chugach National Forest are currently losing about 1.4 mi^3 of ice per year (Berthier et al. 2010; Hayward et al. 2017). Coastal glaciers are more vulnerable to warming than interior glaciers because average winter temperatures of the maritime environment are currently near freezing. In the next 50 years, winter temperatures are projected remain well above freezing at lower elevations during the coldest winter months.

Glacial thinning and recession of the glacial front at low elevations will continue to have a profound impact on adjacent terrestrial, aquatic, and marine habitat. In the terrestrial environment, the area of newly exposed terrain available for colonization by early seral shrubs and trees will continue to increase, particularly in the mid to low elevations.

Loss of ice from the Columbia Glacier in Prince William Sound currently accounts for about half of total ice loss across the Chugach National Forest (Berthier et al. 2010; Hayward et al. 2017). In the next 20 years, the Columbia Glacier is projected to retreat an additional 9.3 miles and split into several tributaries before stabilizing at a point where the glacier is in contact with the floor of the fiord near tideline (Pfeffer 2015). The magnitude of this retreat will increase the size of the bay and also increase accessibility for boat traffic as fewer icebergs are discharged as a result of the glacial terminus becoming bedded.

An increase in newly exposed terrain associated with glacial retreat combined with an increase in human use will increase the risk of invasive plant infestation to the currently pristine habitat surrounding Columbia Bay.

Vegetation Change

The upward migration of treeline and shrubline are associated with warming temperatures; however, in the coastal rainforest environment, the projected increase in high elevation snow pack could impede the expansion of trees and shrubs into alpine environments. Within the coastal rainforest region, the greatest climate linked shift in vegetation composition will be associated with glacial retreat in mid to low elevations. The area occupied by early seral shrublands and woodlands expanding into recently deglaciated terrain is expected to increase as glaciers recede.

Insects and Diseases

Non-native insects and diseases are emerging as important damage agents within the coastal rainforest region of the Chugach National Forest. The mild winters of 2014-15 and 2015-16 triggered an increase in spruce aphid (*Elatobium abietinum*) activity along the coast of the Kenai Peninsula (see Forest Insects and Diseases section). This infestation on the Kenai Peninsula represents a significant extension of its previous known distribution. With warmer winter temperatures predicted throughout the region, infestations of spruce aphid could become more common throughout the Prince William Sound and Copper River Delta geographic areas. Spruce bud blight (*Gemmamyces piceae*) could also become established in coastal rainforests.

Invasive Plants

Owing to the lack of roads, trails, and other development, the Prince William Sound Geographic Area currently has the lowest level of invasive plant species occurrences across the Chugach National Forest. Invasive species typically thrive in disturbed terrain, and such sites are abundant along the coastline of Prince William Sound and also in recently deglaciated terrain, which is continuing to expand with warming temperatures. The expected rise in recreational use and visitation will increase the chance of establishment and spread of invasive species throughout the Prince William Sound Geographic Area. Although the aquatic invasive plant *Elodea* spp. has not been documented in Prince William Sound, freshwater lakes in the region that are frequented by float planes are at risk of establishment of the species, particularly if the infestations in the Copper River Delta and Anchorage areas not eradicated.

Management activities affecting levels of use, such as wilderness designation and recreational opportunities, will have an impact on the potential for invasive plant spread in the region.

Copper River Delta Projected Vegetation Change

Temperature and Climate Trends

The Copper River Delta is within the coastal rainforest biome, and over the next 50 years, this biome is projected to retain most of its current distribution and potentially expand (Hayward et al. 2017). Climate trends in the Copper River Delta Geographic Area are expected to be similar to those described for the Prince William Sound Geographic Area.

Vegetation Succession

On the dynamic surface of the Copper River Delta, vegetation changes associated with uplift caused by the 1964 earthquake are ongoing. Regional subsidence will eventually return the surface to pre-earthquake levels. In addition to succession related to the uplift, the Copper River Delta front is shifting seaward due to progradation from the sediment load delivered by the Copper River (Boggs 2000). Over the next 50 years, vegetation shifts associated with these dynamics will likely be more pronounced within the delta portion of the Copper River Delta than vegetation change linked to climate warming.

Since the 1964 earthquake, new tidal marshes have developed on uplifted sediments that were previously submerged or subtidal. Tidal marshes exist in a dynamic equilibrium maintained by sedimentation and tidal inundation. In the absence of another major uplift, tidal marshes are expected to persist and advance gradually into tidal flats through ongoing sedimentation and vegetation establishment (Boggs 2000).

On the uplifted marsh, the 1964 earthquake caused the area to shift from saltwater-influenced wetlands to freshwater systems. In wetlands, succession is expected to continue along predicted trajectories from ponds and marshes to fens and ultimately bogs. Currently, fens are the dominant peatland type on the uplifted marsh. Fens are wetlands with organic soils developed from peat-forming mosses (*Sphagnum* spp.) and vegetated with wetland sedges or cottongrass and dwarf or low shrubs. Over time, a fen may lose inflows of nutrient-rich water through peat buildup and flow diversion, resulting in conversion of the peatland into a bog. Succession from shallow ponds to peatlands is not necessarily directional. On the uplifted marsh, beavers play an important role in regulating the water table and can influence both the distribution of surface water and also the direction of successional trajectories through dam building and eventual dam failure.

Along the levees of the uplifted marsh, certain areas became sufficiently well-drained after the earthquake to support forest vegetation. Woody vegetation, including alder, willow, and spruce, gradually established along levees (Boggs 2000). Over the next 50 years, succession is expected to continue toward Sitka spruce and eventually western hemlock forest types along these well drained levees.

The disturbance dynamics of the outwash plain and floodplain were not substantially altered by the earthquake, and thus successional patterns and processes can be expected to follow vegetation dynamics typical of these systems (Boggs 2000). On well drained outwash and floodplain terraces, alder, willow, Sitka spruce and cottonwood are expected to persist in proportion to disturbance frequency. Shrublands and young cottonwood dominate frequently disturbed sites and mature forests of cottonwood, Sitka spruce and eventually western hemlock develop on terraces that are infrequently flooded. Distal outwash deposits are farther from the glacier and are currently vegetated by peatlands and other wetlands types. Peatland vegetation succession is likely to proceed toward later seral stages, such as from fens to bogs; however, succession is not necessarily directional. Stringers of shrubs and trees have formed along levees and where sediment deposition has raised the surface above the surrounding peatland.

Barrier islands are, by definition, shifting landscape features; the islands are migrating seaward due to progradation of the estuary, and they were uplifted by as much as 10 feet during the 1964 earthquake. Since the earthquake, barrier islands have grown in length and shifted according to coastal currents. The uplift will eventually by compensated for by regional subsidence and sea level rise. In the absence of another major earthquake, it is expected that succession will continue on stabilized portions of dunes.

The aquatic invasive plant *Elodea canadensis* has been established in ponds and lakes near Cordova and in the Copper River Delta since 1982 (see Invasive Species, this section). Managers have initiated a small-scale study of infested ponds in order to evaluate the impacts of the herbicide floridone on fish, native aquatic plants, and macroinvertebrates, and also to determine the feasibility of eradicating this species across the Copper River Delta; if managers deem the effects of treatment outweigh the risk of chemical application to aquatic systems, this highly invasive species could be eradicated from the Copper River Delta in the near future depending on the availability of financial resources.

Along the road system, monitoring and eradication of terrestrial invasive species is expected to continue.

Insects and Diseases

The Copper River Delta features large expanses of deciduous trees and shrubs within the floodplain and outwash plain of the Copper River. Within alder shrublands, extensive alder dieback has been documented and mapped between 2010 and 2016 (see Forest Insects and Diseases section map 6). There is evidence that climate warming may be a contributing factor to recent increases in observed dieback caused by alder canker, a fungal pathogen caused by *Valsa (Cytospora) melanodiscus*. In addition, canker mortality is greater on alder stressed by defoliation from insects. In the coming decades, the projected increasing temperature trends could make an already severe epidemic even more damaging. Removal or reduction of alder from riparian ecosystems on a landscape scale would profoundly affect long term nutrient cycling and forest productivity (see the Forest Insects and Diseases section).

Other deciduous trees and shrubs, including cottonwood and willow, are abundant on the outwash and floodplain of the Copper River and are also susceptible to insect defoliation. While it is impossible to predict which insect or plant species will be impacted, over the next 50 years it is likely that damaging infestations of defoliating insects will impact deciduous trees and shrubs in this region.

As in Prince William Sound, new emerging insects and disease threats are expected to continue to impact coastal forests of the Copper River Delta Geographic Area. Spruce aphid has been detected within the Copper River Delta in the past (in 2004 and 2005), and mild winter temperatures could facilitate further outbreaks (see Insects and Diseases section). Spruce bud blight has not yet been detected within the Copper River Delta, but it could become established in coastal rainforests and emerge as a greater damage agent. More information is needed about how this disease might impact coastal forests before predictions can be made about future scenarios (see Forest Insects and Diseases section).

Terrestrial Ecosystem Integrity

As described in the terrestrial condition assessment (USDA 2014a), the natural range of variation is a useful tool for assessing the ecological integrity of selected ecosystem characteristics.

Vegetation currently in the Tern Lake area of the Kenai Peninsula developed within the past 2,500 years (Ager 2001). In the Girdwood area, forests similar to those of today have dominated for at least the past 2,700 years (Ager et al. 2010). Development of forest communities in Prince William Sound similar to those of today took place during the past 2,000 years (Heusser 1983). Based on these data, the past 2,500 years may be a useful reference period for evaluating natural range of variation across the national forest.

Baseline studies to describe the natural range of variation are rare for the Chugach National Forest. Therefore, only general patterns of historical ecology can be described. An intensive analysis of the natural range of variation is not warranted given the limited potential influence of management activities on most characteristics of the terrestrial system. Current vegetation across the national forest is primarily the result of natural processes.

The expansion of invasive plant populations is one key ecosystem characteristic in the current condition that was uncommon prior to development of roads, railroads, and trails. Because terrestrial invasive plants are relatively rare in the natural communities of the Chugach National Forest, they likely do not pose an immediate threat to ecological integrity but do pose a potential long term threat if left untended. Management actions to prevent the introduction and spread of terrestrial invasive plants and to reduce areas of current infestation are ongoing. The aquatic invasive plant, *Elodea* spp., has the potential to damage ecological integrity if left unchecked; it has been known to reduce dissolved oxygen and severely impact native fisheries. Climate change could further increase the rates of establishment and spread of invasive plants (DeVelice et al. 2005).

Changes in vegetation composition and structure have occurred or are occurring within the national forest with effects on the terrestrial ecosystem condition. A majority of these changes would be expected based on evaluation of the trajectory of the systems as they develop following the last glacial maximum. With current management, there is little direct human influence to the vegetation of about 96 percent of the national forest. Key ecosystem characteristics of terrestrial vegetation are functioning in a way that continues to contribute strongly to ecosystem integrity and sustainability within the plan area.

The forest plan assessment (USDA 2014a) and the climate change assessment (Hayward et al. 2017) both illustrate that terrestrial ecosystems across the vast majority of the Chugach National Forest experience ecosystem disturbances and express ecological pattern and function consistent with the natural range of variation. In fact, human caused disturbance has decreased, and ecosystem integrity has increased since the 1900s. The richness and diversity of the native vegetation within the national forest provides a high level of resistance and resilience in response to climate change, and the diversity in vegetation conditions is likely to remain well beyond the current plan timeframe.

Environmental Consequences

Alternative A No Action

Alternative A would continue current management as described in the 2002 forest plan. The current programs of habitat enhancement, hazardous fuels reduction, and treatments to remove invasive species would continue under alternative A as dictated by availability of resources and funding.

The alternative A (no action) designated wilderness study area boundary and wilderness recommendation would remain consistent with the 2002 forest plan. There are 4,372,657 acres open to mineral entry under alternative A (no action) if the recommended wilderness designation is not acted upon and the current condition remains unchanged.

Alternative A recreation opportunity spectrum classes and management prescription areas would remain consistent with the 2002 forest plan. Opportunities for summer and winter motorized and non-motorized activities and guided special uses would remain the same. Potential impacts to terrestrial ecosystems from snowmachines, helicopters, and ATVs would remain at current levels. Though the opportunities for recreation would remain unchanged, the ongoing trend toward more recreational use will likely result in increased impacts to vegetation resources from non-motorized recreation use, such as camping and foot, wheeled, and pack animal traffic. In general, all of these recreation effects are short term and low except at points of concentrated use. Proper management, use of BMPs, and standards and guidelines outlined in the 2002 forest plan would continue to reduce potential recreational impacts to vegetation resources and overall terrestrial ecosystem conditions.

Alternative B

Alternative B, similar to alternative A, would continue management direction providing for ecological sustainability. The alternative would continue the current program of terrestrial habitat enhancement, hazardous fuels reduction, and treatments to remove invasive plant species. Plan components have been modified and added to provide more of an emphasis on providing ecosystem resilience for changing conditions.

The alternative B wilderness area recommendation, similar to alternative A, would remain consistent with the 2002 forest plan. Upon designation, 71.5 percent of the wilderness study area would become a wilderness area and 1,387,510 acres would be withdrawn from mineral entry.

The changes to recreation opportunity spectrum classes between alternative A and alternative B reflect the Kenai Winter Access Project and reflect current travel management rules, therefore, no additional impacts to vegetation resources are anticipated from these changes. Slightly smaller summer and winter motorized settings are available in alternative B than alternative A within the Kenai Peninsula Geographic Area. While the number of acres and percent change are not large, the distribution and variety of locations did change for both winter non-motorized and motorized access. These changes were developed collaboratively with the public during the Kenai Winter Access Project.

Potential impacts to terrestrial ecosystems from snowmachines, helicopters and OHVs would decrease negligibly compared to alternative A. Impacts to terrestrial ecosystems associated with opportunities for non-motorized recreation use, such as camping, hiking, biking, and pack animal traffic would remain the same as alternative A.

Alternative C

Similar to alternative B, plan components have been modified and added to provide more of an emphasis on providing ecosystem resilience for changing conditions.

Compared to alternatives A and B, alternative C increases the amount of area recommended for wilderness by 432,190 acres. Under this alternative, 93.8 percent of the wilderness study area has been recommended for wilderness area designation, and upon designation 1,819,700 acres would be withdrawn from mineral entry. This increase in the number of acres that would be withdrawn from mineral activities would reduce potential stressors and impacts to terrestrial ecosystems, including the loss of vegetation and introduction of invasive plant species.

Across the plan area, there are several key changes in recreation opportunity spectrum: compared to alternatives A and B, alternative C has a greater number of acres in the primitive class with a corresponding reduction in acres of the semi-primitive non-motorized class. There are more acres in the semi-primitive non-motorized (winter motorized allowed) class than in alternatives A or B, and slightly fewer acres in the semi-primitive motorized class. Across the Chugach National Forest, the overall indirect effects from alternatives A and B compared to alternative C would be fewer adverse impacts to terrestrial ecosystems resulting from motorized use. Also a higher percentage of land in the primitive recreation class would potentially reduce adverse impacts from concentrated recreational uses and reduce the potential for the transport and establishment of invasive plant species. Indirect effects for each geographic area are described below.

The reduction in area of year-round motorized use and the increase in the area of the primitive recreation class in the Kenai Peninsula Geographic Area could result in fewer adverse impacts to terrestrial ecosystems and less potential for transportation and establishment of invasive plant species.

Within the Prince William Sound Geographic Area, the increase in the primitive class and decrease in the semi-primitive non-motorized class would result in less opportunity for developed recreation of outfitters and guides, which would likely result in fewer adverse impacts to terrestrial ecosystems and less potential for transportation and establishment of invasive plant species.

Within the Copper River Delta Geographic Area, recreation opportunity spectrum changes result in a decrease in the primitive class from 80 to 54 percent, but because these changes reflect current travel management rules (heli-skiing and snowmachining) and current uses (such as airboats), they will not result in additional in indirect effects.

Alternative D

Similar to alternatives B and C, plan components have been modified and added to provide more of an emphasis on providing ecosystem resilience for changing conditions.

Compared to alternative C, alternative D would increase the amount of area recommended for wilderness area designation. This alternative would increase the number of acres withdrawn from mineral activities, which in turn would reduce potential stressors and impacts to terrestrial ecosystems, including loss of vegetation and introduction of invasive plant species. Alternative D would reduce potential adverse impacts associated with mineral development more than any other alternative.

Alternative D would have the largest percentage of the primitive recreation class. The primitive class indicates that there would be less people and smaller parties than the semi-primitive class. Associated impacts from special uses, such as outfitters and guides, may decrease slightly due to management limitations on party size and number of permits. Thus, it is assumed that potential adverse impacts associated with future opportunities for non-motorized recreation use would decrease slightly within eastern Prince William Sound compared to alternatives A and B and decrease negligibly compared to alternative C. It is important to note that that outfitters and guides account for 10 percent of actual use in Prince William Sound. Thus, it is difficult to quantify the amount of terrestrial ecosystem improvement that would occur from these small reductions in potential special use permitting allocations.

Summary of Effects

Changes resulting from ongoing directional climate change (glacial recession and upward migration of the treeline and shrubline) and successional changes on uplifted lands in the Copper River Delta will have a greater effect on terrestrial ecosystems than implementation of any of the proposed alternatives. Increasing human uses, especially recreation, will continue to facilitate the transport and establishment of invasive species. This trend would be offset slightly by the implementation of alternatives C or D, both of which propose a reduction in area of year-round motorized recreation classes and an increase in the area in primitive recreation classes. If wilderness areas are designated, lands would be withdrawn from mineral entry, which would reduce the potential for disturbances that could result in habitat loss and establishment of invasive species on those lands. Consequences of the alternatives to terrestrial ecosystems are summarized in table 93.

Table 93. Summary of the consequences of the alternatives to terrestrial ecosystems

Measurement Indicator	Alternative A No Action	Alternative B	Alternative C	Alternative D
Terrestrial invasive species occurrences	Increase in transport of invasive species. Ongoing treatment.	Increase in transport of invasive species. Ongoing treatment.	Decrease in transport of invasive species. Less opportunity for establishment. Ongoing treatment.	Decrease in transport of invasive species. Less of opportunity for establishment. Ongoing treatment.
Percent of wilderness study area recommended for wilderness area designation	No change.	Assuming wilderness area designation, the reduced area available for mineral entry would result in increased habitat protection.	Assuming wilderness area designation, the reduced area available for mineral entry would result in increased habitat protection (more than B less than D).	Assuming wilderness area designation, the reduced area available for mineral entry would result in increased habitat protection (most area recommended for wilderness area designation).
Percent Area in each recreation opportunity spectrum class	No change.	Incorporates Kenai Winter Access Project decision (which is current management direction).	Increase in primitive class, corresponding decrease in semi-primitive non-motorized class; There are more acres in semi-primitive non-motorized class (winter motorized allowed) than in A or B; and slightly fewer acres in the semi-primitive motorized class.	Largest percentage of primitive class of all of the alternatives.

Cumulative Effects

Terrestrial ecosystems within the Chugach National Forest are in good condition and the landscape pattern is the result of natural ecological processes. Potential cumulative effects on terrestrial ecosystems resulting from past, current, and future management are based on the total amount of disturbance within the effects analysis area described previously. Past management activities have been concentrated within certain areas, particularly along road corridors, and these are the areas where most activities under any alternative would occur. The additional effects of reasonably foreseeable major projects and the plans for adjacent land ownerships is addressed qualitatively and is common across all alternatives.

The effects and environmental consequences of reasonably foreseeable major projects and plans for adjacent land ownerships involve loss of habitat, reduced connectivity, and increased potential for invasive species establishment. For the most part, the adjacent land owners’ management direction aligns with Forest Service management direction, resulting in negligible effects. The only discernable effects on terrestrial ecosystems within the analysis area will be from the Kenai Hydro LLC Grant Lake Project, the Sterling Highway Reroute Project, Seward Highway improvements, and foreseeable development of CAC lands.

Foreseeable direct adverse effects on terrestrial ecosystems resulting from the Kenai Hydro LLC Grant Lake project will be a result of the road and facility construction, loss of vegetation, changes in vegetation adjacent to the lake from fluctuating lake levels, loss of wetland habitat, and alterations to riparian vegetation due to changes in the natural flooding regime. Areas that are disturbed through construction or through altered lake levels will be susceptible to invasive species establishment and spread. These impacts will last the duration of the life of the dam. Implementation of BMPs will mitigate some of these effects.

Foreseeable effects on terrestrial ecosystems resulting from the Sterling Highway Reroute Project include long term direct and indirect effects on vegetation. Long term direct adverse effects include the loss of habitat and habitat connectivity due to the increased footprint of the road corridor and the increased potential for establishment and spread of invasive plant species.

Foreseeable effects on terrestrial ecosystems from the Seward highway improvements project include long term direct adverse and beneficial effects. Long term direct adverse effects include loss of habitat connectivity due increased footprint of the road corridor and the increased potential for establishment and spread of invasive plant species due to road and trail construction and expansion. Beneficial effects include increased early seral habitat for moose and increased access to fuelwood for public consumption.

Foreseeable effects on terrestrial ecosystems from future developments on CAC lands are also possible; however, it is difficult to quantify the magnitude and duration of these effects due to the unknown nature of the developments. However, it is anticipated that some of these developments may include construction of access roads and trails to inholdings; mineral extraction, including extraction from subsurface estate lands owned by CAC; and timber harvest. Each of these activities has the potential to impact terrestrial ecosystems and increase the risk of invasive plant infestations.

Given projections for shifts in terrestrial ecosystems due to climate change, it is likely that terrestrial habitats will not remain static on the landscape. Habitat models predict that alpine tundra, particularly on the Kenai Peninsula, will decrease in area as trees and shrubs encroach into higher elevation tundra. However, the Chugach National Forest is bounded by several landownerships sharing management goals for conservation and sustainability, which will provide an additional buffer to biome shifts linked to climate change. Adjacent ownerships with management goals promoting conservation include Chugach State Park, Kenai National Wildlife Refuge, Kenai Fiords National Park, and Wrangell-Saint Elias National Park. The presence of these protected areas provides further assurance of ecosystem connectivity across the broader region.

Analytical Conclusions

Changes resulting from ongoing directional climate change (glacial recession and upward migration of the treeline and shrubline) and successional changes on uplifted lands in the Copper River Delta will have a greater effect on terrestrial ecosystems than implementation of any of the proposed alternatives. Increasing human uses, especially recreation, will continue to facilitate the transport and establishment of invasive species. This trend would be offset slightly by the implementation of alternatives C or D, both of which propose a reduction in area of year-round motorized recreation classes and an increase in area in primitive classes. If wilderness is designated, lands would be withdrawn from mineral entry, which would reduce the potential for disturbance that could result in habitat loss and establishment of invasive species on those lands. Consequences of the alternatives to terrestrial ecosystems are summarized in table 94.

Table 94. Summary of consequences to terrestrial ecosystems by alternative

Measurement Indicator	Alternative A No Action	Alternative B	Alternative C	Alternative D
Terrestrial invasive species occurrences	Increase in transport of invasive species. Ongoing treatment	Increase in transport of invasive species. Ongoing treatment	Decrease in transport of invasive species. Less opportunity for establishment. Ongoing treatment	Decrease in transport of invasive species. Less of opportunity for establishment. Ongoing treatment
Vegetation type (acres)	No change	No change	No change	No change
Rare or uncommon ecosystems	No change	No change	No change	No change
Percent of wilderness study area recommended for wilderness designation	No change	Assuming wilderness designation, increased habitat protection within wilderness study area, and reduced area available for mineral entry	Assuming wilderness designation, increased habitat protection within wilderness study area, and reduced area available for mineral entry (more than B less than C	Assuming wilderness designation, increased habitat protection within wilderness study area, and reduced area available for mineral entry (most area recommended for wilderness)
Percent area in each recreation opportunity spectrum class	No change			

Rare Plants

The Forest Service Manual (FSM 2670) established policy directing the regional forester to designate as sensitive species plants or animals whose population viability is a concern and to give special attention to management of these species. Plan components addressing sensitive species were an important part of the 2002 forest plan. The 2012 Planning Rule also identifies at-risk species for particular conservation attention, but established species of conservation concern as the method for addressing plants or animals for which population viability is a concern. A species of conservation concern is “known to occur in the plan area and for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species’ capability to persist over the long-term in the plan area” (36 CFR 219.9 (c)). Species of conservation concern will assume the conservation planning role formerly held by sensitive species. Because the formal transition from the sensitive species approach to the species of conservation concern approach will occur only when the record of decision is signed, this DEIS will evaluate and disclose outcomes for sensitive plants (Goldstein et al. 2009) known to occur on the Chugach National Forest, but plan components have not been added for any SS.

Species of Conservation Concern

Aleutian Cress (*Aphragmus eschscholtzianus*)

The regional forester identified Aleutian cress (also known as Eschscholtz's little nightmare) as a species of conservation concern during this plan revision. The process employed to identify species of conservation concern for the Chugach National Forest is described in the Process Record for Species of Conservation Concern Evaluation (available in the planning record). Ecological conditions and habitat that support the Aleutian cress, population status and trend, and current threats and stressors are summarized (USDA 2014a).

Aleutian cress is distributed broadly in Alaska from the Aleutians westward to the southern Yukon and into British Columbia. There are 57 known populations scattered over a large geographic area. Its conservation status rank is G3S4, which indicates rare or uncommon globally and apparently secure but uncommon within the state; may be a long-term conservation concern (UAA 2017). Only one population is known from the Chugach National Forest. This population, located in the upper end of Palmer Creek Valley on the Seward Ranger District, was first collected in 1951 and was relocated by Forest Service botanists in 2011.

Habitat for this plant includes moist to wet sites in alpine tundra, solifluction slopes, mossy seeps, seepage areas among rocks, and snow melt areas (UAF 2008; Rollins 1993). It is also known to occur on calcareous or non-acidic substrates (see table 95). The alpine habitat where this plant occurs is fragile and slow to recover following physical disturbance.

The known location of the Aleutian cress population in the Palmer Creek Valley is in an area where historic mining activities occurred, and also near popular hiking destinations and communications sites. Habitat is not currently limiting, however, the projected reduction in suitable habitat due to climate change combined with increased recreational impacts pose a threat to the persistence of this species in the plan area.

Regional Forester's Sensitive Species

The biological evaluation (Boucher and Christensen 2018) reviewed the current conservation status rank, population ecology, habitat, and threats of sensitive plants known or suspected within the plan area including sessileleaf scurvygrass (*Cochlearia sessilifolia*), pale poppy (*Papaver alboroseum*), Unalaska mist-maid (*Romanzoffia unalaschcensis*), spatulate moonwort (*Botrychium spathulatum*), moosewort fern (*Botrychium tunux*), moonwort fern (*Botrychium yaaxudakeit*), spotted lady's slipper (*Cypripedium guttatum*) mountain lady's slipper (*Cypripedium montanum*), large yellow lady's slipper (*Cypripedium parviflorum* var. *pubescens*), Calder's lovage (*Ligusticum calderi*), Alaska rein orchid (*Piperia unalascensis*), dune tansy (*Tanacetum bipinnatum* subsp. *huronense*), and a lichen (*Ricasolia amplissima* subsp. *sheiyi* formerly, known as *Lobaria amplissima)*.

Species known to occur within the plan area were examined in the forest plan assessment (USDA 2014a), and long-term trends for three of these species were evaluated in the climate change assessment (Hayward et al. 2017). Conservation status for those species documented in the plan area is described below, including ecological conditions and habitat supporting each species along with population status and trend (USDA 2014a).

Table 95. Habitat characteristics and conservation status rank for plants on the regional forester's sensitive species list (and the species of conservation concern Aleutian cress) known to occur within the plan area

Common Name (Scientific Name)	Rank	Coastal Systems	Alpine	Riparian	Forest	Other
Aleutian cress* (*Aphragmus eschscholtzianus*)	G3S4		Moist to wet sites			Calcareous or non-acidic substrates
Sessileleaf scurvygrass (*Cochlearia sessilifolia*)	G1G2Q S2Q	Intertidal, estuarine				
Unalaska mist-maid (*Romanzoffia unalaschcensis*)	G3S3S4	Gravelly, wet-moist beach		Rocky riparian		
Spotted lady's slipper (*Cypripedium guttatum*)	G5S4				Woods	Shrub/forb, meadow
Pale poppy (*Papaver alboroseum*)	G3G4S4		Scree slopes			Gravelly, dry, disturbed

*species of conservation concern

Sessileleaf scurvygrass is known from 21 locations in southcentral Alaska from Kodiak Island to Prince William Sound (CPNWH 2017). This narrow endemic is considered critically imperiled to imperiled globally; however, questions persist about the taxonomy of this species, and some authors consider it a variety of the more common *Cochlearia groenlandica*. The plant grows in low energy estuarine sites in the intertidal zone and on gravel bars or spits inundated at high tide. Proposed management activities under the forest plan should not affect the availability of suitable habitat, impair the ecological features on which this species depends, or compound the major threats to this species. Habitat for this species is largely within the intertidal zone, which is outside the jurisdiction of the Forest Service.

Unalaska mist-maid is known from 46 locations in North America, all of which are in Alaska (CPNWH 2017). Its range extends from the eastern Aleutian Islands across the south coast to southeastern Alaska. It is known from nine locations within the Chugach National Forest. Suitable habitat and ecological conditions to support the Unalaska mist-maid do not appear to be limiting within the plan area. Two occurrences of the species, both in Columbia Bay, are in the vicinity of approved special use permits for camping and hiking (Mohatt 2016), but additional threats to the species persistence have not been identified within the plan area.

Spotted lady's slipper is known from at least 102 locations across Alaska and northern Canada (CPNWH 2017) and is widespread in temperate and boreal eastern Europe and Asia. Habitat for this species includes open shrubby areas, open spruce forest, and mixed forb meadows. A single population of less than 10 plants was known from the Chugach National Forest from the Portage Valley about 2.4 kilometers west of the outlet of Portage Lake. The population occurred at the edge of a small pond in a meadow area adjacent to shrublands. The population was destroyed when a gravel pit was created, and the plant has not been found again within the Chugach National Forest. Within the plan area, the ecological conditions needed to support the plant appear to be largely intact.

Pale poppy is known from at least 48 locations across southcentral Alaska and British Columbia (CPNWH 2017). It is distributed from the Kamchatka Peninsula in Russia, across the Aleutian Islands to southcentral Alaska, east to the Juneau Icefields, and occurs disjunctly in north-central British Columbia. While it is an uncommon plant across its range, it is relatively abundant in Portage Valley within the Kenai Peninsula Geographic Area. Habitat for this species includes open, well-drained habitat, and an occasional disturbance either creates or maintains this habitat. The plant has been documented from disturbed sites, including glacial moraines, alpine scree slopes, road sides, railroad track beds, and old gravel pits. Proposed management activities under the forest plan should not affect the availability of suitable habitat, impair the ecological features on which this species depends, or compound the major threats to this species.

Environmental Consequences

Effects Common to All Alternatives

Sensitive plant surveys have not been conducted across all landscapes on the Chugach National Forest, therefore the understanding of sensitive plant distributions in the planning area is limited because most botanical surveys were focused on specific project areas.

The land management plan provides a programmatic framework that guides site-specific actions but does not authorize, fund, or carryout any project or activity, therefore all effects are considered indirect. However, there may be implications, or longer term environmental consequences, of managing the Chugach National Forest under this programmatic framework.

The amount of ground disturbing activity that would be conducted within the national forest is not expected to vary by alternative. Ground disturbing activities can alter vegetation and soil structure, increase habitat fragmentation, facilitate introduction of invasive plants, and can increase competition from other native plants by altering canopy structure. Indirect effects to sensitive plants common to all alternatives include short term habitat damage or degradation caused by hazardous fuel reduction, vegetation treatment for wildlife habitat enhancement, personal use timber and fuelwood, and commercial timber harvest. Long-term effects include habitat damage or loss associated with road construction and infrastructure development. Road construction facilitates increase access, which can increase the potential for invasive species introductions and increase damage from trampling.

The ground disturbing activities listed can affect many types of habitat, but in general, lower elevations and forested environments are affected to a greater extent than alpine habitats. Sensitive plant habitat most likely to be impacted by these activities includes wetlands, riparian areas, and forests. Where ground disturbing activities take place, forestwide standards and guidelines as well as BMPs are in place to protect against or mitigate impacts to wetlands and riparian zones, and to minimize the spread of invasive species.

Effects to Plant Species of Conservation Concern

Aleutian Cress (Aphragmus eschscholtzianus)

Availability of Suitable Habitat

As described previously, this species grows in moist mossy areas, seeps, heaths, and scree slopes in subalpine and alpine locations. Within the planning area, suitable habitat and ecological conditions to support the Aleutian cress are not limiting at present, particularly within the Kenai Peninsula Geographic Area, which currently contains most of alpine dwarf shrub tundra habitat within the national forest.

Threats to Abundance, Distribution, or Persistence

This plant is known from one location in the upper end of Palmer Creek Valley on the Seward Ranger District. The habitat where the known location occurs is in an area of historic mining activity in the Palmer Creek Valley, and also near popular hiking destinations and communications sites. Habitat is not currently limiting; however, the projected reduction in suitable habitat due to climate change combined with increased recreational impacts pose a threat to the persistence of this species in the plan area.

Because there is only one known occurrence of this species in the plan area, coupled with the potential for some level of impact to alpine habitat expected to contain this species, a moderate risk of adverse effects to this species exists under all alternatives.

Indirect Effects

Across alternatives, changes to recreation opportunity spectrum classes could affect future recreational uses in alpine areas, including Palmer Creek Valley, the location of the known population of this species. In all alternatives, the area adjacent to the Palmer Creek Road is considered roaded natural, but in in alternative A, the adjacent areas are considered semi-primitive motorized. In alternatives B, C, and D this area was changed to semi-primitive non-motorized (winter motorized allowed) to incorporate the Kenai Winter Access Project. The reduction in area designated as motorized between the no-action and action alternatives could potentially reduce the amount of motorized use; however, it is important to note that this change affects only summer helicopter access, as there are no designated OHV routes in the area.

In alternatives C and D, the amount of area in the primitive recreation class within the Kenai Peninsula Geographic Area increases to 7 percent from 1 percent in alternatives A and B. This increase in the primitive recreation class could influence future decisions authorizing special use permits for recreational guiding and the density of developed recreation sites in alpine areas. Areas with higher levels of human use are more susceptible to invasive species establishment, which could degrade habitat for native plant species.

Because this plant has been identified as a species of conservation concern, plan components have been developed to avoid adverse effects of management actions. Plan components require field surveys for the plant before site-specific ground disturbing activities and protection of identified populations. Additionally, the revised plan contains plan components designed to prevent the spread of invasive species and promote ecosystem integrity. Responding to declines in Aleutian cress from environmental changes resulting from climate change is beyond the authority of the Forest Service.

Cumulative Effects

Potential impacts to sensitive plant habitat cannot be completely avoided since most proposed actions include some ground disturbing activities. Past vegetation management activities have been concentrated within certain areas, particularly along road corridors, and these are the areas where most activities under any alternative would continue. Because most of the habitat for this plant occurs in alpine habitats, vegetation management activities are not expected to adversely impact this species. However, the habitat for this plant is relatively fragile and vulnerable to modification; in addition, alpine tundra is slow in recovering from disturbance. The known populations are located in an area of historic mining activity in the Palmer Creek Valley and also near popular hiking destinations and communications sites.

Climate change is expected to adversely impact habitat for this species. Within the plan area, the sensitive plant habitat most likely to be impacted by climate change is alpine tundra. The recently completed climate change assessment (Hayward et al. 2017) estimated that the area within a suitable climate envelope for alpine tundra will decline by 87 percent by 2060 and that alpine tundra will be replaced at the ecotone by trees and tall shrubs. Niche modeling for this species suggested that climate change may lead to drying of habitat that could extirpate the plant from the Chugach National Forest (Carlson and Cortes-Burns 2012; USDA 2014a).

The increasing demand for outdoor recreational opportunities is likely to be most pronounced within the Kenai Peninsula Geographic Area because of the road system and the concentration of trails and developed recreation sites. The increase in recreational use could degrade alpine tundra and increase the potential for invasive plant introduction and spread.

Determination of Effect and Rationale

Within the plan area, suitable habitat and ecological conditions to support the Aleutian cress do not appear to be limiting at present; however, the projected reduction in suitable habitat due to climate change combined with increased recreational impacts, could adversely impact habitat for this species.

Because there is only one known occurrence of this species in the plan area, coupled with the potential for some level of impact to alpine habitat known to contain this species, a moderate risk of adverse effects to this species exists under all alternatives. The risk of adverse impacts is slightly less in alternatives C and D than in alternatives A and B.

Implementation of the forest plan may adversely impact individuals but is not likely to result in a loss of viability in the plan area, nor cause a trend toward Federal listing.

Effects to Plants on the Regional Forester's Sensitive Species List Known to occur within the National Forest

Sessileleaf Scurvygrass (*Cochlearia sessilifolia*)

Availability of Suitable Habitat

As described previously, sessileleaf scurvygrass grows in low energy estuarine sites in the intertidal zone and on gravel bars or spits; habitat is typically inundated at high tide. Within the plan area, suitable habitat and ecological conditions to support this plant do not appear to be limiting.

Threats to Abundance, Distribution, or Persistence

Sessileleaf scurvygrass is a narrow endemic of south coastal Alaska. The habitat is vulnerable to the effects of uplift or subsidence resulting from tectonic events and from the effects of tidal waves. Sessileleaf scurvygrass is rare throughout its range and current abundance is low enough that stochastic events could lead to imperilment. Habitat may also be impacted by modern stressors, such as pollution, construction at shoreline, and recreation; this is especially true of the populations reported from Valdez Arm. Populations in high use recreation areas are vulnerable to dragging boats across beaches and other ground disturbance in the scurvygrass habitat. While this plant is extremely rare, its habitat occurs below mean high tide, and is therefore outside of the regulatory control of the Forest Service.

Indirect Effects

Within the plan area, the ecological conditions needed to support this plant appear to be largely intact. The extensive, undeveloped coastline provides abundant undisturbed habitat adjacent to the intertidal habitat that supports this plant.

Although the habitat for this species is below mean high tide, changes in recreation opportunity spectrum classes could affect the amount and intensity of recreational use in coastal areas, particularly in Prince William Sound. The proposed management under all alternatives may result in disturbance to some individual populations; however, none of the alternatives of the forest plan should affect the availability or distribution of suitable habitat.

Cumulative Effects

Because this plant's habitat is below mean high tide, management activities are not expected to impact the viability of this species within the planning area. Increasing recreational use could adversely impact individuals, particularly in high use areas. Additionally, pollution or stochastic events, such as tsunamis or tectonic shifts, could also adversely impact populations.

Determination of Effect and Rationale

Proposed management activities under the forest plan should not affect the availability of suitable habitat, impair the ecological features on which this species depends, or compound the major threats to this species. Implementation of the forest plan may adversely impact individuals, but is not likely to result in a loss of viability in the plan area, nor cause a trend toward Federal listing.

Unalaska Mist-maid (*Romanzoffia unalaschcensis*)

Availability of Suitable Habitat

As described previously, the Unalaska mist-maid grows on ledges and crevices within rock outcrops, in gravelly areas along stream banks, and gravel or cobble beach areas along the coast. The extensive, undeveloped coastline and abundance of undisturbed streambanks provides ample, relatively undisturbed habitat, the majority of which is managed to maintain natural processes and conserve fish and wildlife. Within the plan area, the ecological conditions needed to support Unalaska mist-maid appear to be largely intact.

Threats to Abundance, Distribution, or Persistence

Populations in areas with high recreation use, such as Columbia Bay, are vulnerable to human disturbance from trampling and the threat of invasive species establishment, which could displace native plants over time.

Indirect Effects

Recreation opportunity spectrum settings and wilderness area recommendations differ by alternative, which could influence future decisions authorizing special use permits for recreational guiding and the density of developed recreation sites along the coast. Areas with higher levels of human use are more susceptible to invasive species establishment, which could degrade habitat for native plant species. Within the Prince William Sound and Copper River Delta geographic areas, alternatives A and B provide similar recreation opportunity spectrum classes and recommended wilderness area, alternative C recommends a greater percentage of the wilderness study area for wilderness area designation and more area in the primitive recreation class, and alternative D recommends nearly all of the wilderness study area as a wilderness area and provides the most area in the primitive class. Therefore, fewer adverse impacts from plan activities or permitted uses would occur under alternatives C or D than under alternatives A or B.

The forest plan contains plan components designed to prevent the spread of invasive species, reduce adverse impacts to riparian zones, and promote the persistence of natural ecosystem processes.

Cumulative Effects

Potential impacts to sensitive plant habitat cannot be completely avoided since most proposed actions include some ground-disturbing activities. Past management activities have been concentrated within certain areas, particularly along road corridors, and these are the areas where most activities under any alternative would continue. Because most of the habitat for this plant occurs in areas managed for the conservation of fish and wildlife habitat and ecological processes, including backcountry, ANILCA 501 (b), and the wilderness study area, management activities are not expected to impact the viability of this species within the plan area.

Climate change is not suspected to result in adverse impacts to this species. In locations with tidewater glaciers, such as Columbia Bay, the area of suitable habitat may be increasing owing to glacial recession. However, many of these same areas are popular visitor destinations, and exposed terrain combined with human impacts creates a risk for establishment and spread of invasive species, which could displace native species, such as the Unalaska mist-maid.

Determination of Effect and Rationale

Suitable habitat and ecological conditions to support the Unalaska mist-maid do not appear to be limiting within the Chugach National Forest.

Because of the low number of known occurrences of this species in the plan area coupled with the potential for some level of impact to coastal habitat known to contain this species, a moderate risk of adverse effects to this species exists under all alternatives. The risk of adverse impacts is slightly less in alternatives C and D than in alternatives A and B.

Implementation of the forest plan may adversely impact individuals but is not likely to result in a loss of viability in the plan area, nor cause a trend toward Federal listing

Spotted Lady’s Slipper Orchid (*Cypripedium guttatum*)

Availability of Suitable Habitat

As described previously, spotted lady’s slipper is known from at least 102 locations across Alaska and northern Canada. Habitat for this species includes open shrubby areas, open spruce forest, and mixed forb meadows. Within the plan area, the ecological conditions needed to support the plant appear to be largely intact.

Threats to Abundance, Distribution, or Persistence

The only known population of spotted lady’s slipper within the plan area was destroyed when a gravel pit was created, and the plant has not been found since within the boundary of the Chugach National Forest.

Indirect Effects

Recreation opportunity spectrum classes and wilderness area recommendations differ by alternative, which could influence future decisions authorizing special use permits for recreational guiding and the density of developed recreation sites. Areas with higher levels of human use are more susceptible to invasive species establishment, which could degrade habitat for native plant species, such as the mountain lady’s slipper. Alternatives A and B provide similar recreation opportunity spectrum classes and recommended wilderness area, alternative C recommends a greater percentage of the wilderness study area for wilderness designation and more area in the primitive recreation class, and alternative D recommends nearly all of the wilderness study area as wilderness and provides the most area in the Primitive recreation class. Therefore, fewer adverse impacts from plan activities or permitted uses would occur under alternatives C or D than under alternatives A or B.

Cumulative Effects

Potential impacts to sensitive plant habitat cannot be completely avoided since most proposed actions include some ground disturbing activities. Past management activities have been concentrated within certain areas, particularly along road corridors, and these are the areas where most activities under any alternative would occur. Construction projects and the creation of gravel pits and associated roads could negatively impact this species. Populations are also vulnerable to flower pickers, plant collectors, and people who dig wild plants for transplanting; this is especially true in areas near the road system. Because most of the habitat for this plant occurs in areas managed for the conservation of fish and wildlife habitat and ecological processes, including backcountry, ANILCA 501 (b), and wilderness study area, management activities are not expected to impact the viability of this species within the plan area.

Climate change is not expected to result in adverse impacts to this species, but future increases in recreational uses could increase the potential for the establishment and spread of invasive species, resulting in habitat degradation.

Determination of Effect and Rationale

Suitable habitat and ecological conditions to support spotted lady's slipper do not appear to be limiting within the Chugach National Forest, and furthermore, this species is not considered rare by the Alaska Native Heritage Program (AKNHP) (UAA 2017) or NatureServe (NatureServe 2017).

Implementation of the forest plan may adversely impact individuals but is not likely to result in a loss of viability in the plan area, nor cause a trend toward Federal listing.

Pale Poppy (*Papaver alboroseum*)

Availability of Suitable Habitat

As described previously, this plant is known from multiple locations within the plan area and is locally abundant in the Portage Valley. The poppy requires open, well-drained habitat, and occasional disturbance either creates or maintains this habitat. Within the plan area, the ecological conditions needed to support the plant appear to be largely intact.

Threats to Abundance, Distribution, or Persistence

While disturbance may help maintain suitable open habitat, repeated human disturbance, as in the Portage Valley, may affect the plant's ability to reproduce. Along the road system, invasions of exotic plants are flourishing in some areas of pale poppy habitat. In the absence of disturbance, natural succession eventually shades out the poppies. Populations are vulnerable to flower pickers and plant collectors; this is especially true in the Portage Valley area, which is on the Anchorage road system. Proposed management activities under the forest plan should not affect the availability of suitable habitat, impair the ecological features on which this species depends, or compound the major threats to this species.

Indirect Effects

The forest plan contains plan components designed to prevent the spread of invasive species and promote the persistence of natural ecosystem processes.

ROS classes and wilderness area recommendations differ by alternative, but these differences would not affect the availability of suitable habitat for the pale poppy, and therefore there are no indirect effects across all alternatives.

Cumulative Effects

Because there are no direct or indirect effects, there can be no cumulative effects.

Determination of Effect and Rationale

Proposed management activities under the forest plan should not affect the availability of suitable habitat, impair the ecological features on which this species depends, or compound the major threats to this species. Implementation of the forest plan will have no impact on the pale poppy.

Terrestrial Wildlife and Habitats

Introduction

This section evaluates and discloses the potential environmental consequences to terrestrial animal species or marine species dependent on terrestrial habitats (often referred to as wildlife in this section) that may result from the adoption of a revised land management plan for the Chugach National Forest. The first section describes the ecological systems supporting wildlife species, including a review of the environmental history and dynamics of those systems with an emphasis on evaluating the ecological integrity and sustainability. The second section examines the current status and characteristics of several important wildlife groups: at-risk species; Regional Forester's Sensitive Species; those species particularly important for their role in ecosystem services or multiple resource use; and migratory birds that have regional, national, and often international significance. The potential environmental effects of forest plan alternatives on these species are examined in the third section.

This section of the DEIS references and builds upon the understanding of the Chugach National Forest and effects of the 2002 forest plan that were thoroughly examined in the FEIS (USDA 2002a) and the forest plan assessment (USDA 2014a); the understanding from those documents are included by reference.

Methodology

This analysis is focused on identifying and evaluating differences between alternatives that have the potential to alter the availability of suitable habitat or other factors sufficient to broadly affect the abundance, distribution, or persistence of wildlife species inhabiting the Chugach National Forest. Effects that are minor, site specific, and not expected to influence abundance, distribution, or persistence of species across the national forest will not be discussed in this analysis but will be evaluated during subsequent project specific NEPA analyses. Because a land management plan does not authorize or mandate any site-specific projects or activities (including ground disturbing actions), there can be no direct effects.

Management direction, including standards and guidelines, affecting many wildlife species have been carried forward from the 2002 forest plan and are consistent across all four alternatives. Table 10 identifies a wide range of ongoing activities and uses that are expected to continue at similar levels under any of the four alternatives. Since the management direction and expected uses are consistent, the effects to most wildlife species, addressed in the FEIS for the 2002 forest plan, remain consistent and are not duplicated here. Focusing analysis on the effects of key differences between the alternatives helps managers and the public clearly understand any relevant consequences and trade-offs while minimizing information less relevant to the decision. Where the effects to wildlife vary by alternative or existing management direction continues to raise concerns for species habitat, abundance, distribution, or persistence, they are discussed in detail in the analysis below.

Spatial Scale

The lands within external boundary of Chugach National Forest serve as the primary analysis area for evaluating the indirect effects of the alternatives. This 6,255,652 acre analysis area encompasses the entirety of both Prince William Sound and the Copper River Delta, although marine waters and major rivers are excluded from the acreage calculations. It is bordered by other large conservation units (two national parks, one national wildlife refuge, and one state park), the Gulf of Alaska, and a large area of undeveloped glacier capped lands to the north. Although managed under a variety of frameworks, these lands make up an extensive landscape supporting predominantly natural, unroaded interconnected ecosystems with few human barriers to wildlife movement. Many wildlife populations move between conservation units, and certain threats can affect species using these interconnected habitats across vast areas regardless of ownership.

From an ecological standpoint, establishing a generalized analysis area to be used for a broad range of species can be somewhat arbitrary, and often the area to be affected by management becomes the appropriate area for analysis. To a large degree, the boundary of the Chugach National Forest follows distinct physical features (watershed divides, glacial ice sheets, or coastlines), some of which serve as habitat transition zones, while others may function as natural barriers for some species. This provides some ecological rationale for using the national forest boundary as limits of the analysis area. Combined with the extreme size of the management area, and the differing missions, management objectives of the numerous adjoining land owners, the Chugach National Forest boundary was selected as the primary analysis area for addressing the indirect effects of the forest plan alternatives.

Cumulative effects have been identified for only a few wildlife species, which follow very different life histories. Rather than establish a generalized analysis area that may be inappropriate, the analysis area for cumulative effects analysis is described in detail with the cumulative effects section.

Temporal Scale

The timeframe used to evaluate indirect effects is the 15-year plan period. Descriptions of human activities going well back into the 1800s are occasionally included as part of the discussion, but this information is used to set the ecological stage and provide a perspective on how these systems have changed through time in response to natural and human factors. In some cases references are made to climate change scenarios that address changes up to 50 years in the future, but these are not directly incorporated into the analyses of indirect effects.

Similar to indirect effects, the timeframe used for cumulative effects analyses is the 15-year plan period.

Measurement Indicators

Three measurement indicators have been used to analyze the effects of the proposed alternatives on terrestrial wildlife species:

- The current and long-term availability of suitable wildlife habitat within the national forest
- The effects of Forest Service management on specific threats to key species
- The amount of lands potentially open to motorized access

The details of each measurement indicator follow.

Availability of Suitable Habitat

As a means of evaluating the effects of management and displaying any differences between the alternatives, a number of factors were used in this analysis to classify the availability and suitability of key important habitat. These factors are described below and in table 96.

- Habitat abundance: relative abundance of specific habitats, and potential effects of proposed management
    - Descriptors: abundant, limited, rare
- Habitat condition: relative condition of specific habitats, and potential effects of proposed management
    - Descriptors: good, fair, poor
- Habitat distribution: descriptor of habitat distribution and potential effects of proposed management
    - Descriptors: forestwide, dispersed, patchy, localized, isolated
- Habitat connectivity: descriptor of habitat connectivity, and potential effects of proposed management
    - Descriptors: unrestricted, reduced (patchy, unevenly distributed habitats), restricted (limited corridors, widely separated), isolated (habitat islands surrounded by hostile matrix)
- Effects of proposed management: range of positive to negative effects are +3 major benefits, +2 moderate benefits, +1 minor benefits, 0 no measurable effects, -1 minor detriments, -2 moderate detriments, -3 major detriments

Table 96. Measures for availability of suitable habitat indicator

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments
Example	Abundant 0 no measurable effects	Good 0 no measurable effects	Forestwide 0 no measurable effects	Unrestricted 0 no measurable effects

Threats to Wildlife Abundance, Distribution, and Persistence

A number of factors were used in this analysis to classify threats to key wildlife species as a means of evaluating the effects of management and displaying any differences between the alternatives. These factors include the following and are described in table 97:

- Threat prospect: Relative likelihood a threat will affect abundance, distribution, or persistence
- Severity of consequences: Relative measure of the severity of the effects to the abundance, distribution, or persistence
- Scope of the threat: Relative spatial scale of the effects of the threat
- Immediacy of the threat: Time period over which the threat is likely to have measurable effects on species
- Primary management control: Agencies or organizations with the appropriate authority or capability to implement management actions likely to reduce or mitigate threats
- Forest Service potential to reduce or mitigate the threat: Type and relative contribution of Forest Service management to reduction or mitigation of the threat

Table 97. Threats to abundance, distribution, and persistence

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Disturbance	Low	Moderate	Localized	Zero-5 years	National Marine Fisheries Service	Direct/minor
	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (over 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-Forest Service actions) /major, limited, minor, none

Lands Open to Motorized Access

The only measure used in the analysis of lands open to motorized access is acres by recreation opportunity spectrum class (semi-primitive motorized, or semi-primitive non-motorized (winter motorized allowed)) of NFS lands that are currently open or potentially open to motorized access as the result of either existing travel management decisions or recreation opportunity spectrum classes identified in the alternatives.

One factor complicating this analysis is that the current travel management plan does not reflect the existing recreation opportunity spectrum classes in all locations. As a result, evaluating only the recreation opportunity spectrum classes leads to the conclusion that alternatives C and D would potentially make an additional 296,000 acres of NFS lands available for motorized access. However, combining current travel management plans with the recreation opportunity spectrum classes for each alternative to display the actual lands open or potentially open for motorized access presents a different picture. In reality, alternatives C and D would reduce the NFS lands potentially available for motorized access by over 124,000 acres, a total difference of nearly 420,000 acres between the two calculations. This difference in acreage is due to one travel management decision authorizing winter non-motorized use for large blocks of land northeast of Cordova.

Since wildlife species respond to the effects of actual human disturbance, this analysis will use acreage figures for the recreation opportunity spectrum classes updated to reflect the existing authorized winter non-motorized use near Cordova (see table 98). The acreage of recreation class semi-primitive non-motorized (winter motorized allowed) for alternatives A and B were calculated by adding an additional 419,657 acres, which are currently open by travel management decision to the recreation opportunity spectrum acreages displayed for alternatives A and B, which do not account for the existing travel management decisions.

Table 98. Lands potentially open to motorized access by alternative

Type of Motorized Access	Alternative A	Alternative B	Alternative C	Alternative D
Semi-primitive Non-motorized (Winter Motorized Allowed)	1,124,655	1,111,972	1,134,682	1,134,550
Semi-primitive Motorized	583,283	574,556	449,129	449,151
Total motorized access	1,707,938	1,686,528	1,583,811	1,583,701

Analysis Methods and Assumptions

The methods used for the effects analyses for terrestrial wildlife are relatively simple, but given the lack of detailed habitat and population data available for Alaskan wildlife and the limited scope of vegetation and ground disturbing activities being considered the use of complex modeling and analysis tools would be problematic, time consuming, and unlikely to provide much additional insight. Fortunately the relatively undisturbed ecological condition of most lands within and surrounding the Chugach National Forest support ecologically intact landscapes and nearly the full suite of native wildlife species. The forest plan assessment concluded that the ecological integrity of terrestrial systems remains high and capable of supporting most native wildlife populations well into the future (USDA 2014a). Therefore the analyses will focus on the factors known to affect key species for which there are conservation or management concerns.

Each of the alternatives proposed in the forest plan was analyzed to determine the effects of the proposed actions on key terrestrial wildlife species by evaluating the three indicators described in the preceding section:

- The amount of NFS lands potentially open to motorized access as determined through recreation opportunity spectrum classes and existing travel management decisions
- Availability of suitable habitat
- The effects of proposed management on specific threats to the abundance or distribution and persistence of key wildlife species

Availability of Suitable Habitat

Due to the vast landscapes, limited road access, and serious logistical challenges of field work in Alaska, detailed vegetation and habitat mapping has not been completed for most species or locations within the state. Most vegetation mapping has been conducted at a scale insufficiently detailed to provide more than a generalized vegetation classification, which does not provide the detail required to derive specific wildlife habitat suitability maps. The same logistical challenges limit the collection of detailed data on wildlife populations and distributions, so accurate estimates of current populations and distributions are unavailable for most species. These limitations make it impractical to use complex habitat modeling and analysis methods to evaluate the effects of broad scale forest planning alternatives. So this analysis will address habitat availability and suitability for key wildlife species and the potential effects proposed management would have on these habitats during the plan period.

This habitat analysis is based on the following assumptions:

- Wildlife habitat on the large majority of the national forest (wilderness study area and inventoried roadless lands, which are generally not subject to vegetation or ground disturbing activities) remains in suitable condition and can effectively support native wildlife species and communities at levels of abundance expected in unmanaged landscapes.
- Current habitat abundance and distribution across the landscape generally reflects landscape patterns present prior to European settlement.
- Natural ecological processes, such as fire, succession, flooding and windthrow, continue to operate across the national forest and surrounding lands at levels within the natural range of variation, influencing habitat availability, and wildlife abundance and distribution across the national forest.
- Habitat connectivity on most lands within the Chugach National Forest and adjacent Federal and State conservation units remains unimpaired, due to the predominantly unroaded character of the lands, supporting unhindered opportunities for animal movement.
- Changes in habitat abundance and distribution in response to ecological processes and long-term shifts in weather and climate patterns, along with the corresponding changes to species abundance and distribution, are expected and considered a component of the natural range of variation, rather than a departure from it.

The specific habitat factors being considered in this analysis include:

- Habitat abundance: relative abundance of specific habitats and potential effects of proposed management
- Habitat condition: relative condition of specific habitats and potential effects of proposed management
- Habitat distribution: relative descriptor of habitat distribution and potential effects of proposed management
- Habitat connectivity: relative descriptor of habitat connectivity and potential effects of proposed management
- Effects of proposed management: relative descriptor of potential effects ranging from moderately beneficial to moderately detrimental

The effects of each alternative on the availability of suitable wildlife habitat will be determined based on the extent to which the proposed management actions are likely to alter existing habitat conditions affecting dependent wildlife populations.

Threats to Wildlife Abundance, Distribution, and Persistence

As discussed in the habitat analysis section, the ecologically intact landscapes of the Chugach National Forest and surrounding lands support wildlife populations that are well distributed, and expected to persist indefinitely (USDA 2014a). However, certain wildlife species and groups are subject to specific threats, which have the potential to affect their abundance, distribution or persistence at the local, regional, or even range-wide scale.

Threats to wildlife species can arise from a wide variety of factors, some clearly the result of specific localized human actions, while in other cases multiple environmental factors may interact in complex and obscure ways to affect a species or group. Certain types of threats, such as human disturbance or reduced marine productivity, may affect a broad range of wildlife, while other threats may be specific to a single species or a particular location.

The ability of the Forest Service to implement actions that will effectively reduce or mitigate specific threats is a key factor considered in the threats analysis process. Often one or more of the key threats to a species may be outside Forest Service's authority or capability to address. While they have been included in the individual species tables and discussions to provide a more complete picture of the full range of conservation challenges, threats outside Forest Service management authority or capability are excluded from alternative comparisons.

The analysis of threats to wildlife is based on the following assumptions:

- During periods spent in other locations, migratory wildlife species may be subject to a variety of threats that may have a substantial influence on species populations, potentially altering the abundance, distribution, and persistence of wildlife species within the Chugach National Forest.
- Hunting and subsistence harvest activities, which are managed by the State and the FSB respectively, can have a substantial influence on the abundance, distribution, and persistence of wildlife species using NFS lands.
- The threats identified for individual species or groups are not intended to serve as an exhaustive list, but generally represent a compilation of the more significant threats facing species or groups relying on habitats within the Chugach National Forest.
- The underlying cause(s) for some wildlife threats may be poorly understood or unknown, and consequently there may be no clear methods or strategy for reducing or mitigating the threat.

The factors used in this analysis to stratify wildlife threats and help establish conservation management priorities include:

- Threat Prospect: relative likelihood a threat will affect abundance, distribution, or persistence
- Severity of consequences: relative measure of the severity of the effects to the abundance, distribution, or persistence
- Scope of the threat: relative spatial scale of the effects of the threat
- Immediacy of the threat: time period over which the threat is likely to have measurable effects on species
- Primary management control: agencies or organizations with the appropriate authority or capability to implement management actions likely to reduce or mitigate threats
- Forest Service potential to reduce or mitigate the threat: type and relative contribution of Forest Service management to reduction or mitigation of the threat

Lands Open to Motorized Access

From the perspective of wildlife species and habitats, the primary difference between the four alternatives is the amount and distribution of lands open, or potentially open, to motorized access. The recreation opportunity spectrum and existing travel management decisions must be integrated to accurately understand and display the differences in these alternatives; this integration was described in the preceding section on this indicator.

The analysis of lands open to motorized access is based on the following assumptions:

- Lands currently open to motorized access under existing travel management decisions will remain open under the revised forest plan, unless or until modified through new travel management decisions.
- Future travel management decisions will tier from the recreation opportunity spectrum classes established by the revised forest plan.
- The lands currently open for winter motorized access northeast of Cordova are accurately represented by the polygons identified in the recreation opportunity spectrum classes for alternatives C and D as semi-primitive non-motorized (winter motorized allowed) in the same area.
- Not all lands identified in the recreation opportunity spectrum classes as potentially suitable for motorized access will necessarily be designated by subsequent travel management decisions as open to motorized use.

The specific factors being considered in this analysis include:

- Acres of NFS lands open or potentially open for motorized or winter motorized access.

Affected Environment

The following summarizes the affected environment:

- The Chugach National Forest is dominated by intact ecological systems with high integrity and significant capacity for resilience supporting an array of wildlife species regarded as similar to that that occurred prior to the designation of the national forest.
- Significant environmental change (major earthquakes, development of shrubland and forest as glaciers retreat, ecological disturbance from forest insects), particularly directional change associated with snow and ice, have resulted in changing ecological conditions and therefore changing wildlife populations in the region regardless of human activities. Wildlife habitat and wildlife populations in the region are not static.
- During the late 1800s thru the mid-1900s, human use of resources within the plan area and neighboring marine environment led to significant changes in ecosystems and wildlife. Mining, timber harvest, hunting and trapping, fox farming, and fishing were extensive. Direct human impacts on ecosystems and wildlife of the Chugach National Forest are less extensive and generally less intense than in the late 1800s and the 1900s.
- Because 99 percent of Chugach National Forest watersheds are in Class 1 (good, functioning properly), they are considered to have high integrity and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities. Consequently the wetland, riparian, and stream ecosystems of the plan area support the range of wildlife expected for this region.

- Key ecosystem characteristics of terrestrial vegetation are functioning in a way that continues to contribute strongly to ecosystem integrity and sustainability within the plan area and is within expectations for the natural range of variation. Therefore terrestrial ecosystems within the plan area support the range of wildlife expected for this region.

Introduction: Dynamic Ecosystems and Changing Wildlife Populations

The Chugach National Forest occurs in a region where two climate regimes (Cook Inlet and southcentral Alaska regions) meet, at the intersection of several terrestrial biomes, and at the interface between land and sea (USDA 2014a; Shulski and Wendler 2007; Wiens 2013). Consequently the national forest supports a broad array of wildlife (e.g., mammals, birds, amphibians, and invertebrates). Throughout this document animal and wildlife are used interchangeably and refer to terrestrial organisms from the animal kingdom. Because little is known regarding many non-vertebrates, emphasis is on vertebrates. Several characteristics of the Chugach National Forest that are uncommon to other national forests contribute to this diversity, including:

- The presence of ice from tidewater glaciers in near-shore waters supporting marine mammals (O'Neel et al. 2015)
- 4,800 kilometers of shoreline in Prince William Sound along with shoreline exposed to the Gulf of Alaska providing diverse habitats at the land/sea interface (Wiens 2013)
- Shoreline that varies from the steep slopes to large bedrock and cobble beaches in western Prince William Sound to lower profile topography and extensive intertidal areas in eastern Prince William Sound (Wiens 2013), including key coastal wetlands, intertidal mudflats, and barrier island habitats
- A wide range of stream types supporting all five Pacific salmon and a vast array of aquatic life, which in turn support terrestrial wildlife
- Variation in nearshore waters conditions (e.g., salinity, temperature, and current) providing diverse shoreline conditions
- A rich history of human use over the past 4,000 years (Wiens 2013)
- Variation in the influence of terrestrial disturbances, such as deglaciation, fire, flood, ice damage, earthquakes, and windstorms, leading to dynamic terrestrial habitat conditions

As outlined in the forest plan assessment (USDA 2014a) and based on information from the Alaska Natural Heritage Program, the Chugach National Forest supports an estimated 50 mammal species, 178 bird species, and two amphibian species. The high level of terrestrial ecological integrity and capacity for resilience (USDA 2014a), along with the low number of designated endangered or threatened animals, and low number of species of conservation concern suggest the ecological systems supporting wildlife populations within the plan area remain intact. The species diversity and distribution of wildlife is thought to be similar to what occurred prior to the designation of the national forest (which was also the case when the forest plan was revised 15 years ago (USDA 2002a; USDA 2014a)). In this introduction background is provided on the environmental history of the region emphasizing the role of natural and human-caused ecological disturbances in the current status and trend of ecological systems and habitats used by wildlife. Following this introduction, the current status and past trends in wildlife and the ecosystems supporting terrestrial animals is examined.

The ecological systems and therefore wildlife associated with the Chugach National Forest occur in a region of dynamic directional ecological change and significant natural disturbance (USDA 2014a; Hayward et al. 2017). The region has been transitioning from almost complete ice cover 18,000 years ago to the present condition where an estimated 35 percent of the national forest supports icefields and glaciers and 21 percent of watersheds have over 50 percent ice cover (USDA 2014a).

Concurrent with the directional change in ice cover, associated processes of plant establishment, colonization by wildlife, and changes in biomes have occurred at variable rates due to significant shifts in global climate at the temporal scale of centuries to millennia. Forests were uncommon in the region just 1,000 years ago and even during the last 300 years, glacier cover has both increased and decreased demonstrating the dynamic nature of broad scale disturbance and landscape change (Hayward et al. 2017).

Hence, as will be emphasized further in the next few paragraphs, ecosystems within the Chugach National Forest are dynamic, and their status, including their capacity to support particular wildlife, should be evaluated through that lens of long term directional and non-directional change driven by natural processes (USDA 2014a; Hayward et al. 2017).

Natural disturbances in conjunction with human activities in the recent and distant past led to the current condition of ecosystems and wildlife within the plan area. Episodic mega-earthquakes have occurred in the region every 400 to 1,300 years, resulting in subsidence and uplift of 10 meters or more. As a consequence, cyclic patterns of vegetation disturbance and succession occur along coastal areas and can reach miles inland from current high tide in low gradient areas (Plafker et al. 1992). During a five-minute period, the 9.2 magnitude earthquake on March 24, 1964, resulted in changes in shoreline ranging from negative six feet to 30-plus feet (Wiens 2013) leaving intertidal organisms well above shoreline in western Prince William Sound and inundating coastal wetlands in areas of the eastern Chugach National Forest killing trees and changing wetland conditions over vast areas.

In contrast to seismic events, retreat of glaciers from their maximum extent has led to strong directional (rather than cyclic) changes in geomorphology, hydrology, and ecology. During the current period of rapid warming (Fresco and Floyd 2017) the region has experienced a westward shift in ocean isotherms concurrent with increased coastal freshwater input in the northern Gulf of Alaska (Royer and Grosch 2006 in Wiens 2013) leading to shifts in species distributions, community composition, and food chains. In addition to the directional warming trend resulting in retreat of glaciers, less snow cover at low elevations, and reductions in icefields, the region also experiences periodic climate regime shifts (cycles rather than directional change); most recently climate regime shifts occurred in 1976/77, in 1989, and in 1998 (Hare and Mantua 2000; Royer et al. 2001).

Changes in climate regime, which result from north-Pacific processes rather than general global climate warming, directly influence ecological systems and human use of those systems as evidenced by significant declines in Prince William Sound salmon resulting in the closing of canneries during the late 1950s (Wooley 2002). In summary, significant environmental change, particularly directional change associated with snow and ice, results in changing ecological conditions and therefore changing wildlife populations in the region regardless of human activities.

As outlined in the forest plan assessment (USDA 2014a), annual snow accumulation, avalanches, annual input of marine nutrients to the terrestrial system via salmon, lightning caused fire, native insects and disease outbreaks killing trees and shrubs, floods, windthrow of trees, and beaver activity in riparian areas all represent ecological disturbances leading to changes in ecological conditions at different temporal and spatial scales. Ecological dynamics, including vegetation succession following these disturbances, are important to the diversity of habitats available to wildlife and result in local and regional changes in the abundance of animal species within the plan area emphasizing that the

Chugach National Forest is not a static landscape but one of constantly changing ecological conditions.

Human activities in the past and current human use of the Chugach National Forest also influence the status of wildlife. While it is largely unroaded and ground-disturbing human activities influence a very small portion of the national forest (approximately one percent), human activities in the region have not been inconsequential. Over thousands of years, Alaska Native people occupied southcentral Alaska developing a sophisticated maritime culture, harvesting sea mammals, fish, and a broad range of terrestrial plants and animals (Wiens 2013; Wooley 2002). Beginning with Russian, French, English, and Spanish exploration in the late 1700s, human influence on ecosystems in the region increased.

Examples demonstrating the extent of human influence on wildlife and the ecosystems of the Chugach National Forest include the following (summarized largely from Wooley 2002): commercial fur trade and associated trapping lead to increased harvest of mammals by Alaska Native hunters and extensive trapping by employees of the Alaska Commercial Company; “trapping had a major impact on the size and distribution of regional fur bearer populations,” according to Wooley 2002. Mining brought thousands of people through the region. In 1898, over 3,000 people moved through the Copper River region and by 1907, Prince William Sound had experienced a mineral boom with large copper mines at Ellamar, Latouche, Port Fidalgo, and Knight Islands. Fifteen companies produced over 200 million pounds of copper from Prince William Sound between 1910 and 1930, resulting in associated chemical pollution, logging, and land development. Beginning in the 1880s, commercial fishing expanded in Prince William Sound and southcentral Alaska. As an example, in 1936, 56,000 tons of herring were processed near Latouche. By 1959, the last salmon cannery in Prince William Sound at McClure Bay had closed as a consequence of devastated local herring and salmon stocks resulting in a cascade of effects to stream and terrestrial ecosystems.

Timber harvest, although persistent for thousands of years in association with Alaska Native villages, expanded in Prince William Sound in association with mining, canneries, and to provide railroad ties. Evidence in 1927 suggests harvest of second growth trees on Knight Island underscoring the long-term nature of tree harvest in the past two centuries.

In the 1900s, commercial marine mammal hunting along with market, trophy, and bounty hunting substantially affected populations in the region, but records documenting the extent of whale and sea lion harvest are poor. During this period, hunting also affected the abundance of bear, moose, sheep, and caribou in the region. Finally, fox farming was dispersed throughout the Chugach National Forest, introducing an exotic predator to the region. Nearly 60 fox farms existed in Prince William Sound and over 100 special use permits were issued by the Forest Service for fox farms (Janson 1985). Impacts from fox farming include predation by feral foxes on seabirds and other native animals and harvest of an enormous amount of wild animals for feed necessary to maintain farming. One farm on Nuka Island stored 11,000 salted salmon for feed but also added sea lion and seal meat (200 seals in one season) (Wooley 2002). A photograph of a fox farm on the Kenai Peninsula showed more than 5,000 snowshoe hare drying for fox feed.

Beginning in March and April 1989, spilled oil from the *Exxon Valdez*, which ran aground in Prince William Sound, coated shorelines to varying degrees (Wiens 2013) and killed countless plants and animals in western Prince William Sound and along the north Gulf of Alaska coast westward past Kodiak Island. The EVOS Trustee Council facilitated millions of dollars of research, monitoring, and restoration/recovery projects after the spill to help recover species that were injured. Progress toward restoring ecosystems to pre-spill conditions has been made. Monitoring, restoring, and improving resources affected by the spill is ongoing. Lingering oil remains on the landscape in subsurface beach habitat in addition to the endemic natural oil that seeps into the region annually (Wiens 2013). The Forest Service is an active member of the EVOS Trustee Council.

A recent classification of the status of resources and species monitored following the spill suggests recovery of all except the following species classified as:

- *not recovering*: killer whales-AT1, Pacific herring, pigeon guillemots;
- *very likely recovering*: cutthroat trout, rockfish;
- *recovering*: Barrow’s goldeneye, black oystercatcher, clams, mussels, sea otters; and
- *unknown*: Kittlitz’s murrelet, marbled murrelet.

Wiens et al. (2013) provides a more recent summary of recovery results with slightly different conclusions for some species.

Direct human impacts on ecosystems and wildlife of the Chugach National Forest are less extensive and generally less intense than periods in the late 1800s and the 1900s. During World War II and again in the 1970s with the development of oil resources throughout Alaska, the human population of the region expanded increasing hunting and recreational pressure on the Chugach National Forest. As outlined in the 2002 forest plan and associated FEIS (USDA 2002a; USDA 2002b), ground disturbing activities on NFS lands have been limited to a small fraction of the national forest during the past two decades; the direct human footprint has decreased over the past 50 to 70 years.

Status and Trend of Ecosystems that Support Key Wildlife

The recently completed forest plan assessment (USDA 2014a) in combination with this DEIS provide the information used to consider potential changes in wildlife distribution or abundance along with threats posed to wildlife as a result of changes in ecosystem conditions. In this section, the results of the forest plan assessment (USDA 2014a) and DEIS (see Terrestrial Ecosystems section) analysis of ecosystem status and trend is reviewed to examine the status of the ecosystems that support wildlife within the national forest. An overview of ecosystem status and integrity is first. Ecosystems are then examined particularly as they relate to specific terrestrial at-risk species and terrestrial species that are key in the delivery of ecosystem services.

The forest plan assessment and the examination of ecosystem integrity in this DEIS both illustrate that systems across the vast majority of the Chugach National Forest experience ecosystem disturbances and express ecological conditions (composition, structure, function, and connectivity) as would be expected in the absence of strong human influence. While ecological trends are directional as a result of long-term climate patterns (see previous pages) (Hayward et al. 2017), and human contributions to climate change are influencing physical and ecological patterns, most ecological conditions across the national forest are not expected to be measurably outside the expected range as a consequence of climate change during the next 15 years (Hayward et al. 2017). Wetland, aquatic, and terrestrial systems throughout the Chugach National Forest have high ecological integrity and are expected to display resilience (within the capacity of their inherent characteristics) during the planning period except for those conditions noted below. As a result, ecological conditions within the plan area are expected to support resilient populations of wildlife within the range of variation experienced commonly in the past.

Based on core national watershed condition indicators, 273 of 275 watersheds (HUC 6) are rated as good/functioning properly (USDA 2014a). When watersheds are functioning properly, they create and sustain functional terrestrial, riparian, aquatic, and wetland habitats that are capable of supporting diverse populations of native aquatic and riparian dependent species. Because 99 percent of Chugach National Forest watersheds are in Class 1 (good, functioning properly), they are considered to have high integrity and are more likely to recover to the desired condition when disturbed by large natural disturbances or land management activities.

Status and trend of riparian and wetland ecosystems within the plan area reflect the high integrity of watersheds in the region. The majority of the riparian areas within the Chugach National Forest are in good condition (Class 1). The trend of strong integrity for the 92 percent of Chugach National Forest riparian areas in good condition is expected to continue (USDA 2014a)

Riparian areas and associated wildlife are influenced by salmon runs on over 75 percent of the stream systems. Beginning about 100 years ago, up to 60 percent of each year's salmon return has been caught by commercial fishermen and a lesser amount, in recent decades, by sport, personal use, and subsistence harvests. The reduced number of salmon reaching the spawning grounds means that the source of marine derived nutrients entering these ecosystems has likewise been reduced, potentially changing riparian habitat and food availability for associated wildlife (USDA 2014a).

Terrestrial ecosystem patterns across the national forest are primarily the result of natural processes. Consequently, the ecological integrity of terrestrial ecosystems rates high across the majority of the plan area. Examples of significant natural disturbances occurring in the past and continuing in the plan area include fire ignited by lightning, native insects and disease outbreaks, earthquakes, snow avalanches, landslides, windthrow of trees, glacial action, floods, and beaver activity. Changes in vegetation composition, structure, and connectivity have occurred or are occurring within the national forest with effects on terrestrial ecosystem condition. A majority of these changes would be expected based on evaluation of the trajectory of systems as they develop following the last glacial maximum. There is little direct human influence to the vegetation on about 99 percent of the national forest. Key ecosystem characteristics of terrestrial vegetation are functioning in a way that continues to contribute strongly to ecosystem integrity and sustainability within the plan area and is within expectations for the natural range of variation.

As noted in the forest plan assessment (USDA 2014a), Romme et al. (2012) described a framework for examining the natural range of variation. If the conditions of key ecosystem characteristics today are similar to conditions of the past or the conditions expected based on native trajectories, then there may be no concern regarding the ecological integrity of those characteristics. However, some characteristics that were ecologically common in the past may be socially unacceptable today. For example, the spruce tree mortality associated with the recent spruce bark beetle infestation has resulted in socially unacceptable levels of standing dead trees in some areas, even though the infestation is similar to those seen in the past (USDA 2014a). Management actions to reduce hazardous fuels are ongoing, especially in the wildland urban interface (Kenai Peninsula Borough 2004). These treatments will result in more socially acceptable ecological conditions, particularly reduced fire risk for a number of years. The treatments also produce ecological features that were rare (and in some cases never existed) in the past, including an abundance of tree stumps, removal of tree boles from forests, and ground disturbance from roads and skid trails.

The most extensive ongoing vegetation treatment (intentional management actions) within the Chugach National Forest is hazardous fuel reduction on the Kenai Peninsula, where an average of about 875 acres is treated annually (a range of about 400 to 1,500 acres from 2004 through 2013). Wildlife habitat improvement, forest vegetation establishment and improvement, and invasive plant treatment projects also occur within the national forest.

Invasive plants represent one of the more extensive threats to ecological integrity within the national forest. The extent and abundance of invasive species is increasing, particularly in areas of human disturbance. The total area of infestation of highly invasive terrestrial plant species for the Chugach National Forest is estimated at less than 1,000 acres. About 86 percent of the non-native plant occurrences are on the Kenai Peninsula (USDA 2014a). The nature and extent of invasive species occurrence within the plan area does not currently have a known measurable effect on the habitat or populations of terrestrial wildlife.

A variety of insects and plant pathogens influence vegetation condition in the plan area (USDA 2014a). Whether some of these should be regarded as native or invasive is uncertain, but evidence suggests that the geographic distribution of many insect herbivores and other plant pathogens is changing; distributions tend to be moving northward with the changing climate (Hollingsworth et al. 2017; Lundquist 2009; Reich et al. 2014). Mortality of individual trees and shrubs as well as spatially extensive injury and death of plants resulting from insect and pathogen attack has occurred in the past and is an expected native disturbance process. The extent of tree and shrub mortality varies substantially among years (USDA 2014a; Hollingsworth et al. 2017; Lundquist 2009; Reich et al. 2014). Climate change is likely to interact with pathogens changing the rate of mortality over the long term and therefore changing the structure and composition of vegetation (Hollingworth et al. 2015). Information synthesized since the forest plan assessment (USDA 2014a) provides greater resolution regarding potential trends in tree and shrub mortality from insects and pathogens. These potential changes in the distribution and abundance of spruce, aspen, and alder will influence a broad array of wildlife but are not expected to result in future trends resulting in concerns regarding the long term persistence of any wildlife in the plan area.

Ecological changes occurring as a consequence of climate change represent a potential negative impact on wildlife. As described in Hayward et al. (2015) terrestrial ecosystems in the region will exhibit variable ecological responses to climate change. The Chugach National Forest supports 10 broad land cover types with coastal temperate rainforest dominated by Sitka spruce and western hemlock, and transition boreal forest dominated by Lutz and black spruce being the most widespread. Models examining potential changes in the distribution of cover types suggests that the coastal temperate rainforest will retain most of its current distribution and expand westward while subalpine shrub and alpine tundra are likely to decline as forest and shrublands move upward in elevation. The area within a suitable climate envelope for alpine tundra land cover may decline by 87 percent by 2060.

However, the dynamics of vegetation change will lag behind the climate envelope, and a range of ecological factors will interact with current vegetation, soils, and disturbance processes; consequently, the rate of afforestation or shrub establishment in alpine will be less rapid. The influence of both fire and insects on forest and shrub communities is likely to change as a result of directional climate change. While fire will remain rare in coastal rainforest communities, the potential for fire will increase on the western Kenai Peninsula. Defoliating insects that periodically cause extensive defoliation of conifer and deciduous trees and shrubs have shifted distribution northward over the past several decades (see paragraph above). Rising winter temperatures may facilitate more frequent defoliation events and reductions in tree/shrub vigor.

The richness and diversity of native vegetation within the Chugach National Forest likely provides a high level of resistance and resilience in response to climate change, and the current diversity in vegetation conditions is likely to remain well beyond the current planning cycle. The gradual but relatively rapid decline in the spatial extent of alpine tundra described above likely represents the most important broad-scale change in ecosystem conditions and habitat for terrestrial fauna occurring within the plan area. Species associated with alpine tundra are experiencing a decline in habitat area.

Ecological conditions, including the structure, composition, and connectivity of ecosystems within the plan area, are influenced directly and indirectly by human transportation systems. Transportation corridors, particularly the Sterling Highway, Seward Highway, and railroad lines in conjunction with private land development along these, are the most important human-caused barriers for movement of some organisms and influence the initiation and spread of disturbance processes, such as fire. Roads, railroad lines, utility corridors, and development along them represent abrupt linear ecological edges with variable width and differing ecological conditions. The consequences of these barriers differ substantially among specific plant and animal species and potential negative consequences will be noted below for specific wildlife and the ecological conditions that wildlife depend upon.

The forest plan assessment (USDA 2014a) examines a range of metrics evaluating the spatial pattern of vegetation (e.g., patch density, landscape shape index, perimeter-area fractal dimension, and patch cohesion). This analysis demonstrates the inherent patchiness of the terrestrial landscape. This patchiness is expected for a national forest that includes an archipelago (Prince William Sound) in a predominantly mountainous region. Results of the spatial analysis, in the context of the ecological history of the Chugach National Forest raise no evidence for concern regarding ecological integrity.

In summary, the intact nature and high integrity of the vast majority of the ecosystems found throughout the Chugach National Forest suggest that ecosystem composition, structure, function and connectivity reflect the range of values expected based on the directional trajectory of the system outlined earlier in the analysis.

Status and Trend of Habitats for Key Species

Building on the previous section that reviews the status of ecosystems supporting terrestrial wildlife within the plan area, this section evaluates and discloses the current status and trend of select species or groups of species. This includes at-risk species, species identified as especially important to delivery of ecosystem services and multiple use management, and migratory birds. At-risk species include animals that are federally designated as threatened, endangered, proposed, or candidate (36 CFR 219.9(c)) (and associated ecological conditions) under the Endangered Species Act (ESA) and NFMA, and also species of conservation concern defined under the 2012 Planning Rule as species "for which the Regional Forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area," (36 CFR 219.9(c)). Also included are wildlife designated by the Regional Forester's Sensitive Species List. In addition, a number of species or subspecies not evaluated in depth that contribute to the biodiversity of the plan area based on their status as endemics and are briefly examined. Past (or potential) extinction of species are also disclosed (see below).

The range of one bird subspecies species, Kenai song sparrow (*Melospiza melodia kenaiensis*), is restricted to the Kenai Peninsula and Prince William Sound with no clear conservation concerns. Two small mammal taxa are restricted to Montague Island in Prince William Sound. The Montague tundra vole (*Microtus oeconomus elymocetes*) occurs exclusively on Montague Island and has been recorded from shoreline to high elevations (Lance 2002). The vole was removed from the Regional Forester's Sensitive Species List in 2009 based on a systematic review process outlined in a Regional Supplement to FSM 2670 (USDA 2005). This evaluation included an examination of threats and consideration of the demography of Microtus. The environment supporting this vole is largely intact and there are no clear conservation concerns.

The status of Montague hoary marmot (*Marmota caligata sheldoni*) was reviewed in 2012 (USFWS 2012) returning the conclusion that the status of the marmot was unknown. Based on limited surveys, the marmot had not been observed in decades and the subspecies may not be extant. Conservation actions and threats were not identified. Based on a combination of poor understanding of the marmot status on Montague Island and the relative absence of clear threats the marmot was dropped from the Alaska Region sensitive species list echoing the conclusions of the U.S. Fish and Wildlife Service (USFWS 2012) review.

A subspecies of wolf (*Canis lupus alces*) was described for the Kenai Peninsula in 1941 and considered extirpated by 1915 as a result of unregulated hunting and trapping (Bangs et al. 1982). Wolves were not observed on the Kenai Peninsula again until the 1960s. Hunting and trapping resumed in 1974 and managers assumed that wolves occupied most available habitat (Bangs et al. 1982). The distinct character of the potentially extinct subspecies (*Canis lupus alces*), along with a number of other subspecies originally established based on morphological characteristics, is uncertain (Chambers et al. 2012).

Table 99. Wildlife species and groups evaluated in detail

Common name	Scientific Name
At-risk Species	
Steller sea lion	*Eumetopias jubatus*
Cook Inlet beluga whale	*Delphinapterus leucas*
Dusky Canada goose	*Branta canadensis occidentalis*
Regional Forester's Sensitive Species	
Black oystercatcher	*Haematopus bachmani*
Kittlitz's murrelet	*Brachyramphus brevirostris*
Aleutian tern	*Sterna aleutica* (formerly *Onychoprion aleuticus*)
Ecosystem Services	
Brown bear	*Ursus arctos*
Sitka black-tailed deer	*Odocoileus hemionus*
Moose	*Alces alces*
Caribou	*Rangifer tarandus*
Dall sheep	*Ovis dalli*
Mountain goat	*Oreamnos americanus*
Migratory Birds	
Migratory birds in general	
Bald eagles	*Haliaeetus leucocephalus*

Similar to wolves, caribou were extirpated from the Kenai Peninsula in the early 1900s, which eliminated a formally described separate species *Rangifer stonei* (MacDonald and Cook 2009; Morton and Huettmann 2017). Caribou were reintroduced to the Kenai Peninsula in the mid-1960s and resulted in establishment of two herds (Bangs et al. 1982) with further releases in the mid-1980s (Morton and Huettmann 2017). Estimates suggest about 750 caribou inhabit the peninsula largely occupying alpine habitats foraging on lichen. Based on current the classification of caribou and the consolidation of multiple subspecies in Alaska to a single taxa, the status of *Rangifer stonei* as a species is questionable (MacDonald and Cook 2009). There is also uncertainty regarding the distribution of caribou currently (largely alpine) relative to pre-1900 habitat use (which may have been forest) (Bangs et al. 1982). See USDA 2014a for expanded discussion of extirpations and introductions of vertebrates to the plan area and surrounding region.

At-risk Species

The conservation status of animal species occurring within the plan area were evaluated as part of the forest plan assessment (USDA 2014a) to identify at-risk species (36 CFR 219.9(c)). The evaluation identified one species, the Steller sea lion *(Eumetopias jubatus)*, listed as threatened under the ESA, and one species, dusky Canada goose *(Branta canadensis occidentalis)*, as a species of conservation concern (see USDA 2014a and associated record). Although the Cook Inlet beluga whale does not use lands or water managed by the Chugach National Forest, this species is addressed because certain Forest Service authorized activities have the potential to affect Cook Inlet beluga whales foraging in adjacent waters.

Steller Sea Lion (*Eumetopias jubatus*)

The forest plan assessment (USDA 2014a) reviews the ecological conditions and habitat that support Steller sea lion, the population status and trend, and current threats and stressors. The following summarizes that more extensive review.

The U.S. population of Steller sea lions was listed as threatened on April 5, 1990 (55 FR 126451), and a western distinct population segment, which includes the Chugach National Forest, was recognized and classified as endangered by the National Marine Fisheries Service (NMFS) in 1997 (62 FR 24345; 62 FR 30772). The western distinct population segment declined by 75 percent between 1976 and 1990 and another 40 percent between 1991 and 2000. Recent evaluations suggest the western distinct population segment is either stable or slightly declining (NMFS 2008).

Sea lions obtain 100 percent of their diet from the marine environment but depend on terrestrial environments for rookeries (birthing areas) and haulouts (non-birthing resting/loafing areas). Rookeries occur on gently sloping terrestrial surfaces that are protected from waves but are adjacent to marine waters. Sites used as rookeries in the breeding season may also be used as haulouts during other times of year. Some haulouts are used year round while others are used only on a seasonal basis (NMFS 2008).

Critical habitat was designated on August 27, 1993, based on the location of terrestrial rookery and haulout sites, spatial extent of foraging trips, and prey availability (58 FR 45269). Currently, the National Marine Fisheries Service has identified two rookeries and seven haulouts as critical habitat within the Chugach National Forest (50 CFR 226.202). Steller sea lion critical habitat includes a 20 nautical mile buffer that may incorporate specific fishery management measures around all major haulouts and rookeries, as well as a terrestrial zone that extends 3,000 feet inland from the base point of each identified rookery and haulout and an air zone that extends 3,000 feet above the terrestrial zone of each rookery and haulout, measured vertically from sea level.

The 2002 forest plan requires Forest Service managers to “design and locate facilities or apply seasonal restrictions on human activities when necessary and appropriate to reduce disturbance in important habitat areas, such as birthing areas, nesting areas and winter ranges,” including those identified for the Steller sea lion. All projects must comply with requirements of the ESA and Marine Mammal Protection Act (MMPA) and their implementing regulations as well as other applicable Federal and State laws and Forest Service policy. In addition, the 2002 forest plan directs the Forest Service to “manage human activities within 750 feet of any hauled out sea lion or seal on land areas to avoid disturbance." Critical habitat with associated buffer zones and fishery management measures were designed to reduce potential for direct human caused mortality and indirect mortality and injury caused by disturbance, as well as localized competition for Pacific cod and Atka mackerel, important Steller sea lion prey species (NMFS 2008).

The 2008 threats assessment for the western distinct population segment concluded that threats from Alaska Native subsistence harvest, illegal shooting, entanglement in marine debris, disease, disturbance from vessel traffic, and scientific research were relatively minor (NMFS 2008). A great deal of uncertainty remained about the magnitude and likelihood of competition with fisheries, environmental variability, incidental take by fishermen, toxic substances, and predation by killer whales as potential threats to recovery of the western distinct population segment (NMFS 2008). Of these potential threats to species recovery, most are outside the scope of Forest Service management. Measures taken in the 2002 forest plan (USDA 2002b) to reduce disturbance to sea lions at rookeries and haulout sites are regarded as important to recovery of Steller sea lion. The nature of further conservation action by the Forest Service to improve ecological conditions for sea lions is unclear and the ecological conditions necessary to support recovery appear to be in place. The influence of climate change on Steller sea lion, particularly prey species, is unclear and beyond the authority of the Forest Service.

Cook Inlet Beluga Whale (*Delphinapterus leucas)*

The summarized account of the Cook Inlet beluga whale below is taken predominantly from the Recovery Plan for the Cook Inlet Beluga Whale (NMFS 2016).

In Alaska there are five recognized beluga whale stocks, delineated based on their summer ranges, but the Cook Inlet stock has been isolated from other stocks north of the Alaska Peninsula for several thousand years. The Cook Inlet beluga whale stock was designated as depleted under the MMPA in 2000, but it was not until 2008 that the Cook Inlet distinct population segment was established and listed as endangered under the ESA. Historically the Cook Inlet population was estimated at 1,293 individuals based on 1979 surveys. Between 1979 and 1994 the Cook Inlet beluga whale population declined at roughly five percent annually, but the specific reasons for this decline have not been fully determined. Between 1994 and 1998, the population declined nearly 50 percent, likely due to unsustainable subsistence harvest. Despite subsequent restrictions on subsistence harvest, the population has continued to decline by 1.3 percent annually. The most recent survey in 2014 estimated a total of only 340 individuals for the population.

The distribution of Cook Inlet beluga whales has shifted dramatically since the 1970s. Originally inhabiting Cook Inlet as far out as Tuxedni Bay, the population has contracted and now appears concentrated in the upper portion of Cook Inlet generally extending no farther than Moose Point. Multiple data sources indicate that Cook Inlet beluga whales exhibit seasonal shifts in distribution and habitat use within Cook Inlet, but they do not migrate out of the inlet. Seasonal use patterns appear related to changes in the physical environment and food resources. Large aggregations of Cook Inlet beluga whales in specific areas of upper Cook Inlet from May to October are presumed to indicate a critical time period for foraging based on the need to assimilate resources for overwinter survival. Cook Inlet beluga whales frequently aggregate near river and stream mouths when anadromous fish are present, apparently relying on the shallow waters and river channels to concentrate fish and facilitate foraging. In addition to comprising important feeding habitats, the shallow waters of the upper Cook Inlet may also play important roles in reproduction.

Cook Inlet beluga whales are known to feed on prey that concentrate, including shrimp and schooling or spawning fish (Seaman et al. 1982), and Cook Inlet beluga whale presence has been used by fish harvesters as indicators of fish abundance. Beluga whales in Cook Inlet appear to feed extensively on concentrations of spawning eulachon in the spring; Cook Inlet beluga whales then shift to foraging on salmon species as eulachon runs diminish and salmon return to spawning streams. Recent analysis suggests Cook Inlet beluga whale diets changed in the last few decades and they have been feeding at lower trophic levels. Pacific salmon, including Chinook (king) salmon, are an essential feature of Cook Inlet beluga whale critical habitat. Therefore there is concern that recent reductions in run strength of Chinook salmon stocks across Alaska, particularly in Cook Inlet, may be affecting Cook Inlet beluga whales.

While the recent downward trends in Cook Inlet beluga whale abundance and range are well documented, little is known about the mechanisms impeding recovery. Threats to the population include natural and human caused catastrophic events, including mass strandings, cumulative effects from multiple stressors, anthropogenic noise, disease, habitat loss or degradation, contaminants, predation, harvest, and changes in prey availability.

A small portion of the Chugach National Forest borders the waters of Cook Inlet, including lands adjacent to the majority of the Twentymile River. The tidally influenced portions of this river are seasonally important foraging habitat for Cook Inlet beluga whales. The Forest Service has management authority over the uplands, but no jurisdiction over activities occurring on the inlet or the tidally influenced portions of the Twentymile River. Therefore Forest Service management for Cook Inlet beluga whales is limited to addressing activities or actions conducted or authorized by the Chugach National Forest.

Dusky Canada Goose (*Branta canadensis occidentalis*)

The following summarizes the forest plan assessment (USDA 2014a) review of the ecological conditions and habitat that support the dusky Canada goose, the population status and trend, and current threats and stressors.

The regional forester designated the dusky Canada goose as a species of conservation concern on December 1, 2015. The dusky Canada goose occurs as a nesting population within the plan area primarily on the Copper River Delta and in Prince William Sound; they primarily winter in the Pacific Northwest along with several other sub-species of Canada geese (*Branta canadensis*) and the smaller bodied species of cackling geese (*Branta hutchinsii*). Unlike dusky Canada geese, the abundance of other geese, especially the cackling goose (*B. h. minima*), has increased dramatically on the wintering grounds causing significant agricultural losses in Oregon and Washington. Until recently, regulations in Washington, Oregon, and Alaska allowed for an incidental harvest of dusky Canada geese during harvest of the more abundant geese as part of efforts to reduce crop depredation. The regulations no longer allow legal harvest of dusky Canada geese (WDFW 2015).

Nesting dusky Canada goose abundance is greatest on the Copper River Delta in uplift marsh habitat and on neighboring barrier islands. Springtime aerial surveys suggest that use of glacial outwash plain habitats by nesting geese may be increasing, where historically nests were found in low densities in these sites. In contrast, nesting in uplift marsh habitats, where nest densities were medium to high in the past, is declining (USDA 2014a).

Predation of adults, nests, and gosling dusky Canada geese significantly reduces productivity on the Copper River Delta. Since 1984, the Forest Service, in partnership with other agencies and organizations, installed artificial nest islands to improve reproduction by reducing predation and increasing the number of potential nesting ponds. Use of artificial nest islands has steadily increased and is predicted to continue to increase. From 1984 to 2012, nest success on artificial islands has averaged 65 percent, nearly twice the rate found at natural sites in the area (USDA 2012). The Pacific Flyway Council identifies the artificial nest island program as one of the best known tools to maintain populations of this species. The long term value of the system depends on availability of nesting ponds suitable for artificial platforms. Plant succession models (DeVelice et al. 2001a) predict that many of the current ponds will eventually turn into sphagnum moss bogs, eliminating the potential for successful nesting.

Prior to the Great Alaska Earthquake in 1964, the dusky Canada goose population suffered from high hunter harvest and periodic tidal flooding of nests. Uplift of the Copper River Delta (three to four meters), altered the saltwater marsh habitat reducing tidal flooding, increasing drainage, reducing salinity, and creating potential nesting ponds. Vegetation succession in the uplift area since the earthquake has increased tree and shrub cover rendering nesting geese more susceptible to terrestrial and avian predators. In response to habitat change, bald eagles have become more abundant on the nesting grounds and are a primary predator of dusky Canada geese and their eggs, especially in years when the eagles' preferred prey of eulachon, a small anadromous fish, are scarce during the dusky Canada goose nesting period.

While wintering habitat is predominantly in Oregon and Washington, a portion of the population is non-migratory (1,000 to 1,500 birds) and winters in Prince William Sound (see region 10 evaluation for Dusky Goose and Isleib and Kessel 1973). These geese use forested islands and are dispersed broadly.

The breeding distribution of the dusky Canada goose extends from Bering glacier in the northeast Gulf of Alaska westward to Cook Inlet. As noted above, the highest nesting abundance is in the Copper River Delta, but significant numbers nest dispersed among islands in Prince William Sound. Middleton Island, in the Gulf of Alaska 120 kilometers southwest of Cordova, Alaska, was colonized following the 1964 earthquake. Although nesting abundance has risen to about 1,350 adults, the young hatched on Middleton Island do not successfully fledge (Cooper pers. comm. 2017). From 2000 thru 2007, the abundance of dusky Canada geese on the Copper River Delta and Middleton Island combined remained relatively constant at just under 12,000 birds (Pacific Flyway Council 2008).

The dusky Canada goose was identified as a management indicator species (MIS) in the 2002 forest plan with guidance for management in the Waterfowl and Shorebird Habitats Management section (USDA 2002b). Recent evaluation of the status of the species (region 10 Evaluation Form: dusky Canada goose 2013) suggests substantial concern for persistence in the plan area based largely on the long term negative trend in the condition of nesting habitat on the Copper River Delta and from vulnerability of the dusky Canada geese to hunter harvest during winter periods in Washington and Oregon. The ongoing management program, which maintains a system of artificial nest islands in the Copper River Delta along with the stable nesting conditions throughout Prince William Sound, appears to have stabilized the population of the dusky Canada goose.

Regional Forester's Sensitive Species

The Forest Service Manual FSM 2670 established policy directing regional foresters to designate as sensitive species plants or animals whose population viability is a concern and to give special attention to management of these species. Plan components addressing sensitive species were an important part of the 2002 forest plan. The 2012 Planning Rule also identifies at-risk species for particular conservation attention, but established species of conservation concern as the method for addressing plants or animals for which population viability is a concern. A species of conservation concern "is known to occur in the plan area and for which the Regional Forest has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area" 36 CFR 219.9 (c). Under the revised forest plan, species of conservation concern will replace sensitive species in the regulatory based conservation role to prevent species from becoming federally listed. Because the formal transition from the sensitive species to the species of conservation concern approach will occur only when the Record of Decision is signed, the DEIS will evaluate and disclose outcomes for Chugach National Forest sensitive species based on the current list from 2009 (Goldstein et al. 2009), but plan components have not been developed for any sensitive species. Once the Record of Decision is signed, the sensitive species list will no longer apply to the Chugach National Forest.

Four species occurring in the plan area are listed on the Alaska Region, Regional Forester's Sensitive Species List: dusky Canada goose, Kittlitz's murrelet, Aleutian tern, and black oystercatcher (Goldstein et al. 2009).

Black Oystercatcher (*Haematopus bachmani*)

Black oystercatcher was added to the sensitive species list in 2009. Black oystercatchers occur over a broad geographic range occupying coastal habitats from the west Aleutian Islands eastward along the coast and coastal islands of Alaska south to Baja California. Oystercatchers occur in the plan area during the spring and summer when they breed and rear young. Most black oystercatchers migrate from the plan area to protected bays and inlets with abundant mussel beds to winter (USDA 2014a; Gill et al. 2004; Tessler et al. 2010). Nesting habitat is restricted to shorelines immediately above high tide or often adjacent to high tide on substrate ranging from sand and gravel beaches to rocky exposed headlands. Shorelines of islands and islets represent high quality nesting habitat particularly in areas without trees and little vegetation. Low sloping or level substrates along shorelines represent quality feeding habitat because food comes almost exclusively from the intertidal zone (Andres and Falxa 1995).

The ecological systems supporting the black oystercatcher were significantly compromised in 1989 by the *Exxon Valdez* oil spill in portions of Prince William Sound and along the coast of the Gulf of Alaska, westward. Evaluations of environmental consequences of the oil spill on the shoreline ecosystems used by oystercatchers universally described extensive negative effects (Wiens et al. 2013). By 2010, black oystercatcher and the breeding habitat used by the species was considered recovering (EVOS Trustee Council 2010) or recovered (Wiens et al. 2013).

Dominant threats to the species include oil spills and other aquatic pollution, potential changes in prey as a result of climate change (e.g., ocean pH and increased storm activity), and disturbance (particularly of nesting birds) by human activity on shorelines (largely associated with recreation).

This large shorebird and its habitat demonstrated resilience to major ecological disturbance following the *Exxon Valdez* oil spill. Furthermore, the species demonstrated an ability to disperse into, occupy, and increase in new habitat following the exposure of open shore habitat on Middleton Island resulting from the 1964 earthquake (Gill et al. 2004). There is no evidence that significant areas of potential habitat are unoccupied in the plan area or that densities are low relative to the ecological capacity of the species. The most substantial management threat, recreation activities, appears to negatively influence a limited number of birds (Poe et al. 2009). Potential changes in ocean conditions associated with climate change represent the threat of greatest concern but the direction and rate of change in conditions that influence the oystercatcher are unclear at this time (IPCC 2007). Much of the coastal area occupied in the plan area is strongly influenced by glacial freshwater input, which will influence the marine response to climate on coasts of the Chugach National Forest and therefore the level of threat (e.g., pH changes). Rising marine pH, if it occurs broadly in the plan area, could reduce the abundance and growth of oystercatcher prey species, which relies on calcareous shells. The interaction between the Alaska Coastal Current and glacier input to that current, marine conditions in Prince William Sound and along the Gulf of Alaska, and Pacific marine waters together will influence the marine conditions experienced by species consumed by black oystercatchers. It is reasonable to assume that marine conditions for prey species (which all form shells and therefore are influenced by marine pH) will gradually deteriorate but the rate of change and variability across the plan area are unknown. Patterns of marine pH vary across time and space (Fietzke et al. 2015), particularly in the coastal waters of the plan area.

Kittlitz’s Murrelet (*Brachyramphus brevirostris*)

Kittlitz’s murrelet was identified as a sensitive species in the 2002 forest plan and retained as a sensitive species in 2009. Kittlitz’s murrelet, which is difficult to distinguish from marbled murrelets by non-experts, nest across an extremely broad geographic range extending from southeast Alaska northwest through the Aleutians and along the western Alaska coast northward past the Bering Strait (Day et al. 1999). Breeding habitat is barren scree slopes or steep rocky slopes or rarely cliff faces near marine environments (but up to 80 kilometers distant). All foraging occurs in marine ecosystems, usually in bays and fiords. In Prince William Sound, foraging habitat is generally in nearshore waters that are icier, more turbid, cooler, and less saline than marine waters used by marbled murrelets (Day et al. 1999).

The nesting habitat of this species is found on lands managed by the Forest Service, U.S. Fish and Wildlife Service, National Park Service, the State of Alaska, Native lands, and Department of Defense lands (USFWS 2011). Kittlitz’s murrelets are known to nest on lands within the Chugach National Forest. Barren areas, which are characterized by bare rock, gravel, sand, silt, or clay with little green vegetation, represents preferred nesting habitat (USFWS 2013a). On the mainland in south-coastal Alaska, nunataks appear to be favorable habitats presumably because of their isolation from terrestrial predators (USDA 2014a). Suitable nesting habitat is not limited (occurring across extensive areas of the national forest and increasing in extent as a result of glacier and snowfield melting) and is not generally negatively affected by Forest Service land management.

Day et al. (1999) summarized information from Kendall and Agler (1998) suggesting that the summer abundance of Kittlitz’s murrelet in Prince William Sound is estimated at 3,368 ± 4,072. Worldwide population estimates range from 18,300 through 100,000 birds (summarized in Day et al. 1999). Reliable evidence regarding population trends in Kittlitz’s murrelet are unavailable (Day et al. 1999) or inadequate to evaluate whether or not the species has experienced a dramatic range-wide population decline (Day 2011). Similarly, there is considerable uncertainty regarding the status and trend of Kittlitz’s murrelets within Prince William Sound (USFWS 2013a).

Some biologists suggest that loss of tidewater glaciers is a threat to Kittlitz’s murrelet (USFWS 2011) and therefore warming climate may be a threat. The Kittlitz’s murrelet is considered highly vulnerable to marine oil pollution because this species spends most of its annual cycle at sea, forages by diving and pursuing prey, and is typically found in areas of greatest potential risk for this hazard.

The Kittlitz's murrelet was evaluated as a potential species of conservation concern for the Chugach National Forest and evidence of substantial concern for persistence in the plan area over the long term was not found (details of evaluation are in the project record). In October 2013, the U.S. Fish and Wildlife Service determination in their 12-Month Finding on a petition to list Kittlitz's murrelet as an endangered or threatened species stated "that listing the Kittlitz's murrelet is not warranted at this time." This finding removed the murrelet from candidate status (Federal Register Vol. 78, No. 192, 2013). Based on the analysis, the U.S. Fish and Wildlife Service (USFWS 2013) found "that the stressors are not of sufficient imminence, intensity, or magnitude to indicate that the Kittlitz's murrelet is in danger of extinction (endangered), or likely to become endangered within the foreseeable future (threatened), throughout all of its range," which includes the plan area. Kittlitz's murrelet habitat is not limited to lands within the Chugach National Forest or typically affected by Forest Service management. Ecological conditions to support Kittlitz's murrelet in the plan area appear to be largely intact and major threats are not apparent.

Aleutian Tern (*Sterna aleutica/Onychoprion aleuticus*)

Aleutian tern was added to the list of sensitive species in 2009. The Aleutian tern breeds in Alaska and eastern Siberia and nests in coastal colonies that are distributed over an extremely vast area on both east and west sides of the north Pacific (North 2013). Nesting occurs in a variety of habitats near coastal waters ranging from flat islands, dwarf-shrub-tundra, grass or sedge meadows, sandy spits, to freshwater and coastal marshes (North 2013). Aleutian terns forage in marine waters, freshwater ponds, and in marshes for fish and zooplankton. Details of wintering range are not known but some evidence indicates wintering may occur in Southeast Asia and the western Pacific (North 2013; Renner et al. 2015).

Ecological conditions to support breeding Aleutian terns appear to be largely intact in the plan area. The availability of quality nesting habitat does not appear to be a limiting factor for Aleutian terns in southcentral Alaska or along the southern Gulf of Alaska coast (Renner et al. 2015).

Marine conditions, and therefore foraging conditions in the region, were compromised by the *Exxon Valdez* oil spill and may not have fully recovered (based on limited analysis for Arctic terns in the region (Wiens et al. 2013)). The Aleutian tern was not evaluated for damage. Based on analysis of environmental conditions (EVOS Trustee Council 2010; Wiens 2013) ecological conditions to support food for the tern are likely to have largely recovered.

However, even complete recovery from spill effects would not negate the potential for significant changes in food conditions over the long term associated with factors like periodic changes in Pacific Ocean conditions, such as the Pacific Decadal Oscillation (PDO); salmon populations have been shown to respond to these changes in sea surface temperatures (Mantua et al. 1997) and tern forage species would be expected to respond similarly.

Furthermore, environmental conditions for Aleutian terns in the plan area likely changed over time in response to the relative level of human activity along the coast. Resource use by humans during the early 1900s through mid-century may have resulted in disturbance of tern nesting colonies and contamination of coastal marine waters to a greater extent than current conditions based on the extent of historical development in Prince William Sound (USDA 2002; Wooley 2002). After a period of declining human activity in Prince William Sound following WWII, human use of coastal areas of Prince William Sound have increased since 2000 with the opening of the Anton Anderson Memorial Tunnel to Whittier to auto and truck transportation (Poe et al. 2006) and may have resulted in increased nest disturbance or increased nest predation/depredation (e.g., by ravens). However, significant threats to tern nesting colonies have not been identified associated with direct or indirect management of the Chugach National Forest.

The worldwide population of Aleutian tern is extremely difficult to estimate but has been variously estimated between approximately 16,000 and 31,000 individuals (North 2013; Renner et al. 2015). The relationship between nesting populations of terns on the east coast of Asia and the Alaska coast is unknown but the entire global population may act as a dispersed metapopulation. Because terns are known to shift nesting locations between years, nest over vast areas, are difficult to distinguish from other terns, and pose other survey challenges, global trends are difficult to evaluate. Based on patterns reported in North (2013) and Renner et al. (2015), there is some evidence that major shifts in abundance may occur between Siberian and Alaskan nesting areas over long timeframes.

Similar to the difficulty estimating global abundance, evidence regarding abundance in and near the plan area, long term trends in abundance in the plan area, and the relationship between abundance in the plan area and worldwide populations are all unclear. A recent evaluation of global Aleutian tern population trends suggests “a large-scale change in previously documented populations in Alaska” (Renner et al. 2015) associated with a decline of 83.3 to 97 percent from 1960 to 2013. Geographically specific analysis from the same study suggest that “numbers in the Copper River Delta (also in the Gulf of Alaska region), have declined from approximately 2,400 in the 1980s to three birds in 2013” while the largest colony in Alaska, immediately south near Yakutat, Alaska has remained stable since 1914 (Renner et al. 2015). The substantial analyses of Renner et al. (2015) appears to have assembled all available colony counts for Aleutian terns from Alaska and substantial information from Russia. Despite the scope of the effort, the analysis relied on opportunistic surveys of colonies in Alaska in 2013 and an array of factors complicate interpretation of patterns regionally and globally. Current analyses do not provide strong evidence for a range-wide decline in Aleutian tern associated with the apparent substantial decline in Alaska.

Based on available evidence, Aleutian tern was not identified as a potential species of conservation concern in the plan area. The assessment of current status (and associated decision not to identify the Aleutian tern as a species of conservation concern) is built, in part, on the following points. The available evidence suggests that potential nesting habitat and ecological features to support Aleutian tern do not appear to be limiting within the Chugach National Forest. Evaluation of trends suggest a decline in abundance in Alaska and therefore, by inference, in the plan area (Renner et al. 2015), but the magnitude of the decline in the plan area is unclear. The strong dispersal capability of the species, together with an indication of broad scale shifts in breeding abundance, are particularly important in assessing status in the plan area over the long term, particularly whether or not there is evidence to support substantial concern for persistence over the long term. Current evidence suggests a westward shift in breeding in the North Pacific Ocean. Stable to increasing numbers of breeders occur on the coasts of Sakhalin and Kamchatka, Russia, on the Bering and Pacific coasts, and the Aleutian Islands of Alaska. The occurrence of these breeding populations along with the species reliance on marine foods, which vary in abundance both spatially and temporally, temper concerns regarding long-term persistence in the plan area over the long term.

Species Important for Ecosystem Services or Multiple Resource Management

This section examines the current status and trend of several species and groups of species highlighted in the forest plan assessment (USDA 2014a) and the 2002 FEIS (USDA 2002a) as important for ecosystem services and multiple resource management.

Pigeon guillemot *(Cepphus columba)*, Barrow's goldeneye *(Bucephala islandica)*, black oystercatcher, and harlequin ducks *(Histrionicus histrionicus)* are a set of terrestrial animals identified by the EVOS Trustee Council as recovering or not recovered in their most recent report (EVOS Trustee Council 2010) regarding the 1989 *Exxon Valdez* oil spill. Other analyses classify the status of these species slightly differently (Wiens et al. 2013). The status of black oystercatcher and the ecological systems this large shorebird relies upon were discussed previously.

Pigeon guillemot is the only marine bird species injured by the oil spill currently listed as not recovering (EVOS Trustee Council 2010). Pigeon guillemots nest in small colonies on cliffs along coastlines appearing to favor exposed rather than sheltered cliff sites. They forage on fish and bottom dwelling marine organisms in water up to 45 meters deep often above rocky substrate (Ewins 1993). In 2006, guillemot abundance in Prince William Sound was estimated at 2,300 and appears to have experienced a 6.7 percent decline from 1972 to 2004 attributed to gill net bycatch, oil pollution, and predation. The decline is attributed, in part, to the oil spill, but had begun before habitat damage and bird mortality from the *Exxon Valdez* (USFWS 2006).

Based on a summary by the U.S. Fish and Wildlife Service (USFWS 2013), since 1990, the population of pigeon guillemots in Prince William Sound, excluding the Naked Island group, declined about 1 percent per year, while pigeon guillemots breeding on the Naked Island group declined by more than 90 percent. From 1990 to 2008, the population in the Naked Island group dropped from about 1,100 pigeon guillemots to an estimated 100 birds. The pattern of the Naked Island group is significant because of the presence of mink and associated predation in that system. The weight of available evidence suggests the primary limiting factor for pigeon guillemot reproductive success and population recovery on the Naked Island group is now predation by mink (USFWS 2013b). An EVOS Trustee Council funded project was initiated in 2014 by the U.S. Fish and Wildlife Service to reduce the number of Naked Island mink in order to accelerate the restoration of pigeon guillemots and other island-nesting shorebirds susceptible to furbearer predation.

Aside from what may be artificially high predation on nesting pigeon guillemots in some locations, ecological conditions to support breeding pigeon guillemots in the plan area appear to be largely intact and further conservation measures unnecessary.

While Barrow's goldeneye and harlequin duck were classified as recovering rather than recovered by the Trustee Council (EVOS Trustee Council 2010), management concerns related to land management of the Chugach National Forest have not been raised regarding either species. Both species were classified as damaged by the *Exxon Valdez* oil spill (Wiens et al. 2013) but there is no evidence that characteristics of the ecological system necessary to support these species in the plan area are currently compromised.

Nest cavities used by goldeneye for nesting remain at densities expected under the native disturbance regime of the plan area while riparian nest areas likely used by harlequin ducks are intact across the majority of the plan area. Foraging habitat in rivers and streams (harlequin duck) as well as in wetlands and shoreline marine foraging areas is intact and functioning. Numbers of wintering harlequin ducks in Prince William Sound (between 14,000 and 18,000) are the highest of anywhere in North America aside from the Aleutian Islands (Robertson and Goudie 1999). Eadie et al. (2000) indicate that broad patterns suggest a declining trend in Barrow's goldeneye for Alaska but recent patterns for the plan area are unavailable. Sightings of both species are prized by bird watchers and recreationists.

Brown bear, Sitka black-tailed deer, moose, caribou, Dall sheep, and mountain goat all represent important subsistence and/or sport harvest species in the plan area. The forest plan assessment (USDA 2014a) provides background on these species, including ecological interactions, economic value, status, threats, and management considerations. The 2002 forest plan FEIS (USDA 2002a) also provides important context regarding these species and the 2002 forest plan (USDA 2002b) outlines current plan components. All are incorporated here by reference.

Brown Bear (*Ursus arctos*)

Brown bear represented an important forest plan design species for the 2002 forest plan. Brown bear occur across the Chugach National Forest on the mainland and on Montague, Hinchinbrook, and Hawkins islands in Prince William Sound. The Kenai Peninsula, particularly the western portion managed as the Kenai National Wildlife Refuge, supports the greatest abundance of brown bear in or near the plan area.

Brown bear habitat differs seasonally and, outside of winter denning, habitat and therefore important ecological conditions to support brown bear, is determined by distribution of seasonal foods. During spring, particularly on the Kenai Peninsula, immediately after emergence from the den, brown bears depend on forbs, horsetails, and graminoids, which are found in moist sites, including moist alpine meadows, alluvial fans, and wet meadows or riparian areas often at low elevations. Ungulates also form a large portion of the initial spring diet either as carrion or from direct predation, so brown bears also use the winter ranges of moose and Dall sheep as spring foraging habitat. Summer and autumn habitat for brown bears occurs along streams that support spawning salmon. In autumn, berries become a large part of the brown bear diet, and brown bears may frequently move between high elevation berries and lower elevation salmon spawning streams (Suring et al. 1998). During all seasons, brown bear habitat use favors areas with low densities of human development and roads (Suring et al. 2006), but this feature does not preclude areas of high human use near salmon spawning streams or other important foods (e.g., human waste disposal sites).

Reliable estimates of brown bear abundance are unavailable for the plan area except for the Kenai Peninsula, where an objective estimate of 582 bears (95 percent Confidence Interval 469 ± 719) was produced from field sampling in 2010 (Morton et al. 2015). Prior to this estimate, management of bears on the Kenai Peninsula was based on the assumption that approximately 280 adult bears occurred (Del Frate 1999). The 2010 sampling examined 74 percent of available brown bear habitat on the Kenai Peninsula and the sample area was bounded on 88 percent of its perimeter by ice, glacier, marine waters, or other non-habitat, resulting in a reliable estimate for summer 2010 (Morton et al. 2015). From 2012 to 2014, changes in the management of bears on the Kenai Peninsula resulted in higher mortality than in the past; human caused mortality over the three-year period was three times the 1995 to 2011 average. Human caused adult female mortality averaged four per year from 1995 to 2011 and 14 per year from 2012 to 2014 (USDA 2014a; Morton 2015). The forest plan assessment (USDA 2014a) provides additional background on brown bear populations and harvest for the Kenai Peninsula and elsewhere in the plan area.

The high mortality of brown bears in 2013 and 2014 may represent renewed cause for uncertainty regarding brown bear status on the Kenai Peninsula. Harvest exceeded suggested sustainable harvest rates based on literature (USDA 2014a). The 2010 estimate of over 500 brown bears in conjunction with land management practices (such as the 2002 forest plan standards and guidelines and brown bear core areas) provided conditions for brown bear sustainability. Management decisions outside Forest Service authority may compromise brown bear populations in the future.

Human activities, such as logging, mineral and energy development, water impoundments, recreational development, development of private lands, and hunting, have led to an increased likelihood of human-bear conflicts (Suring et al. 1998). Humans are the primary cause of mortality in bears, and given the importance of adult female bears to population growth in this long-lived species, effective management to sustain populations must consider rates of adult female mortality when establishing population management goals.

The 2002 forest plan includes plan components designed to reduce human-bear conflicts and sustain bear populations. These include management (for multiple resources) to maintain productive anadromous fish habitat, large unroaded areas that include summer alpine habitat, and provisions to manage human activity to minimize encounters and illegal bear kills.

Effective past management of brown bears stemmed in part from a broad, collaborative process leading to the Kenai Peninsula Brown Bear Conservation Strategy (ADF&G 2000), and collaborative science advice from the Interagency Brown Bear Study Team; chartered to coordinate brown bear investigations on the peninsula and to summarize knowledge of bears (ADF&G 2000). Neither the broad, formal, collaborative management structure nor the Interagency Brown Bear Study Team contribute to coordinated bear management.

As an important element of current management to reduce bear mortality, the Forest Service has partnered with other agencies and organizations to teach national forest users and local residents about the importance of keeping human foods, waste, and other attractants away from bears. Precautions include not using bird feeders or compost near bear habitat, use of bear-resistant garbage facilities, not raising chickens in bear habitat or using appropriate electric fences to deter bears, implementing food storage requirements in campgrounds, and providing guidance on fish waste management in high-use areas. These precautions have reduced problem bears deaths on NFS lands since the 2002 forest plan was approved. The Forest Service has participated in a particularly effective public involvement campaign with the Anchorage Bear Committee and iTREC! (Iditarod Trail to Every Classroom) teachers in Girdwood. The results are improved food storage, safety for humans, and fewer bear incidents in Girdwood. Cordova also collaborates with the Forest Service to educate residents on how to live and work safely in bear country. Despite these efforts, concerns remain for human safety and for high potential for human/bear conflicts. The most important of these occurs along the Russian River where significant numbers of humans and bears congregate during salmon spawning. Accumulation of fish waste (skeletons of fish after fishermen filet fish along the stream) along the stream attracts bears to an area with particularly high densities of recreationists, requiring site-specific management to reduce the probability of negative human/bear encounters. See USDA 2014a for further information on the contribution of brown bear to social, cultural, and economic conditions in the plan area.

Sitka Black-tailed Deer *(Odocoileus hemionus)*

Sitka black-tailed deer are abundant and indigenous to the coastal regions of southeast Alaska and northwest British Columbia. Introduced to Hinchinbrook and Hawkins Islands in 1916 and 1923, Sitka black–tailed deer (hereafter Sitka deer or deer) expanded their distribution through Prince William Sound, onto the Kenai Peninsula, and are occasionally observed as far north and west as Anchorage (Crowley 2011). Following the last glacial maximum, distribution of Sitka deer was limited by geographic barriers, such as large icefields and marine waters, to lands south of the Chugach National Forest. Dispersal west and north from human introductions in eastern Prince William Sound demonstrate the suitable ecological conditions for deer in the region. Modeling suggests range expansion will continue with increased abundance on western portions of the plan area (Morton and Huettmann 2017).

During snow-free periods, deer occur in a broad range of habitats from sea level to alpine feeding on browse. Snow depth and duration are the primary limiting factors for Sitka deer populations within the region. Consequently, throughout southeast and southcentral Alaska, quality Sitka deer winter habitat occurs in areas with suitable browse and forest canopy cover. Productive old growth forests have high value because the forest canopy captures significant snow resulting in low effective snow depth and greater access to forage, which is relatively abundant in old growth forest (Hanley et al. 2012; Parker et al. 1999; Person and Brinkman 2013).

Snow depth and duration in combination with the extent of old growth forest are the primary limiting factors for Sitka deer populations throughout the region. As a result, Sitka deer experience fluctuations in abundance in response to winter severity as defined by snow depth and duration. In especially severe winters, access to quality browse is limited by snow even in areas of extensive old growth forest. During years of deep snow of long duration, deer decline in body condition, and congregate at lower elevations (and in the intertidal zone) with large proportions of the deer dying of starvation and increasing vulnerability to hunter harvest (Person and Brinkman 2013; USDA 2002).

The Alaska Department of Fish and Game established a population objective for Sitka deer in game management unit (GMU) 6 (see game management unit map in map package) for 2010 at 24,000 to 28,000 deer, which is projected to support a sustainable annual harvest of 2,200 to 3,000 deer (USDA 2014a). The Alaska Department of Fish and Game estimated harvest in game management unit 6 of 1,900 deer in 2008-09 and 1,600 deer in 2010 (Crowley 2011) suggesting harvest is close to objective. The highest deer densities in hunt unit (HU) 6D occurred on Hinchinbrook, Hawkins, and Montague islands. Lower densities occurred on the smaller islands and mainland areas around Prince William Sound. Deer populations remained relatively stable in game management unit 6 during the last decade until the winter of 2011-12, when near record snows across Prince William Sound reduced the population by 50 to 70 percent (USDA 2014a).

Sitka deer play key roles in ecosystem services for the Chugach National Forest by influencing the vegetation of islands and the mainland when deer abundance is high (Martin et al. 2011) and as prey and carrion for large predators, such as wolves, brown bear, black bear, and mustelids. Deer also serve key human values providing food and cultural focus for individuals in subsistence, sport, and non-consumptive settings. Ecological conditions to support Sitka deer in the plan area appear to be largely intact and management in the region appears to be meeting Alaska Department of Fish and Game objectives for deer. See USDA 2014a for further information on the contribution of Sitka deer to social, cultural, and economic conditions in the region.

Moose (*Alces alces*)

Moose are native to several portions of the plan area, including the Kenai Peninsula where they are widespread and most abundant, the Nellie Juan River valley in Prince William Sound, and Hawkins and Hinchinbrook islands. Moose were introduced in the Copper River Delta between 1949 and 1958 where they have become well established; moose populations supported harvest by 1960 (MacCracken et al. 1997).

Moose are wide ranging browsers that forage on stems, leaves, and buds from the current year’s growth of trees and shrubs. For instance, on the Copper River Delta, willow (*Salix* spp.), sweet gale (*Myrica gale*), alder (*Alnus sinuate*), and poplar (*Populus trichocarpa*) are dominant forage

(MacCracken et al. 1997). In southcentral Alaska, moose select early- and mid-seral habitats dominated by deciduous shrubs and trees that provide both food and cover. Quality forage generally occurs in riparian areas (e.g., river bottoms) and post-glacial early-seral landscapes. The abundance and productivity of moose is strongly related to the availability of deciduous forage.

In winter, snow depth interacts with habitat to determine the distribution of moose. Moose restrict their movements when snow is more than 30 inches deep, and experience a starvation diet in severe winters. Winter habitat availability is significantly curtailed when snow depths are more than 36 inches.

The best quality moose habitat within the Kenai Peninsula is located on the western peninsula within the Kenai National Wildlife Refuge. Current conditions on the eastern peninsula are less suitable and less productive. Moose habitat on the Copper River Delta occurs primarily in wetlands. Habitat in the wetlands has experienced drying and successional development due to the 1964 earthquake caused uplift. The Forest Service has partnered with others to model moose habitat within the region and developed habitat improvement projects to enhance early seral species, particularly willow.

The seral nature of moose habitat leads to significant change in the distribution and extent of quality moose habitat over time. This is illustrated by the following brief review of the pattern of wildfire and moose abundance on the Kenai Peninsula based on the history reported by Bangs et al. (1982). Early hunting guides in the late 1800s reported that caribou were plentiful but moose quite rare. A series of human-caused fires occurred in the early 1900s as miners and trappers moved onto the Kenai Peninsula resulting in it being characterized as the best hunting area for moose in the world by 1916. Large fires in 1947 and again in 1969 led to extensive early seral deciduous habitats and steady increases in moose populations (Bangs et al. 1982). In 1971, an estimated 9,000 moose occurred on the Kenai Peninsula, but the role of snow and winter severity was demonstrated after a series of severe winters from 1971 to 1975 reduced the population to an estimated 3,500 moose. Current moose abundance is low across much of the Kenai Peninsula relative to the late 1960s; much of the early seral habitat has matured, and forage is limiting.

In most of the plan area, moose habitat is declining due to natural plant succession and a decline in quality browse. Succession in some areas is transforming deciduous vegetation types (e.g., birch, cottonwood, and willow) into conifer stands. In other areas, deciduous vegetation is growing to sizes less valuable as moose browse. Current population estimates suggest moose are stable in eastern Prince William Sound with an estimate of 1,250 moose in game management unit 6 (see game management unit map in map package). This population grew following the initial introduction in the 1950s to about 1,600 moose by 1988 and is currently about 1,250 (USDA 2014a). Although introduced relatively recently, moose in game management unit 6 are considered an important subsistence species. Moose in game management unit 7 (see game management unit map in map package) on the eastern side of the Kenai Peninsula (within the Chugach National Forest) where quality habitat is limited, occur at relatively low densities. Estimates of abundance are uncertain due to challenges with surveys in the mountainous terrain and dense forest cover but patterns of moose harvest give some indication of trends in abundance. In the mid-1960s, about 250 bulls were harvested annually. This figure declined to about 100 by the mid-1970s and to 28 moose by 2006. The best current estimate of moose in game management unit 7 is from 600 to 800 individuals (Selinger 2012).

Moose play key roles in ecosystem services for the Chugach National Forest by influencing vegetation development following disturbance, particularly fire, and as prey and carrion for large mammals, such as wolves, brown bear, black bear, and wolverine. Moose are a highly prized meat and trophy animal, important to many Alaskan residents for subsistence and sport hunting and are a popular viewing species within the national forest. Moose rank as one of the most important subsistence foods throughout Alaska, including the communities near the Chugach National Forest. Many non-residents prize moose as a destination guided hunt species. Moose antlers and bones are frequently used in local craft and art industries. See USDA 2014a for further information on the contribution of moose to social, cultural, and economic conditions in the region. Public comments during the assessment phase of this forest plan revision indicated the public is interested in having more abundant moose in the region.

Moose can cause safety and property concerns for motorists and homeowners. Moose-vehicle collisions have led to moose mortality and human injury along the Seward and Sterling highways. Vehicle collisions have killed more moose in game management unit 7 than hunters in recent years and the Kenai National Wildlife Refuge reported that an average of 225 moose were killed annually during the last decade by vehicles on the Kenai Peninsula (USFWS 2014).

As noted, the extent of quality moose habitat has declined over the past half century across the Chugach National Forest but particularly on the Kenai Peninsula. Mechanical treatment of habitat, largely through Hydro ax scarification in shrublands on the Copper River Delta has been used to reverse succession and increase moose browse (primarily willow). These treatments focus on those areas with alder and spruce encroachment in core winter range. These relatively small treatments effectively improve the availability of winter range for moose (USDA 2014a). In contrast, habitat treatments, such as thinning on the Kenai Peninsula, have generally been too small to effectively increasing moose numbers. The 2002 forest plan included an objective to “Create early to mid-successional habitat for moose and other early and mid-seral dependent wildlife species,” (USDA 2002b) and a guideline (under vegetation) to “Manage hardwood or mixed spruce/hardwood vegetation within one-quarter mile of Seward, Hope, or Sterling highways on the Kenai Peninsula as late seral stage. In winter moose range beyond one-quarter mile of Seward, Hope, or Sterling highways on the Kenai Peninsula, create vegetation that is attractive to moose during the winter months,” (USDA 2002b).

Hazardous fuel reduction on the Kenai Peninsula, where an average of about 875 acres is treated annually (a range of about 400 to 1,500 acres from 2004 through 2013) results in some habitat improvement for moose. Annual forest vegetation establishment and improvement acreage ranged from about 200 to 680 acres from 2004 through 2013 (USDA 2014a).

Caribou (*Rangifer tarandus*)

Caribou were extirpated from the Kenai Peninsula in the early 1900s (see details earlier in this analysis). Depending on taxonomic authority, the extirpation may have eliminated a distinct form of caribou, *Rangifer stonei* (MacDonald and Cook 2009; Morton and Huettmann 2017).

Reintroductions in the 1960s and 1980s resulted in four herds that together include about 1,000 caribou (Morton and Huettmann 2017). The Kenai Mountains herd, one of the four caribou herds, occurs primarily on NFS lands and was estimated to include approximately 300 individuals in 2009. Following introduction, this herd reached almost 350 animals by 1975 and fluctuated between about 190 and 450 individuals during the next three decades due, in part, to harvest rates. This herd, like the other three on the Kenai Peninsula, does not exhibit large migrations (ADF&G et al. 2003; USDA 2014a).

Caribou on the Kenai Peninsula generally occupy alpine habitats and forage on ground lichen. The Kenai Mountains herd is estimated to use about 850 square kilometers of summer habitat and 390 square kilometers of winter range (ADF&G et al. 2003) over a landscape of about 1,400 square kilometers (Selinger 2013). Specific characteristics of quality alpine habitat have not been identified. The spatial extent of alpine on the Kenai Peninsula is declining as a result of climate change and is expected to continue declining as shrubs and trees rise in elevation (Dial et al. 2007; Hollingsworth et al. 2017; Morton and Heuttmann 2017). Some estimates suggest that, Kenai Peninsula wide, approximately 300,000 acres of tundra have been lost over the past 50 years (Morton and Heuttmann 2017) and the extent of quality habitat for caribou will continue to decline as a result of tree and shrub encroachment in the alpine (Hollingsworth et al. 2017). The rate of encroachment is expected to exceed land exposed from deglaciation and subsequent colonization by lichen (Morton and Heuttmann 2017); however, the pattern of tree and shrub encroachment will vary geographically on the Kenai Peninsula and predicting the pattern for the future is complex (Dial et al. 2007; Dial et al. 2016). Soil, slope, aspect, elevation, permafrost, and proximity to colonizing trees or shrubs all influence the potential for tree and shrub invasion and the rate of invasion. It is clear, though, that over the long term, the extent of alpine habitat on the Kenai Peninsula will decline.

Caribou play a smaller role in ecosystem services and multiple use resource use on the Kenai Peninsula than moose or Sitka deer as a result of the relatively small number of caribou. Caribou influence plant cover and species distributions in areas with significant grazing, and caribou on the Kenai were thought to reach densities that resulted in changes in the alpine by the mid-1970s (Bangs et al. 1982). In 2010, the FSB determined customary and traditional use of the Kenai Mountain herd and established a Federal season with a quota of five animals. The Kenai Mountain herd is the most hunted and is managed to maintain a caribou population of 300 to 400 animals (Selinger 2013).

Dall Sheep (*Ovis dalli*)

Dall sheep occur in the Kenai and Chugach mountains, which is the southernmost range of the species. The plan area is one of the few places in Alaska where both Dall sheep and mountain goats can be observed in close proximity to each other. Sheep in the Kenai and Chugach mountains are some of the most publicly accessible Dall sheep herds.

In contrast to mountain goats, which in Alaska are generally associated with coastal mountains, Dall sheep occur in relatively dry mountain landscapes feeding and resting on open alpine ridges and slopes and in high mountain meadows with steep slopes and rugged escape terrain in the immediate vicinity. Summer diets include a broad range of alpine grasses, forbs, and sedges. Winter diets are more limited to dried grasses and sedges along with lichen and moss in locations that are windblown and have lower snow depth. In addition to alpine forage, important ecological conditions for Dall sheep include escape cover and mineral licks. Licks are frequented in springtime and some sheep travel considerable distances to visit appropriate geologic formations.

Surveys covering most suitable habitat on the Kenai Peninsula in 1992 recorded about 1,600 sheep; a reduction from 1968 when similar surveys recorded over 2,000 individuals (Herreman 2013). Comparable surveys have not been completed since 1992. Some evidence from less thorough surveys suggest a downward trend since about 1997 (Herreman 2013).

Few sheep are harvested from the plan area or the Kenai Peninsula. From 2008 to 2012, annual harvest averaged nine rams for game management units 7 and 15 combined (entire Kenai Peninsula) with an average of 114 hunters participating each year (Herreman 2013). Dall sheep rarely occur in densities such that herbivory is expected to significantly influence plant distribution and abundance.

Dall sheep abundance is determined by a number of factors. Sheep populations tend to increase following a series of mild winters and decline after severe winters; winter severity is largely determined by snow depth, duration, and distribution. Disease is an important concern with Dall sheep; mountain sheep, in general, are extremely susceptible to disease introduced by domestic livestock. Bacteria and viruses cause respiratory illnesses, typically pneumonia, often resulting in mortality for a large proportion of mountain sheep in infected herds. Dall sheep and mountain goats in Alaska have not been exposed to many of the pathogens commonly carried by domestic sheep (Garde et al. 2005; Miller et al. 2008), but evidence suggests they are as sensitive as bighorn sheep to some respiratory pathogens (Jex et al. 2016). Careful management to maintain separation of Dall sheep and mountain goats from domestic livestock is key to maintaining this condition. The use of domestic goats or other hooved mammals as pack animals increases the exposure risk (Schommer and Woolever 2008) and the probability of disease affecting sheep over the entire peninsula.

Disturbance of sheep represents another threat. Increasing human use of alpine areas can increase energy expenditure and reduce feeding time for Dall sheep. Dall sheep are sensitive to a range of disturbances, such as low-elevation flights, skiing near individuals, and machinery noise during winter when sheep are more likely to be in poor condition (food and cover are limited). Disturbance may cause animals to move away from important habitat, become injured, or use vital energy at a time of declining body condition.

Disturbance on key habitats, such as winter ranges or lambing grounds, is a serious threat. If disturbed, sheep may leave or avoid using important habitats, become injured, or expend vital energy during periods of declining body condition, all of which can affect the health and survival of individuals and populations. To address these concerns, the 2002 forest plan included two guidelines specifically designed to reduce disturbance to Dall sheep and mountain goats (USDA 2002b):

- “Locate concentrated human activities away from important wintering, kidding and lambing habitat. A minimum of one-mile avoidance distance is recommended but could vary depending on site-specific circumstances as long as these habitats are adequately protected.”
- “Forest Service permitted or approved activities such as but not limited to, aircraft flights (fixed-wing and helicopter), heli-skiing, or heli-hiking should maintain a minimum landing distance of one-half mile from all observed mountain goats or Dall sheep. While flying, aircraft will maintain a 1,500-foot minimum vertical distance from all observed goats or sheep. Pilots will use flight paths that avoid mountain goats and their habitat as much as possible. Such flight paths will generally avoid ridge tops.”

These guidelines focused on potential sensitivity of mountain goats and Dall sheep to disturbance (Goldstein et al. 2005), particularly from low-level aircraft, associated with summer lambing and kidding habitats and wintering areas on open slopes (USDA 2002b). With minor modifications to language, these guidelines have been carried forward into all alternatives.

Mountain Goat (*Oreamnos americanus*)

Mountain goats are endemic to the mainland around Prince William Sound, Bainbridge, Culross, and Knight Islands, and the Kenai Peninsula. Unlike Sitka deer or caribou, mountain goat distribution has not shifted in recent years, although goats are sensitive to high harvest rates and changes in abundance have occurred.

Ecological conditions to support mountain goat populations differ among seasons largely as a consequence of snow depth influencing forage availability. Across all seasons, mountain goat habitat is characterized by areas of adequate forage adjacent to steep slopes used as escape terrain and refugia from predators. During spring, these requirements result in use of avalanche chutes and low elevation south slopes near escape cover. Following snowmelt, mountain goats in the plan area use high elevation alpine and subalpine areas. During winters with deep snow, mountain goats forage in forest (most frequently old forest) with high canopy cover or on windswept areas with little snow cover (Westing 2014). Goats forage on a broad range of plants, including alder and other shrubs, new shoots of ferns, rhizomes, early emergent sedges, and forbs. Snow and plant conditions limit winter forage, which tends to be dominated by shrub stems and buds, conifers, mosses, and lichens with some forbs, ferns, and grasses (Westing 2014).

Mountain goat abundance in the plan area appears to have declined in the 1940s as World War II increased the number of humans present and the resulting hunting pressure. Goat abundance remained low during the late 1970s and 1980s (Westing 2014). Estimates of mountain goat abundance in and around Prince William Sound (in game management unit 6) suggest approximately 3,400 in 1987 with further reductions to 3,000 by 1994. Careful harvest management begun in the 1980s and continued to present resulted in population increases by 1999 and what appears to be a stable population since, with an estimated abundance of 2,500 to 3,500 goats and a formal minimum population objective of 2,400 (Westing 2014).

On the Kenai Peninsula, mountain goats appeared to decline from the 1990s through 2006 by as much as 30 to 50 percent. Careful harvest management appears to have led to a slight increase since 2006 (Herreman 2014).

Management of harvest rates is particularly important for sustainable mountain goat populations. They have a lower potential for population increase than most ungulates due to late maturity (females often don't breed until four years old) and low twinning rates. The limited extent of suitable habitat (forage near escape terrain) restricts the abundance of goats and results in semi-isolated bands further complicating management (Westing 2014).

Compared to other ungulates, mountain goats are particularly sensitive to anthropogenic disturbances (White and Gregovich 2017), including low elevation flights; human activities, such as skiing; and machinery noise (Goldstein et al. 2005; Richard and Côté 2016). Disturbance on key habitats, such as winter ranges or kidding grounds, is serious threat. If disturbed, mountain goats may leave or avoid using important habitats, become injured, or expend vital energy during periods of declining body condition, all of which can affect the health and survival of individuals and populations. To address concern over the combination of reduced demographic potential, restricted habitat availability, and sensitivity to disturbance, the 2002 forest plan incorporated two guidelines specifically designed to reduce disturbance to Dall sheep and mountain goats (USDA 2002b):

- "Locate concentrated human activities away from important wintering, kidding and lambing habitat. A minimum of one-mile avoidance distance is recommended but could vary depending on site-specific circumstances as long as these habitats are adequately protected."
- "Forest Service permitted or approved activities such as but not limited to, aircraft flights (fixed-wing and helicopter), heli-skiing, or heli-hiking should maintain a minimum landing distance of one-half mile from all observed mountain goats or Dall sheep. While flying, aircraft will maintain a 1,500-foot minimum vertical distance from all observed goats or sheep. Pilots will use flight paths that avoid mountain goats and their habitat as much as possible. Such flight paths will generally avoid ridge tops."

These guidelines focused on potential sensitivity of mountain goats (and Dall sheep) to disturbance (Goldstein et al. 2005), particularly from low-level aircraft, associated with summer kidding habitats and wintering areas on open slopes (USDA 2002b). With minor modifications to language, these guidelines have been carried forward into all alternatives.

Following approval of the forest plan in 2002, mountain goat response to disturbance from helicopter overflights was evaluated. Results suggested that mountain goats in the plan area may be less sensitive to aircraft disturbance than areas studied in Alberta and British Columbia, possibly due to topography and the proximity of escape terrain (Goldstein et al. 2005). However, the distance from mountain goats to aircraft landings and to subsequent use of terrain by recreation users may more strongly influence the level of energy using avoidance behavior by goats (Goldstein et al. 2005)

Migratory Birds

Migratory Birds (general)

Guidance for protection of migratory birds is provided through a number Federal laws and orders, notably the Migratory Bird Treaty Act of 1918 (16 U.S.C. 710), and Executive Order (EO) 13186, which requires Federal agencies to design migratory bird habitat and population conservation principles into agency plans and planning processes, and to coordinate with other agencies and non-Federal partners in planning efforts.

The Forest Service evaluated the population status and ecological needs of migratory birds, including shorebirds, raptors, songbirds, waterfowl and select seabirds, during the development of the forest plan assessment (USDA 2014a). Specific consideration was given to the ecological conditions necessary to support migratory as well as resident species.

Migratory birds: 179 species of birds are thought to occur or could potentially occur consistently within the plan area (USDA 2002a). Except for the dusky Canada goose, there is no scientific evidence to suggest substantial concern for long term persistence of these species. Several species (Kittlitz's murrelet, Aleutian tern, black oystercatcher, pigeon guillemot, and barrows goldeneye) were examined earlier because of their status following the *Exxon Valdez* oil spill and status as Region 10 sensitive species. Bald eagle is examined immediately after this section. Otherwise, migratory birds within the plan area are considered secure and, based on existing plan components, agreements with U.S. Fish and Wildlife Service, outcome of the 2002 forest plan components, and the status of ecosystems on the plan area, considered to function with high integrity.

Portions of the Chugach National Forest are particularly important to migratory birds; the plan area provides thousands of acres of wetlands for nesting waterfowl and shorebirds. Essential migratory bird habitat for millions of western sandpipers, dunlins, and other migratory shorebirds who stop for a few weeks in the Copper River Delta and estuaries of Prince William Sound to double or quadruple their weight during their cross continental migration represent intact, high integrity ecosystems recognized for their global value (USDA 2014a). For example, of the world's 203 species of shorebirds, 33 regularly occur on the Copper River Delta and in Prince William Sound; well over 5 million shorebirds, the largest spring concentration in the Western Hemisphere, visit the region in spring. In some years, 80 percent or more of the western sandpipers in the Pacific Flyway use this region to forage during migration (Bishop and Myers 2000). In addition to birds using wetlands and shoreline habitats, migratory birds occur across all habitats in the plan area. As outlined earlier, the vast majority of landscapes in the plan area support intact ecosystems with high integrity. Ecosystems are expected to continue supporting the array of migratory birds that occurred in the past; however, the relative mix of habitats will change over time as long term directional change combined with human-induced climate change result in biome shifts (Hayward et al. 2017; Hollingsworth et al. 2017), and ecological disturbance processes continue to influence landscapes. Consequences of this directional change are not expected to substantially alter the mix of biomes during the current plan period, but major ecological disturbances, within the range expected based on the natural range of variation, such as mega-earthquakes or wildfire on the Kenai Peninsula, could result in changes in the relative proportions of habitats for migratory birds.

Existing infrastructure in the plan area includes roads, utility corridors, transmission lines, and structures at developed recreational sites. This infrastructure presents some risk to individual birds due to collisions with vehicles or utility structures, and electrocution and may also affect individual migratory bird foraging behavior through the effects of facility lighting and by attracting opportunistic predators like crows, ravens, and jays.

Bald Eagle (*Haliaeetus leucocephalus*)

Under the authorities of 50 CFR Part 22, the bald eagle and golden eagle are protected by the Bald and Golden Eagle Protection Act of 1962 (Eagle Act) (P.L. 87-884). The Migratory Bird Treaty Act (MBTA) and the Eagle Act protect eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service developed National Bald Eagle Management Guidelines to advise land managers under what circumstances the protective provisions of the Eagle Act may apply to their activities. A variety of human activities can potentially interfere with eagles, affecting their ability to forage, nest, roost, breed, or raise young. The guidelines are intended to help minimize such impacts to bald eagles, particularly where they may constitute disturbance, which is prohibited by the Eagle Act. The Eagle Act, as amended, prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald eagles, including their parts, nests, or eggs.

In addition to immediate impacts, this policy also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if upon the eagle’s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

Bald eagles, which were listed as a Federal endangered species in the contiguous 48 states and delisted in 2007, occur throughout the plan area, particularly along coastlines and major rivers. The species achieves its highest density immediately south of the plan area in southeast Alaska (USDA 2002a).

Ecological conditions to support bald eagle populations generally include a combination of forest land adjacent to water bodies with fish or waterfowl prey. Herring, flounder, pollock, eulachon, and salmon are primary prey along the coast while inland birds prey heavily upon salmon. Eagles also prey upon waterfowl, small mammals, sea urchins, clams, crabs, and carrion. Nests most often occur in large trees to support the substantial structure although cliff nests and nesting in human infrastructure occurs.

Bald eagle populations were damaged by the *Exxon Valdez* oil spill but the Trustee Council considered bald eagles recovered from the spill (EVOS Trustee Council 2010) and field studies suggested population increases by 1992 (Bowman et al. 1995). An estimated 1,800 to 2,000 pairs of bald eagles occur in Prince William Sound during the summer (Bowman et al. 1995), and estimates of abundance for the broader plan area are not available.

Bald eagles contribute important ecosystem services to the Chugach National Forest and surrounding area. In particular, as an abundant predator of marine animals, eagles transfer marine-derived nutrients to terrestrial and freshwater systems and process carrion. Bald eagles are an important predator of dusky Canada goose, a Regional Forester's Sensitive Species and designated SCC within the plan area. In years when eulachon (an anadromous fish) are less abundant on the Copper River Delta, predation of geese by bald eagles increases, particularly predation of young geese.

Visitors value observations of eagles; the chance to watch the U.S. national bird functioning in its natural environment is a treasure for many. Bald eagles play a key role in the language, social structure, history, ethical instruction, traditional rituals, and clothing of Alaska Natives. For instance, the eagle is one of two moieties in the Tlingit culture and the eagle wing was used in the past to sweep out tribal houses and the tail for dancing regalia while the beak was sometimes used as a spoon (Wright and Schempf 2008). The cultural and aesthetic importance of the bald eagle has not diminished.

Environmental Consequences

Introduction

At the broad scale, the abundance and distribution of aquatic, riparian and terrestrial habitats are not expected to be measurably affected by any of the four alternatives. Therefore, these habitats should retain the capacity to support thriving populations of most native wildlife species. A great deal of the management guidance established in the 2002 forest plan, including standards and guidelines, remains relevant, and has been incorporated as plan components into all current plan alternatives. Likewise a wide range of ongoing activities and uses are expected to continue at similar levels under all four alternatives (see table 10). Since the management direction and expected uses are consistent, the effects to most wildlife species, addressed in the FEIS for the 2002 forest plan, remain consistent and are not duplicated here. The primary differences are:

- The amount of land recommended for wilderness area designation
- The amount of NFS lands potentially open to motorized access as determined through recreation opportunity spectrum classes and existing travel management decisions
- Specific threats to key wildlife species or habitats that are addressed by plan components or other management actions

This analysis is focused on the effects of key differences between the alternatives to help managers and the public clearly understand any relevant consequences and trade-offs, while minimizing information less relevant to the decision. The environmental consequences for terrestrial wildlife species and habitats are presented in three sections:

- Effects Common to All Alternatives
- Effects of Wilderness and Motorized Access
- Effects to Key Wildlife Species

Effects Common to all Alternatives

Management of the Chugach National Forest remains predominantly focused on sustaining natural landscapes and functioning ecological systems that support thriving native wildlife populations, providing a variety of subsistence, recreational, and commercial opportunities for local residents and visitors. The rugged and remote nature of the landscape, combined with a very limited road system (about 99 percent of NFS lands are roadless) has been important to maintaining these ecological systems, but Forest Service management direction plays a key role as well.

In 1980, ANILCA established three special areas within the Chugach National Forest: the Nellie Juan-College Fiord Wilderness Study Area (1,894,000 acres) and the Copper/Rude River and the Copper River-Bering River areas (1,518,873 acres). The Nellie Juan-College Fiord Wilderness Study Area is managed to maintain its presently existing character and potential for inclusion in the National Wilderness Preservation System until Congress makes a decision regarding wilderness recommendation. For the Copper/Rude River and Copper River-Bering River areas, ANILCA provided specific guidance directing these areas be managed for the conservation of fish and wildlife. Effectively, this legislation prioritizes the conservation of natural landscapes and wildlife habitats on 64 percent of the Chugach National Forest. While the remaining 36 percent of the national forest is not subject to the same legislative direction, these lands also support ecologically intact landscapes and a nearly full complement of native wildlife species.

Nearly all watersheds within the national forest remain in good condition, functioning properly and supporting the wetland, riparian, and stream habitats on which wildlife communities rely. Terrestrial vegetation shows similar ecological integrity and resilience. While large scale climate associated changes may eventually alter these ecological systems, most notably reducing the extent of alpine habitats, ecological conditions are expected to remain within the natural range of variation well beyond the 15-year plan period (USDA 2014a).

The majority of ground disturbing vegetation, fuels, and habitat management projects within the national forest are concentrated into a relatively small footprint, generally in close proximity to the limited road system. This has helped to minimize the spread of invasive species, reduce fragmentation, and sustain habitat connectivity across the landscape.

Due to the vast, ecologically intact landscape supported by the Chugach National Forest and surrounding lands and the limited footprint of ground disturbing actions proposed, the abundance, condition, distribution and persistence of the ecosystems supporting native wildlife communities are unlikely to be measurably affected by any of the alternatives proposed. As a consequence, the abundance, distribution, and persistence of most native wildlife species are likewise not expected to be measurably affected by the proposed alternatives during the 15-year plan period.

Effects of Wilderness and Motorized Access

The effects of the recommended wilderness area designation are common to all alternatives and will be discussed here. The effects of recreation opportunity spectrum classes vary by alternative and will be addressed in the effects section for each alternative.

The recommendations for wilderness area designation range from 26 to 35 percent of the Chugach National Forest, equating to a difference of approximately 496,690 acres between alternatives A and D. While a substantial total, these lands are widely distributed in relatively small blocks across the wilderness study area, and represent only nine percent of the total lands managed by the Forest Service. Wilderness area designation has the potential to effect wildlife primarily in two ways, it would serve to withdraw the lands from mineral entry, and it would place additional restrictions on certain types of activities and uses, most notably certain types of motorized uses.

Historically, numerous claims have been filed and a number of mines have operated on lands within the wilderness study area. Congressional wilderness area designation would lead to withdrawing lands from mineral entry and preventing the location and filing of new mining claims, but would not affect the rights to existing mining claims or mining operations. However, until wilderness is congressionally designated, new claims can be filed at any time on any lands within the entire wilderness study area. While mining operations unquestionably affect certain wildlife species and habitats, in the absence of detailed, site specific proposals, it is not possible to evaluate the potential effects on wildlife populations inhabiting the national forest.

For designated wilderness areas in other parts of the United States, the restrictions on motorized access can have a significant influence on wildlife populations, especially in more remote locations, by minimizing wildlife disturbance from human presence and reducing the transport of invasive species and other contaminants. In Alaska, the regulations governing motorized access in designated wilderness areas are very different. Section 1110 of ANILCA permits in “the use of snowmachines (during periods of adequate snow cover, or frozen rivers conditions in the case of wild and scenic rivers), motorboats, airplanes, and non-motorized surface transportation methods for traditional activities (where such activities are permitted by this Act or other law) and for travel to and from villages and homesites.” As a result, wilderness area designation in Alaska does not provide wildlife populations the same protections it does in other parts of the nation. The limited nature of the access restrictions within wilderness areas in Alaska and the relatively small and dispersed nature of the lands in question make it unlikely that wilderness area designation under any of the alternatives would measurably affect the abundance, distribution, or persistence of wildlife populations across the national forest.

The recommendations for wilderness area designation will have no effects on the ability of the Chugach National Forest to continue to provide an abundance of suitable, interconnected habitats sufficient to sustain thriving native wildlife populations and communities.

Alternative A No Action

Motorized access, especially onto lands well outside the immediate road corridors, can have major effects on the well-being, abundance, and distribution of wildlife populations. Many wildlife species are sensitive to human activities taking place near key habitats, and some species, such as mountain goats, are especially so. Animals may leave or avoid using important habitats, reduce foraging time, become injured while fleeing, or expend vital energy during periods of declining body condition, all of which can affect the health and survival of individuals and populations. The type, duration, frequency, intensity, and unpredictability of disturbances can be important factors in determining the extent to which human disturbances may affect individuals and populations of particular species (USDA 2014a). However, other factors, such as the sensitivity of life stage, season, and availability of escape habitat or cover, weather, mobility, and physiological condition, are equally important. For example, the effects of disturbing mountain goats on limited winter range, causing them to expend vital energy while in declining body condition from a long winter, will likely be much greater than a similar disturbance during the summer when forage is abundant, animals are in good condition, and movement to other habitats is easy.

When evaluating the effects of motorized access, it is important to consider both the disturbance effects of the vehicle and the disturbance effects of other human activities that occur in these areas as a result of gaining access via the vehicle. Motor vehicles are typically loud, move rapidly and unpredictably, and frequently disperse during travel rather than following consistent routes. They can be a major disturbance to many wildlife species.

Winter snowmachine use is the most common and widespread motorized use of NFS lands, and due to habitat limitations, restricted mobility, and the vulnerability of animals in poor physical condition, it may have the greatest effects on sensitive species. Historically, snowmachines were restricted to more moderate terrain, and used primarily for recreational riding, work, and subsistence purposes. Recent technological advances have increased snowmachine range and capabilities, enabling users to traverse steeper and more rugged terrain.

Anecdotal information suggests that in recent years the backcountry skiers and snowboarders traditionally considered as primarily non-motorized recreationists, appear to be relying heavily snowmachines to reach remote high elevation areas previously accessible only by aircraft. Use of aircraft by backcountry skiers and snowboarders is also thought to be increasing, and it has been reported that some recreationists are even using aircraft to transport snowmachines further into remote locations.

The Forest Service does not have the information necessary to determine the current level or patterns of motorized use, how these patterns may be changing, or how this use may be affecting sensitive wildlife species inhabiting the Chugach National Forest. In the absence of this information, the current analysis will focus on the acreage of lands classified open or potentially open for motorized uses as a surrogate to the area of habitat at risk from increased human disturbance.

Like all other alternatives, 21 percent of non-roaded NFS lands would be open or potentially open for use as winter motorized allowed (see table 100). Under this alternative, like alternative B, 11 percent of non-roaded NFS lands would be open or potentially open for general motorized use. This alternative would open or potentially open for motorized use the largest amount (32 percent) of non-roaded NFS lands. Not only does this alternative potentially open a greater percentage of lands for motorized access, but a larger proportion of lands subject to motorized use throughout the year. As a result this alternative would have the largest negative effect on wildlife species.

Table 100. Lands potentially open to motorized access by alternative

Type of Motorized Access	Alternative A Acres (percentage)	Alternative B Acres (percentage)	Alternative C Acres (percentage)	Alternative D Acres (percentage)
Semi-primitive Non-motorized (Winter Motorized Allowed)	1,124,655 (21)	1,111,972 (21)	1,134,682 (21)	1,134,550 (21)
Semi-primitive Motorized	583,283 (11)	574,556 (11)	449,129 (8)	449,151 (8)
Total motorized access	1,707,938 (32)	1,686,528 (32)	1,583,811 (29)	1,583,701 (29)

Alternative B

Like all other alternatives, 21 percent of non-roaded NFS lands would be open or potentially open for use as Winter Motorized Allowed (see table 100). Under this alternative, like alternative A, 11 percent of non-roaded NFS lands would be open or potentially open for general motorized use. Alternative B includes slightly fewer acres open or potentially open for motorized use than alternative A (31 percent of non-roaded NFS lands), but the differences are not significant. The effects of this alternative on wildlife species would be similar to alternative A.

Alternative C

Like all other alternatives, 21 percent of non-roaded NFS lands would be open or potentially open for use as Winter Motorized Allowed (see table 100). Under this alternative, like alternative D, only eight percent of non-roaded NFS lands would be open or potentially open for general motorized use. In total, this alternative would open or potentially open for motorized use 29 percent non-roaded NFS lands. The three percent reduction of year-round motorized use is likely to benefit certain wildlife species. This alternative would have fewer negative effects to wildlife species than either alternatives A or B.

Alternative D

Like all other alternatives, 21 percent of non-roaded NFS lands would be open or potentially open for use as Winter Motorized Allowed (see table 100). Under this alternative, like alternative C, only eight percent would be open or potentially open for general motorized use. In total this alternative would open or potentially open use 29 percent non-roaded NFS lands for motorized. The three percent reduction of year-round motorized use is likely to benefit certain wildlife species. This alternative would have fewer negative effects to wildlife species than either alternative A or B.

Effects to Key Wildlife Species

This section examines the status of ecological conditions supporting specific species, including at-risk species and a set of species particularly important for delivery of ecosystem services and multiple resource management (see table 99). This evaluation provides a more detailed analysis of specific ecological characteristics necessary to support species and address other threats to species.

At-risk Species

Steller Sea Lion (*Eumetopias jubatus*)

The guidance established in the forest plan for protection and management of the Steller sea lion is common to all alternatives, and the environmental consequences for this species are likewise expected to be consistent.

Indirect Effects

The western distinct population segment of the endangered Steller sea lion is not expected to be measurably affected by any of the alternatives, and Forest Service management activities are unlikely to affect the suitability or availability of any rookeries or haulout sites located on NFS lands.

Availability of Suitable Habitat

The only NFS lands used by Steller sea lions are rookery and haulout sites located on gradually sloping ocean shorelines protected from waves. Aside from disturbances, such as catastrophic storms, earthquakes or tsunamis, these habitats should remain suitable for sea lion use. The two rookeries and seven haulouts identified by the National Marine Fisheries Service as critical habitat (50 CFR 226.202) and are protected by Federal regulations from all human disturbance. Steller sea lions use other haulout sites on the national forest but usually in smaller numbers or with less regularity. Forest Service management activities are unlikely to affect any coastal lands that could serve as potential haulout sites, and the forest plan standard designed to minimize human disturbance to this species effectively prevents management actions from disturbing animals using haulouts.

Threats to Abundance, Distribution, or Persistence

Any federally authorized actions or activities within this designated critical habitat require prior consultation with the National Marine Fisheries Service. Sea lions use many other sites across the national forest for haulouts, and may be easily disturbed by human activities. To minimize the potential for disturbance and potential incidental take under the terms of the MMPA, the forest plan includes a specific standard directing that “Actions or activities conducted or authorized by the Forest Service occurring within 750 feet of any sea lion hauled-out on land will be designed and implemented to minimize disturbance to prevent hauled out animals from flushing.” The combination of protecting designated critical habitat and implementing additional measures to minimize the potential for management actions or authorized activities to disturb individual or groups of sea lions should ensure management of the Chugach National Forest does not negatively affect recovery of the Steller sea lion within the western distinct population segment.

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Cook Inlet Beluga Whale (*Delphinapterus leucas)*

The environmental consequences for the Cook Inlet beluga whale and its habitat are common to all alternatives.

Indirect Effects

The Cook Inlet distinct population segment of the beluga whale is not expected to be measurably affected by any of the alternatives. Forest management activities are unlikely to affect the suitability or availability marine waters or the waters of Twentymile River for use by Cook Inlet beluga whales.

Availability of Suitable Habitat

The State of Alaska manages the marine waters of upper Cook Inlet, which are the year-round habitat of the Cook Inlet beluga whale population, and the Twentymile River, which provides seasonally important foraging habitat. While lands administered by the Forest Service adjoin both waterbodies, the management direction proposed by the forest plan would have very limited potential to effect Cook Inlet beluga whales or their habitat. Aside from the immediate highway corridor, the lands adjacent to the Twentymile River remain roadless and have been assigned to the Backcountry management area. Vegetation or habitat management projects and other ground disturbing activities are not proposed for this area.

Threats to Abundance, Distribution, or Persistence

The use of motorboats on the Twentymile River has the potential to disturb Cook Inlet beluga whales and affect their use of this waterway. However, the State owns the submerged lands beneath this river and has management authority over boating and other activities occurring up to the ordinary high water line. The Forest Service can direct activities authorized under special use permits, but has no authority to manage public use of the Twentymile River. Currently three special use permits issued by the Chugach National Forest authorize guides to use motorboats on the Twentymile River to access NFS lands. Concerns for the potential disturbance to Cook Inlet beluga whales led to informal consultation with the National Marine Fisheries Service beginning in November 2016. The National Marine Fisheries Service representatives expressed that their greatest concern was minimizing disturbance during early season feeding following the winter fasting period. In April, Cook Inlet beluga whales forage in the Twentymile River, focusing on smolting salmon and Dolly Varden trout, while in May they target eulachon runs. These discussions led to a modification of existing special use permits, prohibiting use of the river by permit holders prior to June 1 to avoid disturbance during the critical early season foraging period.

The National Marine Fisheries Service representatives also noted that Cook Inlet beluga whales use Twentymile River in August to feed on salmon runs. The importance of the Twentymile River to Cook Inlet beluga whales as late season feeding habitat is unclear, and public use of the river by fishermen is heavy during this period. It is estimated that the combined motorized use of the river by guides operating under the three special use permits authorized by the Forest Service is less than two percent of overall motorized use of the river during the salmon runs.

Revision of existing special use permits to prohibit operation of motorboats on the Twentymile River prior to June 1 has eliminated the potential for Forest Service authorized guide activities to disturb Cook Inlet beluga whales during the critical early season foraging in the river. Since Forest Service permitted activities are estimated to represent less than two percent of overall motorboat use of the river during late season salmon runs, and the extent to which the river is used by Cook Inlet beluga whales during this period is unknown, the potential influence of this use is considered negligible.

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Dusky Canada Goose (*Branta canadensis occidentalis*)

The environmental consequences for the dusky Canada goose and its habitat are common to all alternatives.

Indirect Effects

The status evaluation of the dusky Canada goose (region 10 Evaluation Form: dusky Canada goose 2013) raised substantial concern for persistence of this species in the plan area, due primarily to declining nesting habitat abundance and quality. This led the regional forester to designate the dusky Canada goose as a species of conservation concern on December 1, 2015.

The ongoing nesting habitat degradation is the result of hydrologic changes caused by geologic uplift that occurred during the 1964 earthquake. The forestwide and management area plan components are insufficient to address the declining availability and quality of nesting habitat and would not provide the ecological conditions necessary to maintain a viable population of dusky Canada geese within the plan area. The capability of the Forest Service to effectively resolve the long term availability of suitable nesting habitat on the Copper River Delta is limited. However, two additional plan components provide specific direction to address nesting habitat concerns and reduce human disturbance. The first is an established objective to continue implementation of an effective long term artificial nest program designed to improve reproductive success that appears to have stabilized the population of the dusky Canada goose. This program has recently been broadened to include strategies to reduce predation pressure on nests and young dusky Canada geese. The second is a guideline designed to minimize the potential for human disturbance to nesting dusky Canada geese. Full implementation of these plan components should ensure the ecological conditions within the plan area remain suitable to maintain a stable and viable population of dusky Canada geese through the 15-year planning period.

Availability of Suitable Habitat

Although dusky Canada geese are known to nest in a few different of locations within Prince William Sound and the Gulf of Alaska, the geese nesting in the marsh habitats of the Copper River Delta continue to produce nearly all successful fledglings (Cooper pers. comm. 2017).Natural vegetation succession continues to change these marsh habitats. The 1964 earthquake uplifted these lands three to four meters, leading to drier habitats and an increased abundance of shrubs and trees, making goose nests much more susceptible to both terrestrial and avian predators. Since these marsh habitats support nearly the entire successful reproduction for the dusky Canada goose, maintaining the viability of these nesting habitats is critical. While artificial nesting structures continue to be an effective measure, ongoing vegetation succession remains a concern. Over the long term, many of the existing nesting ponds may slowly become sphagnum moss bogs (DeVelice et al. 2001a) and become no longer suitable for nesting geese. The Forest Service will continue efforts to maintain suitable nesting habitat on the Copper River Delta under all alternatives.

Table 101. Availability of suitable habitat for dusky Canada goose

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
Nesting	Limited +1 minor benefits	Good +2 moderate benefits	Localized 0 no measurable effects	Isolated 0 no measurable effects
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Threats to Abundance, Distribution, or Persistence

A more immediate concern is the effects of increased predation, notably by bald eagles when other prey species, such as eulachon, are unavailable during the nesting season. The Forest Service is working with partners to develop methods for discouraging predator use of important nesting habitat areas and other means of reducing the impacts of predation on dusky Canada geese. At a site specific level, human disturbance can negatively affect nesting dusky Canada geese. To reduce disturbance, a guideline included in the forest plan directs the Forest Service to ensure management actions or authorized activities are located at least 330 feet from key waterfowl or shorebird intertidal concentration or nesting areas. The Forest Service remains committed to monitoring trends in population status and nesting success and to working with partners to maintain or improve nesting success for this species.

Table 102. Threats to abundance, distribution and persistence of the dusky Canada goose

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Predation	Medium	Severe	Population	zero-5 years	FS	Direct/limited
Disturbance	Low	Moderate	Population	zero-5 years	FS	Direct/limited
Harvest	Medium	Severe	Population	6-15 years	USFWS/ ADF&G/ AK/ OR	None
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Cumulative Effects

In 2015, hunting regulations were modified to no longer allow legal incidental harvest of dusky Canada geese in Washington, Oregon, or Alaska, but check stations for monitoring goose harvest have also been eliminated. If these measures are successful at reducing dusky Canada goose mortality, it is hoped that population numbers may increase.

Regional Forester's Sensitive Species

Forest Service Manual FSM 2670 established policy directing regional foresters to designate as sensitive species plants or animals whose population viability is a concern and to give special attention to management of these species. This was an important component of the 2002 forest plan. However, the 2012 Planning Rule established species of conservation concern as the new method for addressing plants or animals for which population viability is a concern. Under the revised forest plan, species of conservation concern will assume a conservation planning role similar to that currently held by sensitive species. Because the formal transition from sensitive species to the species of conservation concern approach will occur only when the record of decision is signed, the DEIS must evaluate and disclose outcomes of the revised plan on regionally designated sensitive species. This section evaluates and discloses outcomes of the proposed alternatives on the current sensitive species list from 2009 (Goldstein et al. 2009).

Black Oystercatcher (*Haematopus bachmani*)

The environmental consequences for the black oystercatcher and its habitat is common to all alternatives.

Indirect Effects

Black oystercatcher populations are not expected to be measurably affected by any differences between alternatives considered, and Forest Service management activities are unlikely to affect the availability of suitable habitat on NFS lands.

Availability of Suitable Habitat

As described previously, black oystercatchers forage primarily within intertidal habitats and nest on sand, gravel, or rocky beaches and headlands just above the high tide line. Within the Prince William Sound and Copper River Delta geographic areas, the Forest Service manages nearly 2,900 miles of coastline, of which approximately 1,800 miles are located within the Nellie Juan-College Fiord Wilderness Study Area. This extensive undeveloped coastline provides abundant black oystercatcher habitat, the majority of which is managed to maintain natural processes, allowing natural ecological processes to operate (see table 103).

Table 103. Availability of suitable habitat for black oystercatcher

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
Nesting	Abundant 0 no measurable effect	Good 0 no measurable effect	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

A cooperative monitoring program was initiated in 2012 employing an objective sampling scheme examining black oystercatcher abundance in Prince William Sound and collaborating with partner agencies for information on areas to the west. Results of that monitoring have not been fully analyzed, but anecdotal and preliminary indications demonstrate widespread distribution of black oystercatchers on coastlines in the plan area and show no evidence suggesting that black oystercatcher populations are unstable. Within the plan area, there are no identified site specific threats to persistence, and ecological conditions to support breeding black oystercatchers appear to be largely intact.

Threats to Abundance, Distribution, or Persistence

At a site specific level, human disturbance can negatively affect individual oystercatchers and their nests (see table 104). The level of human use along the coastal shorelines within the Chugach National Forest varies widely. While the recreation opportunity spectrum classes for certain coastal lands vary by alternative, the amount of shoreline involved is relatively small. Much of the coastline suitable for oystercatchers is often of seldom used or inaccessible to people. Recreation opportunity spectrum classes may have limited site specific effects on human use, but the potential for these to alter human use patterns sufficiently to measurably reduce disturbance to black oystercatcher populations is low. However, the plan provides guidelines requiring management actions or authorized activities be at least 330 feet from key waterfowl or shorebird intertidal concentration or nesting areas, which includes nesting black oystercatchers.

The extensive undeveloped shorelines within the Chugach National Forest provide abundant black oystercatcher habitat, which appears to support an abundant and broadly distributed population. However, the Forest Service will continue coordinating with appropriate partners to identify and address any emerging ecological issues or concerns affecting black oystercatcher populations and availability of habitat on NFS lands.

Table 104. Threats to abundance, distribution, and persistence of black oystercatcher

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Disturbance	Low	Minor	Localized	>15 years	FS	Direct/minor
Forage availability	Medium	Severe	Regional	>15 years	NA	None
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Kittlitz's Murrelet (*Brachyramphus brevirostris*)

The environmental consequences for the Kittlitz's murrelet and its habitat are common to all alternatives.

Indirect Effects

Kittlitz's murrelet populations are not expected to be measurably affected by any differences between the alternatives, and Forest Service management activities are unlikely to affect the availability of suitable nesting habitat on NFS lands.

Availability of Suitable Habitat

The Prince William Sound Geographic Area is dominated by the 1,940,007 acre Nellie Juan-College Fiord Wilderness Study Area, which provides an abundance of suitable nesting habitat in close proximity to preferred marine foraging habitat. Lands within the wilderness study area are designated unsuitable for most vegetation and habitat manipulations and should remain available indefinitely. Suitable nesting habitat is found throughout the Kenai Peninsula and Copper River Delta geographic areas as well (see table 105). While a wide variety of Forest Service management activities may occur on lands outside the wilderness study area, the barren habitats preferred by Kittlitz's murrelets are generally not suitable for vegetation or other management activities and seldom are affected by management activities.

Table 105. Availability of suitable habitat for Kittlitz's murrelet

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
Nesting	Abundant 0 no measurable effect	Good 0 no measurable effect	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Threats to Abundance, Distribution, or Persistence

This species was reviewed by the U.S. Fish and Wildlife Service in 2013 and determined unwarranted for listing under the ESA. A subsequent review by the regional forester found no consistent evidence of a downward population trend or current threats leading to concern for persistence across the plan area. The regional forester chose not to designate the Kittlitz's murrelet as a species of conservation concern. The Forest Service will continue coordinating with appropriate partners to identify and address any emerging ecological issues or concerns affecting Kittlitz's murrelet populations and availability of nesting habitat on NFS lands.

Table 106. Threats to abundance, distribution, and persistence of Kittlitz's murrelet

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Forage availability	Medium	Severe	Regional	>15 years	NA	None
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Aleutian Tern (*Sterna aleutica/Onychoprion aleuticus*)

The environmental consequences for the Aleutian tern and its habitat are common to all alternatives.

Indirect Effects

Aleutian tern populations are not expected to be measurably affected by any differences between the alternatives considered, and forest management activities are unlikely to affect the availability of suitable nesting habitat on NFS lands.

Table 107. Availability of suitable habitat for Aleutian tern

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
Nesting	Abundant 0 no measurable effect	Good 0 no measurable effect	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Availability of Suitable Habitat

As described previously, the Aleutian tern forages in marine waters, nesting colonially in a wide variety of habitats near the coast. Within the Prince William Sound and Copper River Delta geographic areas the Forest Service manages nearly 2,900 miles of coastline, of which approximately 1,800 miles are located within the Nellie Juan-College Fiord Wilderness Study Area. This extensive undeveloped coastline provides an abundance of varied and relatively undisturbed habitat, the majority of which is managed to maintain natural processes, allowing natural ecological processes to operate (see table 107). Evidence suggests that suitable nesting habitat and the ecological features necessary to support Aleutian terns are not limiting on the Chugach National Forest.

Threats to Abundance, Distribution or Persistence

A broad westward breeding shift may have occurred with stable to increasing breeders on the U.S. and Russian coasts, but the reasons for this shift are unknown. There are no clear threats to Aleutian tern populations (see table 108). The Forest Service will continue coordinating with appropriate partners to identify and address any emerging ecological issues or concerns affecting Aleutian tern populations and availability of habitat on NFS lands.

Table 108. Threats to abundance, distribution, and persistence of Aleutian tern

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
None	NA	NA	NA	NA	NA	NA

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Species Important for Ecosystem Services or Multiple Resource Management

This section examines the current status and trend of several species highlighted in the forest plan assessment (USDA 2014a) and the 2002 FEIS (USDA 2002a) as important for ecosystem services and multiple resource management.

Brown bear, Sitka black-tailed deer, moose, caribou, Dall sheep, and mountain goat all represent important subsistence and/or sport harvest species in the plan area. The forest plan assessment (USDA 2014a) provides background on these species, including ecological interactions, economic value, status, threats, and management considerations. The 2002 FEIS (USDA 2002a) also provides important context regarding these species and the 2002 forest plan (USDA 2002b) outlines current plan components.

Brown Bear (*Ursus arctos*)

The environmental consequences for the brown bear and its habitat are common to all alternatives.

Indirect Effects

Brown bear populations are not expected to be measurably affected by any differences between the alternatives, and Forest Service management activities are unlikely to affect the availability of suitable habitat on NFS lands. Implementation of forest plan guidance minimizing human disturbance to brown bear core habitat areas, reducing availability of human attractants, and increasing national forest users' knowledge and awareness of bear behavior and appropriate precautionary measures should continue reducing confrontations between humans and bears and human caused bear mortality.

Availability of Suitable Habitat

The availability of suitable brown bear habitat across the national forest has remained relatively stable over the last 15 years. NFS lands have not been subject to large scale fires or other catastrophic disturbances, and vegetation, fuels reduction and habitat management projects have been limited in scope and concentrated primarily in proximity to the limited road system on the Kenai Peninsula. Reforestation efforts are beginning on Knowles Head on lands recently acquired from private owners that had been previously logged. Once restored, these lands should provide improved brown bear habitat. Under any of the alternatives proposed, the availability of suitable brown bear habitat should remain relatively stable across the national forest throughout the 15-year plan period and well beyond (see table 109).

Table 109. Availability of suitable habitat for brown bear

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All	Abundant 0 no measurable effect	Good +1 minor benefits	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Table 110. Threats to abundance, distribution, or persistence of brown bear

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Disturbance	Medium	Moderate	Forestwide	6-15 years	FS	Direct/limited
Human-bear conflict	High	Severe	Forestwide	6-15 years	FS/ADF&G/ Communities	Direct/limited
Harvest	High	Severe	Forestwide	zero-5 years	ADF&G	None
Predator control	Medium	Severe	Forestwide	zero-5 years	ADF&G	None
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Threats to Abundance, Distribution, or Persistence

Brown bear management was a key component of the 2002 forest plan. Concern for high brown bear mortality, especially on the Kenai Peninsula, led the Forest Service to incorporate specific measures in the 2002 forest plan designed to minimize human disturbance in core brown bear habitat, reduce the availability of human attractants on the national forest and adjacent lands, and increase the national forest user's knowledge and awareness of methods to minimize human-bear interactions. These measures appear to have reduced the number of problem bear deaths on NFS lands in recent years, and are being incorporated into all the alternatives of the proposed forest plan. The Forest Service will continue existing efforts to minimize human disturbance to core brown bear habitat and reduce human-bear conflicts on NFS and neighboring lands, thereby reducing the potential for additional human caused bear mortalities.

Cumulative Effects

The new estimate of 582 brown bears inhabiting the Kenai Peninsula (Morton et al. 2015) suggests the population has greater resilience than expected based on the information available in 2002. However, the increased harvest leading to a threefold increase in human caused bear mortality is well above recommended sustainable harvest rates in published literature (Knapp 2006; Miller 1990; Swenson 2004) and is cause for serious concern. The Forest Service has no direct role in the management of State brown bear harvest, but remains open to opportunities for collaboration in the management of the brown bear on NFS lands.

Sitka Black-tailed Deer (*Odocoileus hemionus*)

The environmental consequences for the Sitka black-tailed deer and its habitat are common to all alternatives.

Indirect Effects

Sitka black-tailed deer populations are not expected to be measurably affected by any differences between the forest plan alternatives, and management activities are unlikely to affect the availability of suitable habitat on NFS lands.

Table 111. Availability of suitable habitat for Sitka black-tailed deer

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
Winter	Abundant 0 no measurable effect	Good 0 no measurable effect	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Availability of Suitable Habitat

Habitat for Sitka black-tailed deer is abundant across Prince William Sound and the Kenai Peninsula. Managed to maintain natural processes, NFS lands in Prince William Sound will continue to be dominated by late seral and old growth forests that provide important cover for wintering Sitka black-tailed deer (see table 111). Deep snowfall and severe winter weather are considered the primary factors limiting the northward expansion of this species. If long term winter weather patterns continue to moderate, Sitka black-tailed deer are likely to continue expanding their range.

Threats to Abundance, Distribution, or Persistence

The Sitka black-tailed deer inhabiting the Chugach National Forest are at the extreme northern limit of their range and are slowly expanding further north and west. Populations within the national forest are generally stable or growing but suffer from occasional declines following severe winters. There are no current threats to the abundance, distribution, or persistence of this population.

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Moose (*Alces alces*)

The environmental consequences for the moose and its habitat are common to all alternatives.

Indirect Effects

Moose populations across the national forest are expected to fluctuate through time in response to the shifting abundance and distribution of early seral vegetation. Over the 15-year plan period, the availability of suitable moose habitat on the Kenia Peninsula is expected to decline slowly due to vegetation succession, while moose habitat on the Copper River Delta is expected to remain stable.

Availability of Suitable Habitat

The natural vegetation patterns of the Kenai Peninsula Geographic Area should continue to sustain native moose populations at relatively low densities typical of these mature seral stage habitats, which are subject to severe winters and deep snow (see table 112). The public desire to increase moose hunting opportunities within the Chugach National Forest would be difficult to accommodate. The artificially high moose populations on the Kenai Peninsula, the result of human caused fires and extensive predator control in the 1950s and 1960s, were unsustainable over the long term, eventually resulting in extensive vegetation damage and large moose die-offs (USDA 2014a). Additionally, the opportunity for using broad scale fire for habitat manipulation has been greatly reduced due to expanded human development throughout the Kenai Peninsula increasing the risk to human safety, property damage, and health threats from smoke. The Forest Service will continue hazardous fuel reduction, vegetation improvement, and habitat treatments, most of which create areas of early seral habitat that provide high quality moose forage. Over the last decade an average of approximately 1,300 acres per year have been treated. The availability of suitable moose habitat within the Kenai Peninsula Geographic Area will likely decline slowly during the 15-year plan period (McDonough 2010), but fuels reduction, vegetation, and habitat improvement projects in relative proximity to the existing road system should provide some additional habitat.

The introduced moose population in the Copper River Delta Geographic Area appears to be stable overall but is increasing slightly near Cordova. The availability of suitable moose winter range is a limiting factor for this population. In recent years, the Forest Service has been using Hydro ax treatments in core winter range to increase browse availability where spruce and alder encroachment has been degrading habitat quality. The availability of suitable moose habitat within the Copper River Delta Geographic Area should remain relatively stable during the 15-year plan period, provided ongoing winter range habitat improvement projects can be periodically maintained to offset natural vegetation succession on core winter range habitat.

Table 112. Availability of suitable habitat for moose

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All (Kenai Peninsula Geographic Area)	Abundant 0 no measurable effect	Fair +1 minor benefits	Dispersed 0 no measurable effect	Unrestricted 0 no measurable effect
Winter range (Copper River Delta Geographic Area)	Limited 0 no measurable effect	Good +2 moderate benefits	Localized 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Threats to Abundance, Distribution, or Persistence

Moose within the Kenai Peninsula Geographic Area remain well distributed at low densities across NFS lands. Populations have fluctuated at low levels since predator populations stabilized and habitat progressed to later seral stages and are expected to remain stable through the 15-year plan period. There are no threats to the abundance, distribution, or persistence of this population.

Moose on the Copper River Delta Geographic Area are abundant, although populations may be affected by a gradual reduction in available willow browse caused by encroachment of spruce and alder into early seral habitats. Aside from the effects of natural succession on habitat suitability, there are currently no threats to the abundance, distribution, or persistence of this population.

Cumulative Effects

Collisions between moose and vehicles is a major cause of mortality along the highway corridors with an estimated average of 225 moose killed annually on the Kenai National Wildlife Refuge alone (USFWS 2014). Additionally, while the moose winter tick (*Dermacentor albipictus*) is not yet present in Alaska, there is concern that the tick is moving north as the climate warms and may soon reach the State, potentially impacting moose populations. Sport hunting and subsistence moose harvest regulations have the potential to substantially influence many aspects of moose populations and could affect the abundance and distribution of this species across the national forest.

Caribou (*Rangifer tarandus*)

The environmental consequences for caribou and its habitat are common to all alternatives.

Indirect Effects

Caribou populations are not expected to be measurably affected by any differences between the alternatives, and forest management activities would not affect the availability of suitable habitat.

Table 113. Availability of suitable habitat for caribou

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All	Limited 0 no measurable effect	Good 0 no measurable effect	Dispersed 0 no measurable effect	Reduced 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Availability of Suitable Habitat

Within the Chugach National Forest, most of the lichen rich alpine habitats favored by caribou remain in a natural ecologically functioning condition, and are generally considered unsuitable for vegetation management due to their sensitivity to fire and other mechanical treatments (see table 113). Although these habitats are not being manipulated by management actions, vegetation patterns are shifting as climatic conditions change. The availability of alpine tundra, which serves as the primary caribou habitat, is gradually being reduced as trees and shrublands move up in elevation. These gradual habitat changes may eventually be reflected in declining caribou populations within the national forest, but the low rate of habitat decline is not expected to affect the abundance, distribution, or persistence of caribou over the 15-year plan period.

Threats to Abundance, Distribution, or Persistence

Caribou populations are affected by natural factors such as weather, snow depth, avalanche, predation, and disease, and human caused factors such as disturbance, vehicle collisions, and harvest. Sport hunting and subsistence harvest are the major human caused mortality factors for caribou inhabiting the Chugach National Forest. For game management unit 7 the subsistence harvest quota is currently five caribou. Due to concerns over past herd declines, the Alaska Department of Fish and Game determines the specific number of caribou sport hunting permits to be issued for game management unit 7 each year based on information collected from previous fall caribou surveys. In recent years the Alaska Department of Fish and Game has issued 25 sport hunting permits annually for game management unit 7. Continued careful management of harvest rates should minimize the human caused threats to caribou abundance, distribution, or persistence.

Table 114. Threats to abundance, distribution, and persistence of caribou

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Harvest	Low	Severe	Forestwide	6-15 years	Alaska Department of Fish and Game	Indirect Minor
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/ major, limited, minor, none

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Dall Sheep (*Ovis dalli*)

Indirect Effects

The availability of suitable winter range and lambing habitat, sensitivity to disturbance, and vulnerability to livestock disease vectors are major factors influencing Dall sheep population size and long term viability.

Table 115. Availability of suitable habitat for Dall sheep

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All	Limited 0 no measurable effect	Good 0 no measurable effect	Localized 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Availability of Suitable Habitat

Within the Chugach National Forest, Dall sheep habitat is generally considered unsuitable for vegetation management, and most of these areas remain in a natural ecologically functioning condition (see table 115). Although forest management activities are not actively manipulating these habitats, vegetation patterns are shifting as climatic conditions change. The availability of alpine tundra, which serves as important Dall sheep habitat, is being reduced as trees and shrublands move up in elevation.

Winter range habitat is critical for Dall sheep. Changing weather, snow depth, and vegetation patterns through the winter or from year to year can alter the winter range selection and use, and during severe winters the overall availability of winter range may be reduced, affecting survival and population size.

Threats to Abundance, Distribution, or Persistence

As discussed in detail in the previous section, Dall sheep are sensitive to many types of disturbance. Two guidelines from the 2002 forest plan (USDA 2002b) designed specifically to reduce disturbance to Dall sheep and mountain goats have been carried forward into all alternatives for forest plan revision. However, the use of aircraft and snowmobiles for recreational access into more remote areas within the national forest appears to be expanding, and the effects of this increased human use on Dall sheep populations are unclear.

Technological developments continue to increase the capability of snowmobiles to traverse steep and rugged terrain and extend their range. In addition to providing recreation and transportation for winter work, these enhanced machines are increasingly being used to provide high elevation access for snowboarders and skiers. Anecdotal information suggests that snowmobile use within the national forest is increasing, that these machines are penetrating farther into the backcountry, and that aircraft are being used to transport snowmobiles even farther from the road system. This expansion of both motorized and non-motorized winter recreation into more remote and high elevation lands increases the potential for disturbance to wintering sheep during the most energetically critical periods. Increased human presence in remote backcountry areas, especially during winter when animals are energetically stressed, dependent, and concentrated on restricted and often marginal habitats, is likely to negatively affect to Dall sheep populations if not carefully managed.

Disease was a primary factor in the decline or extirpation of bighorn sheep populations across much of their historic range (Jex et al. 2016) and remains one of the major threats to wild sheep throughout western North America, including Dall sheep. Mountain sheep are susceptible to a variety of diseases commonly carried by domestic livestock that usually have well developed immunities to the pathogens and may show no symptoms (Jex et al. 2016). The greatest concerns are viral and bacterial respiratory infections that usually lead to fatal pneumonia in wild sheep, and in many cases all age class die-offs with losses ranging from 5 to 95 percent of the population (Jex et al. 2016). Evidence suggests *Mycoplasma ovipneumoniae* (*M. ovi*), a disease vector commonly carried by domestic sheep and goats showing no sign of disease, is a primary causative agent driving epidemic respiratory disease in bighorn sheep (WAFWA 2017). This disease can be subsequently circulated within and between populations of wild sheep and mountain goats with effects ranging from minor health declines to epizootic pneumonia followed by extended periods (years to decades) of lamb deaths and population decline (WAFWA 2017; Jex et al. 2016).

In the western U.S., Federal land managers are developing and implementing strategies to protect native bighorn sheep from diseases carried by domestic livestock grazing on Federal lands. Since there is currently no effective vaccine or treatment for pneumonia in wild sheep (Wehausen et al. 2011), maintaining separation of wild sheep and mountain goats from domestic varieties is essential (WSWG 2012) and likely the only effective means of protecting wild populations. In 2011, the Chief of the Forest Service directed national forests with bighorn sheep populations to analyze the risk of disease transmission between domestic and bighorn sheep. These analyses have focused on identifying and minimizing the risk of contact between domestic and wild sheep and goats. The Bureau of Land Management (BLM) manual published in 2016 takes a similar approach, stating, "The BLM's policy will be to (1) achieve effective separation of BLM authorized domestic sheep or goats from wild sheep on BLM lands, and (2) to minimize the risk of contact between the species." This approach of separating domestic and wild populations is echoed in a variety of strategies and management plans for wild sheep and mountain goat populations throughout North America (WAFWA 2017; WSWG 2012; TWS-AAWV 2015).

Concern over the potential for disease transmission from domestic goats and sheep to Dall sheep and mountain goats is growing in Alaska (Jex et al. 2016; TWS-AAWV 2015). Thinhorn sheep and mountain goats in Alaska and northwestern Canada have not been exposed to many pathogens commonly carried by domestic sheep species (Garde et al. 2005; Miller et al. 2008), but evidence suggests they are as sensitive as bighorn sheep to some respiratory pathogens (Jex et al. 2016). Neither Dall sheep nor mountain goats in the Kenai and Chugach mountains have yet suffered from a major disease outbreak, but the prevalence of livestock on private lands adjacent to the national forest, and the use of domestic goats and other hooved mammals as pack animals increases the exposure risk (Schommer and Woolever 2008) and the probability of disease affecting wild sheep and goats over the entire Kenai Peninsula. Concern for disease transmission led the Alaska Board of Game to ban the use of domestic goats as pack animals while hunting wild sheep, mountain goats, or muskox.

Table 116. Threats to abundance, distribution, and persistence of Dall sheep

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Disease	Medium	Severe	Regional	zero-5 years	AK/FS	Direct/limited
Disturbance (winter range and lambing)	Medium	Moderate	Localized	6-15 years	FS	Direct/major
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Since Dall sheep, mountain goats, or both are present within most areas of the national forest regularly used for land based recreational activities, the potential for contact with domestic pack animals is substantial (see table 116). Even a single contact with infected domestic sheep or goats carries the risk of irreparable harm to all interconnected native Dall sheep and mountain goat populations, making it imperative that the Forest Service implement measures to prevent such contact. The possession or use of domestic goats or sheep is prohibited (by Forest Order) on any NFS lands within the Chugach National Forest. This measure is designed to maintain separation of Dall sheep and mountain goats from domestic livestock and to reduce the risk of wild herds becoming infected with *M. ovi*, a primary pathogen believed to be responsible for epizootic pneumonia (WAFWA 2017).

Cumulative Effects

The presence of domestic livestock, especially sheep and goats kept on small farms, cabins, rural homes and even larger communities adjacent to Dall sheep and mountain goat habitat, presents a serious risk of disease transmission. Many homes and small communities along highway corridors on the Kenai Peninsula are located in close proximity to mountain goat or Dall sheep habitat and present a serious risk for contact between wild and domestic species. Livestock that escape fences can easily travel into adjacent habitats making contact with wild sheep or goats. Additionally, Dall sheep and mountain goats move between various habitats, traversing intervening farmlands and pastures or grazing with domestic livestock enroute to different ranges. In many areas of western North America, these interactions have resulted in transmission of disease leading to large scale die-offs of wild sheep. In Alaska a number of agencies and organizations are working cooperatively on comprehensive strategies to reduce the risk of disease transmission from domestic livestock to Dall sheep and mountain goats.

Table 117. Availability of suitable habitat for mountain goats

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All	Abundant 0 no measurable effect	Good 0 no measurable effect	Dispersed 0 no measurable effect	Reduced 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Mountain Goat (*Oreamnos americanus*)

Indirect Effects

Availability of Suitable Habitat

The availability of suitable winter range and kidding habitat, sensitivity to disturbance, and vulnerability to livestock disease vectors are major factors influencing mountain goat population size and long term viability. Within the Chugach National Forest, mountain goat habitat, while varied, is rugged, steep, and generally considered unsuitable for vegetation management. Most of these habitats remain in a natural ecologically functioning condition, and shifting vegetation patterns are not expected to limit the availability of mountain goat habitat in the near term (see table 117).

Threats to Abundance, Distribution, or Persistence

As noted in the previous section, mountain goats are considered particularly sensitive to anthropogenic disturbances. Disturbance affecting winter habitat is a key concern because mountain goats are expected to be less tolerant of disturbance during the winter (White and Gregovich 2017; NWSGC 2004) and may leave or avoid using important habitats, become injured, or expend vital energy during periods of declining body condition, all of which can affect the health and survival of individuals and populations (see table 118). Two guidelines from the 2002 forest plan (USDA 2002b), designed specifically to reduce disturbance to Dall sheep and mountain goats have been carried forward into all alternatives being considered for the forest plan revision. However, the use of aircraft and snowmobiles for recreational access into more remote areas within the national forest appears to be expanding, and the effects of this increased human use on mountain goat populations are unclear.

Table 118. Threats to abundance, distribution, and persistence of mountain goat

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Disease	Medium	Severe	Regional	zero-5 years	AK/FS	Direct/limited
Disturbance (winter range and kidding)	High	Moderate	Localized	6-15 years	FS	Direct/major
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Technological developments continue to increase the capability of snowmobiles to traverse steep and rugged terrain and extend their range. In addition to providing recreation and transportation for winter work, these enhanced machines are increasingly being used to provide high elevation access for snowboarders and skiers. Anecdotal information suggests that snowmobile use within the national forest is increasing and that these machines are penetrating farther into the backcountry and that aircraft are also being used to transport snowmobiles even farther from the road system. This expansion of both motorized and non-motorized winter recreation into more remote and high elevation lands increases the potential for disturbance to wintering mountain goats during the most energetically critical periods. Increased human presence in remote backcountry areas, especially during winter when animals are energetically stressed, dependent, and concentrated on restricted and often marginal habitats is likely to negatively affect to mountain goat populations if not carefully managed.

Like wild sheep, mountain goats are susceptible to a variety of diseases commonly carried by domestic livestock that usually have well developed immunities to the pathogens and may show no symptoms (Jex et al. 2016) (see section on Dall sheep for detailed discussion on disease). Additionally, the plan area is one of the few places in Alaska where both Dall sheep and mountain goats are found in close proximity to one another. So disease acquired from domestic livestock by one species will almost certainly be transmitted to the other. Since there is currently no effective vaccine or treatment for pneumonia in wild sheep (Wehausen et al. 2011) or mountain goats, maintaining separation from domestic varieties is essential (WSWG 2012), and likely the only effective means of protecting wild populations.

Concern over the potential for disease transmission from domestic goats and sheep to Dall sheep and mountain goats is growing in Alaska (Jex et al. 2016; TWS-AAWV 2015). Thinhorn sheep and mountain goats in Alaska and northwestern Canada have not been exposed to many pathogens commonly carried by domestic sheep species (Garde et al. 2005; Miller et al. 2008), but evidence suggests they are as sensitive as bighorn sheep to some respiratory pathogens (Jex et al. 2016). Neither Dall sheep nor mountain goats in the Kenai and Chugach mountains have yet suffered from a major disease outbreak, but the prevalence of livestock on private lands adjacent to the national forest, and the use of domestic goats and other hooved mammals as pack animals increases the exposure risk (Schommer and Woolever 2008) and the probability of disease affecting wild sheep and goats over the entire Kenai Peninsula. Concern for disease transmission led the Alaska Board of Game to ban the use of domestic goats as pack animals while hunting wild sheep, mountain goats, or muskox. Since Dall sheep, mountain goats or both are present in most areas of the national forest regularly used for land based recreational activities, the potential for contact with domestic pack animals is substantial. Even a single contact with infected domestic sheep or goats carries the risk of irreparable harm to all interconnected Dall sheep and mountain goat populations, making it imperative that the Forest Service implement measures to prevent such contact. The possession or use of domestic goats or sheep is prohibited (by Forest Order) on any NFS lands on the Chugach National Forest. This measure is designed to maintain separation of Dall sheep and mountain goats from domestic livestock and reduce the risk of wild herds becoming infected with *M. ovi*, the primary pathogen believe responsible for epizootic pneumonia (WAFWA 2017).

Cumulative Effects

The presence of domestic livestock, especially sheep and goats kept on small farms, cabins, rural homes and even larger communities adjacent to Dall sheep and mountain goat habitat, presents a serious risk of disease transmission. Many homes and small communities along highway corridors on the Kenai Peninsula are located in close proximity to mountain goat or Dall sheep habitat and present a serious risk for contact between wild and domestic species. Livestock that escape fences can easily travel into adjacent habitats making contact with wild sheep or goats. Additionally, Dall sheep and mountain goats move between various habitats, traversing intervening farmlands and pastures or grazing with domestic livestock enroute to different ranges. In many areas of western North America, these interactions have resulted in transmission of disease leading to large scale die-offs of wild sheep. In Alaska, a number of agencies and organizations are working cooperatively on comprehensive strategies to reduce the risk of disease transmission from domestic livestock to Dall sheep and mountain goats.

Due to the low potential for mountain goat population increase compared with other ungulates, the management of sport hunting and subsistence harvest can have a major long term influence on mountain goat population abundance, distribution, and persistence.

Migratory Birds

Migratory Birds (general)

The environmental consequences for the migratory birds and their habitats are common to all alternatives and therefore will only be addressed in this section.

Indirect Effects

The Chugach National Forest provides an abundance of varied natural habitats supporting a diverse community of migratory birds. The relative proportion and distribution of some of these habitats are expected to change gradually in response natural disturbance processes and climate shifts, but these changes are not expected to alter the migratory bird populations within the 10 to 15 year life of the plan. Certain management actions and authorized activities may affect individuals or small areas of migratory bird habitat, but these activities would affect only a small part of the habitat and are not expected to measurably effect the abundance, distribution, or persistence of migratory bird species inhabiting the plan area.

Availability of Suitable Habitat

Due to the ecologically intact nature of the Chugach National Forest and surrounding landscape, the relatively limited extent of habitat altering management activities conducted, and the specific protection measures incorporated as plan components, implementation of the proposed forest plan would not affect the abundance, distribution, or persistence of migratory birds in the plan area.

Table 119. Availability of suitable habitat for migratory birds

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All	Abundant 0 no measurable effect	Good 0 no measurable effect	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Threats to Abundance, Distribution, or Persistence

At a site specific level, vegetation manipulation, motorized travel, concentrated human activities, and other management actions can negatively affect individual migratory birds and their nests through disturbance or damage to nests and adjacent habitat. However, a variety of plan components provide specific direction to protect certain species or groups that are less common or may be especially sensitive to disturbance, including bald eagles, goshawks, osprey, falcons, trumpeter swans, waterfowl, and shorebirds. For example, specific buffers must be established around known bald eagle, goshawk, osprey, falcon, and trumpeter swan nests. Plan guidelines also address disturbance within 330 feet of nesting areas or intertidal concentration areas used by waterfowl and shorebirds.

Infrastructure, such as roads, utility corridors, transmission lines, and developed recreational sites present risks to individual birds through collision with vehicles or utility structures, electrocution, entrapment, alteration of foraging behavior, and the attraction of opportunistic predators like ravens, crows, and jays. Due to the very limited area of the Chugach National Forest currently affected by developed infrastructure of any type, the effects on migratory bird abundance, distribution or persistence within the plan area are minimal. However, the Forest Service continues to incorporate BMPs and guidance recommended by the U.S. Fish and Wildlife Service to improve design, siting, and construction of utilities and infrastructure projects to minimize risks to migratory birds.

The memorandum of understanding between the Forest Service and the U.S. Fish and Wildlife Service (2008, 2014, and 2016) To Promote the Conservation of Migratory Birds documents the Forest Service's continued commitment to support migratory bird management through interagency conservation efforts, habitat protection and restoration, and minimizing disturbance during key periods.

Table 120. Threats to abundance, distribution, and persistence of migratory birds

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Infrastructure	Low	Moderate	Localized	>15 years	FS	Direct/limited
Disturbance	Low	Low	Localized	>15 years	FS	Direct/limited
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Cumulative Effects

Since there are no direct or indirect effects to migratory birds there can be no cumulative effects.

Bald Eagles (*Haliaeetus leucocephalus*)

The guidance in the forest plan for protection and management of the bald eagle and its habitat is common to all alternatives, and the environmental consequences for this species are likewise expected to be consistent. Therefore the environmental consequences for bald eagle will be addressed only in this section.

Indirect Effects

Bald eagles should continue to thrive across the Chugach National Forest through the 15-year planning period and well beyond. Populations in Alaska remained strong even during the period the species was listed as threatened or endangered in the lower 48 states. Although damaged by the 1989 *Exxon Valdez* oil spill, bald eagle populations in the Prince Willian Sound geographic area were considered increasing by 1992 (Bowman et al. 1995) and considered recovered by 2010 (EVOS Trustee Council 2010). Bald eagle habitat remains abundant and distributed broadly throughout the national forest. Management activities under any of the alternatives would affect a small portion of the national forest, and these actions are not expected to measurably effect the abundance, distribution, or persistence of bald eagles in the plan area.

Availability of Suitable Habitat

All three geographic areas within the plan area support abundant bald eagle habitat (forested habitat adjacent to coastal or inland water bodies supporting fish or waterfowl) (see table 121). The type and extent of vegetation management proposed in the plan varies across the three geographic areas, but the effect on the overall availability and distribution of suitable bald eagle habitat across the national forest would be negligible. While the effects of climate change may eventually shift habitat conditions across the national forest, bald eagle habitat abundance and distribution is expected to remain well within the natural range of variation during the 15-year plan period.

Table 121. Availability of suitable habitat for bald eagle

Habitat Type	Abundance	Condition/ Quality	Distribution	Connectivity/ Accessibility
All	Abundant 0 no measurable effect	Good 0 no measurable effect	Forestwide 0 no measurable effect	Unrestricted 0 no measurable effect
Glossary:				
Descriptive terms	Abundant limited rare	Good fair poor	Forestwide dispersed patchy localized isolated	Unrestricted reduced restricted isolated
Numeric range of effect	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments	+3 major benefits +2 moderate benefits +1 minor benefits 0 no measurable effects -1 minor detriments -2 moderate detriments -3 major detriments

Threats to Abundance, Distribution, or Persistence

At a site specific level, vegetation manipulation and other Forest Service management actions can negatively affect individual bald eagles and their nests through disturbance or damage to nest trees and the adjacent forest stand (see table 122). However, the proposed forest plan contains specific management standards requiring protection of known nests through the establishment of a 330-foot retention zone and additional measures described in the National Bald Eagle Management Guidelines (USFWS 2007).

Table 122. Threats to abundance, distribution, and persistence of bald eagle

Threat Type	Threat Prospect	Severity of Consequences	Scope of Threat	Immediacy of Threat	Primary Management Control	Forest Service Potential to Reduce or Mitigate Threat
Disturbance	Medium	Moderate	Forestwide	6-15 years	FS	Direct/limited
Glossary:						
Descriptive terms	high, medium, low	severe, moderate, minor	localized, forestwide, regional, population	short-term (zero-5 years), medium-term (6-15 years), long-term (> 15 years)	specific agencies or organizations with authority to address threat	direct, indirect (other stressors), support (facilitate non-FS actions)/major, limited, minor, none

Cumulative Effects

Since there are no direct or indirect effects to this species there can be no cumulative effects.

Analytical Conclusions

Effects Common to All Alternatives

For most wildlife species, the effects of resource management vary little between the four alternatives evaluated. The large intact landscapes of the Chugach National Forest continue to support diverse highly functional ecological communities which in turn provide abundant and well distributed habitats for nearly all native wildlife species. The small and concentrated footprint of ground and vegetation disturbing management activities helps to minimize the effects of disturbance and habitat fragmentation.

Effects of Wilderness and Motorized Access

The type, timing, and extent of motorized access permitted under the various alternatives has the greatest potential to affect the well-being, abundance, and distribution of wildlife populations. The type, duration, frequency, intensity, and unpredictability of disturbances can be important factors in determining the extent to which human disturbances may affect individuals and populations of particular species (USDA 2014a). However, factors such as the sensitivity of life stage; season; availability of escape habitat; or cover, weather, mobility, and physiological condition, are equally important. The effects of motorized access on wildlife include both the disturbance effects of the vehicle and the disturbance effects of other human activities facilitated by vehicle access. Winter snowmachine use is the most common and widespread motorized use of NFS lands, and due to habitat limitations, restricted mobility, and the vulnerability of animals in poor physical condition, it may have the greatest effects on sensitive species.

Since information necessary to determine the intensity, patterns, and trends of motorized use are currently unavailable, analyses were limited to acres of land open or potentially open to motorized access as a surrogate to the area of habitat at risk from increased human disturbance. Under alternatives A and B, more area would be open or would potentially be opened to motorized access and could lead to greater negative effects on sensitive wildlife species than under alternatives C and D (see table 123).

Table 123. Summary of consequences by alternative: lands potentially open to motorized access

Type of Motorized Access	Alternative A Acres (percentage)	Alternative B Acres (percentage)	Alternative C Acres (percentage)	Alternative D Acres (percentage)
Semi-primitive Non-motorized (Winter Motorized Allowed)	1,124,655 (21)	1,111,972 (21)	1,134,682 (21)	1,134,550 (21)
Semi-primitive Motorized	583,283 (11)	574,556 (11)	449,129 (8)	449,151 (8)
Total motorized access	1,707,938 (32)	1,686,528 (32)	1,583,811 (29)	1,583,701 (29)

Effects to Key Wildlife Species

For nine of the wildlife species and groups considered in detail, the potential effects of the alternatives on the availability of suitable habitat and the abundance, distribution, and persistence of the species or group are not measurable. In several cases, notably the Cook Inlet beluga whale, Kittlitz's murrelets, and the Aleutian tern, the populations may be seriously affected by problems, such as changing ocean conditions, which are outside the Forest Service's ability to influence. Management actions under the alternatives are expected to provide minor to moderate benefits for five of the species considered in detail. A summary of the effects to the key wildlife species is shown in table 124).

Table 124. Effects to key wildlife species as outlined in table 96 (page 357)

Species	Availability of Suitable Habitat	Threats to Abundance, Distribution, or Persistence
Steller sea lion	0 no measurable effect	0 no measurable effect
Cook Inlet beluga whale	0 no measurable effect	0 no measurable effect
Dusky Canada goose	+2 moderate benefits	+1 minor benefits
Black oystercatcher	0 no measurable effect	+1 minor benefits
Kittlitz's murrelet	0 no measurable effect	0 no measurable effect
Aleutian tern	0 no measurable effect	0 no measurable effect
Brown bear	+1 minor benefits	+2 moderate benefits
Sitka black-tailed deer	0 no measurable effect	0 no measurable effect
Moose	+2 moderate benefits	0 no measurable effect
Caribou	0 no measurable effect	0 no measurable effect
Dall sheep	0 no measurable effect	+2 moderate benefits
Mountain goat	0 no measurable effect	+2 moderate benefits
Migratory birds	0 no measurable effect	0 no measurable effect
Bald eagle	0 no measurable effect	+2 moderate benefits

Summary of Cumulative Effects for Wildlife

The forest plan is a programmatic action that creates a management framework used to guide the development of specific management actions, but it does not constitute an authorization for specific activities. All future on-the-ground actions that result from the proposed changes in management direction will require additional analyses and compliance with the ESA and other applicable laws and policy. Therefore the forest plan does not affect any species directly but may have indirect effects on select wildlife species or groups.

Eight of the terrestrial wildlife species or groups reviewed in detail are not expected to be measurably affected by any of the alternatives, and Forest Service management activities are unlikely to affect the availability or suitability of their habitat on NFS lands. Since there are no direct or indirect effects to these eight species or groups there can be no cumulative effects for them either. For the remaining five species reviewed for which indirect effects were identified, cumulative effects are discussed in detail at the end of each section. Table 125 displays the summary of the cumulative effects to wildlife.

Table 125. Summary of cumulative effects for wildlife

Species	Cumulative Effects
Dusky Canada goose	• Incidental mortality during sport hunting seasons for Canada goose in Washington, Oregon, and Alaska
Brown bear	• Increased brown bear harvest limits managed by the State of Alaska
Moose	• Mortality due to vehicle collision on state highways • Expected arrival of the moose winter tick (*Dermacentor albipictus*) in Alaska due to changing winter climate • Hunting management by the State of Alaska and management of federal subsistence harvest
Dall sheep	• Potential mortality due to introduced domestic livestock pathogen *M. ovi*
Mountain goat	• Potential mortality due to introduced domestic livestock pathogen *M. ovi* • Hunting management by the State of Alaska and management of federal subsistence harvest

Wildland Fire and Fuels

Introduction

This section focuses on two aspects related to wildland fire. The first will be an assessment of the potential effects of management decisions related to human access and the risk associated with wildfire. The second part of this section will focus on the effects of fuels treatments in order to reduce wildland fire risk when protecting and enhancing values associated wildfire and prescribed fire.

Fire activity in the United States is directly influenced by human caused changes on the landscape, including population and road density, and different land use and development patterns. Increased wildfire can follow road networks providing ignitions that substantially change the distribution of fire across the United States (Balch et al. 2017). The recreation opportunity spectrum is a system for classifying and managing recreation opportunities, including roaded and unroaded opportunities, based on the physical setting, social setting, and managerial setting. Through the use of the recreation opportunity spectrum, differences in relative risk for human caused wildfire ignitions by alternative can be estimated.

The analysis also evaluates a proactive, adaptive management approach when utilizing wildland fire and hazardous fuels treatments in order to reduce potential risks associated with wildland fire when protecting human life, communities and other valued assets and resources. The analysis focuses on potential management approaches, such as a range of fuels treatment tools as well as fire management options that directly relate to values at risk identified through a cooperative master agreement with adjoining land management agencies within and surrounding the Chugach National Forests.

Wildland fire terms are defined within the Interagency Guidance for Implementation of Federal Wildland Fire Management Policy (2009) and are defined in the following terms; Wildland Fire – a general term describing any non-structure fire that occurs in the wildland. Wildland fire and/or Fire includes both wildfire and prescribed fire when an ignition occurs in vegetation or natural fuels. Wildfire – is an unplanned ignition of a wildland fire or an escaped prescribed fire. Prescribed Fire – is a wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition.

Fire is a natural ecological process similar to wind, insects, disease, or floods but unlike those other processes, fire is managed by the Forest Service and other agencies to protect lives and assets while enhancing natural resources. Forest fire management programs oversee all aspects of fire prevention, fire use, fire suppression, and hazardous fuels management. Fire management actions are conducted on all known wildland fire incidents. Wildfire can further be defined as unauthorized or accidental fires started by humans, lightning-ignited fires, and/or prescribed fires that have been declared “escaped”. Wildfires can be managed to meet protection objectives, resource management objectives and/or both. Sound risk management is the foundation for all fire management activities. Fire suppression is utilized, when needed, to protect valuable resources and assets from undesired wildfire effects. Suppression includes a full range of options, from very resource intensive (large numbers of personnel and equipment) to less intensive activities (few personnel and minimal equipment). The decision to use one or a combination of options over others depends on many factors, including threats to life, property, and investments; fuel and weather conditions; natural resource concerns; terrain and available resources, such as personnel and equipment. Firefighter and public safety will always be the first priority and will ultimately influence all wildfire management activities.

Fire management includes strategies and actions used both before, during, and after a wildland fire. Management objectives often include modifying fuels to reduce the risk or intensity of undesired wildfire, achieve desired vegetation conditions, improve wildlife habitat and/or complete treatment of fuels generated from management activities. Use of fire to achieve management objectives can restore critical ecosystem processes vital to the character and resiliency of many fire adapted landscapes.

The wildland-urban interface is the line, area, or zone where structures and other human developments and/or values meet or intermingle with vegetation. Population growth, particularly in the West, has led to an increase in these wildland-urban interface areas. The number of communities threatened or affected by wildfire has increased significantly in recent years. To address this concern, as well as concerns about effects of wildfires on natural resources, the Secretaries of Agriculture and the Interior were directed by Congress in 2009 under the Federal Land Assistance Management and Enhancement (FLAME) Act to develop a national cohesive wildland fire management strategy to address the growing costs and losses due to wildfires. The national strategy was signed by the Secretaries in 2014 and provides a vision to: “Safely and effectively extinguish fire, when needed, use fire where allowable; manage our natural resources; and as a nation, live with wildland fire.”

This vision is supported by three strategic goals:

- Restore and Maintain Landscapes: Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
- Fire-adapted Communities: Human populations and infrastructure can withstand a wildfire without loss of life and property.
- Wildfire Response: All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

The National Cohesive Wildland Fire Management Strategy (Cohesive Strategy) is a national collaborative approach to addressing wildland fire across all lands and jurisdictions and was developed with input from wildland fire organizations, land managers and policy-making officials representing all levels of governmental and non-governmental organizations.

The National Fire Plan (USDA 2000) was developed in part to address the increasing concern about the associated risks and impacts of wildfires within and surrounding wildland-urban interface. The National Fire Plan provides a strategic framework for addressing these risks, including identifying the roles of Federal, State, Tribal and private land managers and owners in risk management. The strategic framework emphasizes fuels reduction activities in order to implement strategies and tactics that commit responders only to operations where and when they can be successful, and under conditions where important values actually at risk are protected with the least exposure necessary, while maintaining relationships with people we serve.

The presence of wildland-urban interface affects all fire management decisions in interface areas. While a wide range of fire management options are available by policy, these options are usually narrowed in interface zones due to the concern that the fire may impact private lands, communities and infrastructure. As a result, suppression costs are often higher adjacent to wildland-urban interface areas, and the ability to manage vegetation, particularly vegetation that historically burns at high intensity, is sometimes reduced.

Additionally, the risk of human-caused wildfires originating from the wildland-urban interface is increasing. Wildfires can often occur outside of historical fire seasons when fire management resources are unstaffed or are in short supply. These undesired ignitions also occur during typical fire seasons when weather and fuel conditions align with topographic features which propagate large, high intensity, stand replacing wildfires in the wildland-urban interface, increasing suppression strategy costs associated with the protection of life and property.

Methodology

Spatial Scale

The affected area for the fire and fuels management effects includes lands administered by the Forest Service as well as lands of other ownership, both within and adjacent to the national forest.

Temporal Scale

The effects analysis considered those impacts that are expected within the 15-year plan period. The assessment of the affected environment considered both current conditions and long-term trends extending 50 years into the future.

Past, Present, and Future Activities Used in the Analysis

Past, present, and future activities having the potential to affect wildfire and the associated wildfire risk have been identified for this analysis. These activities include past wildfires, both natural and human caused, past vegetation management projects, and existing roads and trails. These activities were mapped and the maps are included in the affected environment section of this section. Map 31 illustrates the recorded fire history within and surrounding the Chugach National Forest. This map identifies locations of large fires that have occurred since the late 1800s and shows how those fires spread across the landscape. Map 32 illustrates modification of the vegetation by mechanical means (to include hazardous fuels treatments). These treatments are not as obvious due to the scale of the national forest landscape but help identify where treatments occurred in relation to human values at risk. Map 33 illustrates wildfires within the Chugach National Forest landscape and their juxtaposition to existing roads and trails.

Measurement Indicators

Wildfire is comprised of three components that affect fire behavior and intensities: weather, including both short and long term trends; topography of the geographic landscape; and burnable vegetation, commonly referred to as fuels and/or hazardous fuels. Of the three components affecting fire behavior, burnable vegetation is the only component that the Forest Service can actively manipulate to produce a measurable effect on fire behavior and intensity. Fuels treatments result in a change in the amount, configuration, and spacing of live and dead vegetation, with the purpose of creating conditions that result in more manageable fire intensities and behavior.

There are differences in effects on fuels and potential fire behavior from the use of different treatment methods. Prescribed burning generally reduces surface fuels, but may not affect canopy fuels, or the fuels in the crowns of trees, unless combined with a mechanical treatment. Mechanical treatments tend to reduce canopy fuels by thinning trees and increasing the spacing between trees but can often result in increased surface fuel loadings. When prescribed burning treatments are used after mechanical treatment, both a reduction in surface and canopy fuels can occur.

Because plan components related to fuels treatments are the same across all alternatives, the effects analysis doesn’t show significant differences involving fire and fuels. The one exception to this is tied to acres recommended for wilderness area designation by alternative. Wilderness designation would limit implementation of prescribed fire and the ability for fire managers to use this tool for larger landscape fuels management.

- Indicator 1: Acres of recommended wilderness affecting treatment options (prescribed fire treatment, mechanical, etc.) by alternative

Human started wildfires constitute the majority of wildfire starts (greater than 80 percent) in the U.S. Humans have expanded the spatial and temporal fire niche by introducing ignitions into landscapes when fuels are sufficiently dry enough to ignite and carry fire, but when lightning is rare. Overall, human ignitions have dramatically expanded the wildfire season in the U.S. and represent a substantial driver of overall fire risk to ecosystems and economies. Humans primarily alter fire regimes in three ways: changing the distribution and density of ignitions, shifting the seasonality of burning, or altering available fuels. Studies have demonstrated a direct correlation between human caused wildfire ignitions and road networks and wildland-urban interface (Balch et al. 2017). A review of Chugach National Forest fire history supports these correlations, with a majority of wildfires located adjacent to existing roads, the railway or within the wildland-urban interface.

- Indicator 2: Acres by recreation opportunity spectrum class by alternative

Analysis Methods and Assumptions

Ecosystems are highly complex and contain an enormous number of known and unknown living and non-living factors that interact with each other, often in unpredictable ways. There are gaps in available information and knowledge about ecological functioning and an inability to even evaluate what those gaps may be. This gap in information may lessen over time as new information or methodology is devised. The ability to predict fire or other disturbances into the future is limited, and is subject to uncertainty. The level of uncertainty depends on how predictable such factors as natural disturbances, climate change, or human caused influences may be. Of all of the ongoing and foreseeable future actions that have the potential to affect fire, especially unwanted wildfire, climate change is likely to be the single most important factor (EPA 2016). While the exact effects of climate change on the Chugach National Forest are uncertain, fire seasons are expected to become longer, large wildfires are expected to occur more often, and total area burned is expected to increase.

What is known is that key ecosystem characteristics of terrestrial vegetation within the Chugach National Forest are functioning in a way that continues to contribute strongly to ecosystem integrity and sustainability within the plan area. With the exception of urban interface areas, the majority of forest ecosystems are functioning within historic fire regimes and it is assumed that they will continue to do so over the plan period. For this reason, the analysis will focus on effects of human caused wildfire ignitions and availability of various fuels treatment options to reduce those associated wildfire risks. The analysis of risk documented in this section is founded on three basic assumptions:

- Level of development (roads, facilities, wildland-urban interface, etc.) directly influences level of human use; increased development equals increased human use
- Risk for human caused wildfire ignitions increases as human use increases
- Availability of treatment options for reducing fuels affects risk of wildfire spread and intensity

Hazardous fuels reduction by mechanical means will continue under all alternatives. Because all alternatives provide for the treatment of the same number of acres, there are no differences in effects between alternatives tied to acres of mechanical hazardous fuels treatments.

Affected Environment

Climate

The Chugach National Forest is generally described as having a cool, moist climate with low incidence of lightning. The climate change assessment for the Chugach National Forest and the Kenai Peninsula published in 2017 (Hayward et al. 2017) includes the following excerpt that describes climate for the national forest and its influences on wildfire:

> The climate in south-central Alaska is subarctic, with short, cool summers and long winters. Cloud cover is frequent through the summer, particularly after mid-June, and temperatures rarely exceed 26.7° C. In the Kenai Mountains portion of the Kenai Peninsula, the climate is transitional between maritime and continental, with mean annual temperatures of 3.9° C at low elevations and -6.7° C at upper elevations. The annual precipitation ranges from 50 to 200 cm with a mean maximum snow pack of 50 to 300 cm, depending on elevation and location. Climate at the Cooper Lake Hydroelectric Project weather station on the Kenai shows a decline in monthly precipitation from January through June, followed by an abrupt increase in precipitation from July through September. There is a brief period of relative drought in June. This dry period reduces fuel moisture and increases fire frequency in the Kenai Mountains.

Vegetation

Vegetation conditions across the Chugach National Forest are described in detail in the terrestrial ecosystems section of this chapter. As discussed in the terrestrial ecosystems section, forested lands account for 22.7 percent of the terrestrial landscape and extend from sea level to treeline, which typically occurs between 1,500 feet and 2,500 feet depending on region and aspect within the Chugach National Forest. Wetlands account for 7.4 percent of the landscape and shrublands, including dwarf, low, and tall shrub, account for 23.8 percent of the landscape. Forty-three percent of the terrestrial landscape is unvegetated; these barren classes include glaciers, perennial snow, and rock. Vegetation pattern and species composition varies across the Chugach National Forest driven largely by climate and landscape features.

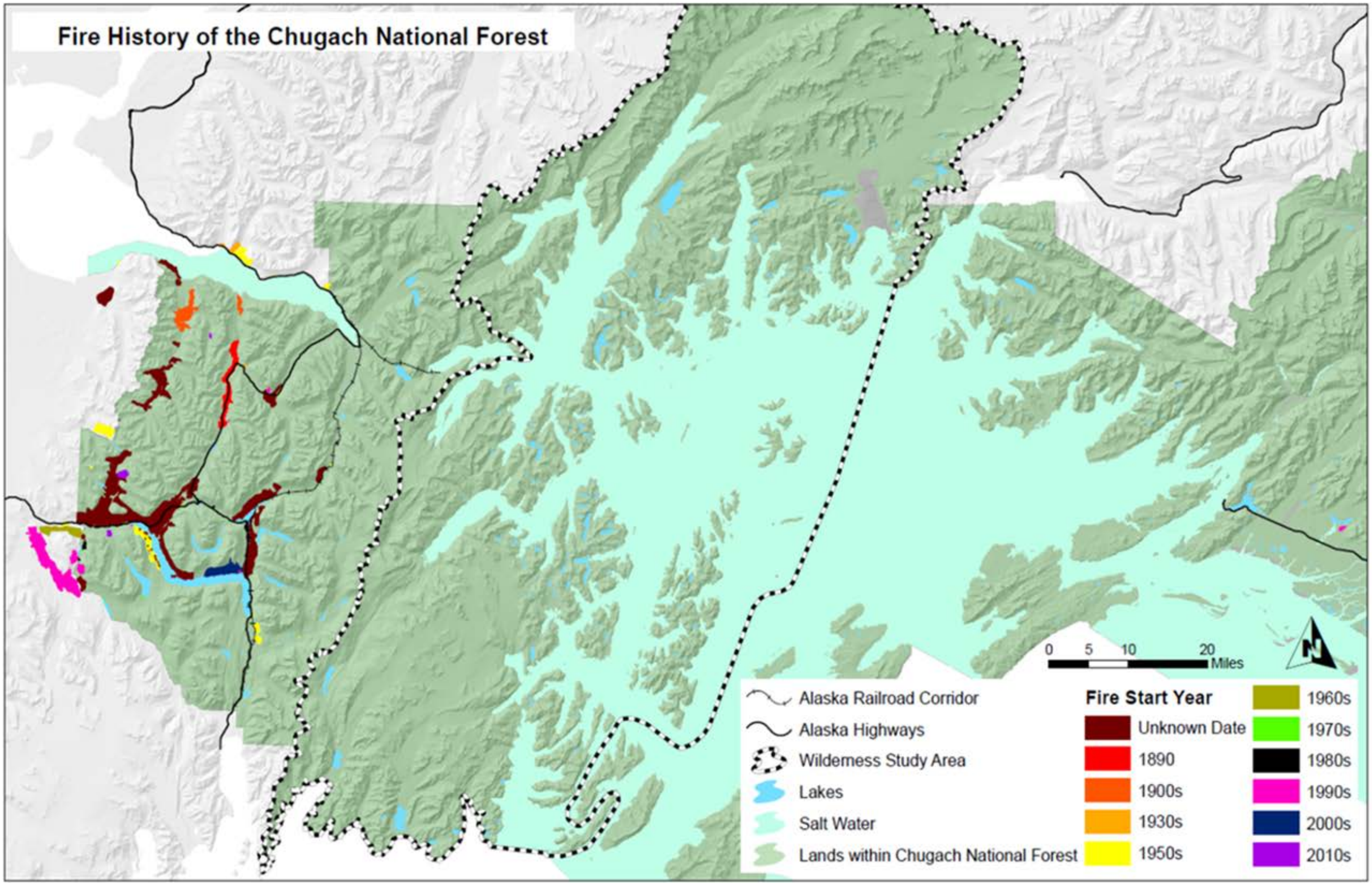
While baseline studies to describe natural range of variation are rare for the Chugach National Forest, the forest plan assessment (USDA 2014a) and the climate change assessment (Hayward et al. 2017) both illustrate that terrestrial ecosystems across the vast majority of the Chugach National Forest experience ecosystem disturbances and express ecological pattern and function consistent with the natural range of variation. Key ecosystem characteristics of terrestrial vegetation are functioning in a way that continues to contribute strongly to ecosystem integrity and sustainability within the plan area.

Vegetation treatments occurring within the Chugach National Forest are primarily hazardous fuel reduction treatments on the Kenai Peninsula (see map 32). An average of 875 acres were treated annually from 2004 through 2013 using a combination of mechanical and prescribed fire treatments primarily in wildland-urban interface, high use areas, and along transportation routes. Since 2014, the Forest Service has treated around 450 acres of hazardous fuels by mechanical means and prescribed burning in high priority areas within wildland-urban interface. The majority of prescribed fire treatments consist of pile burning directly correlated to the completion of mechanical treatments. This combined treatment, in most instances, completes the removal and/or rearrangement of the treated fuel profile.

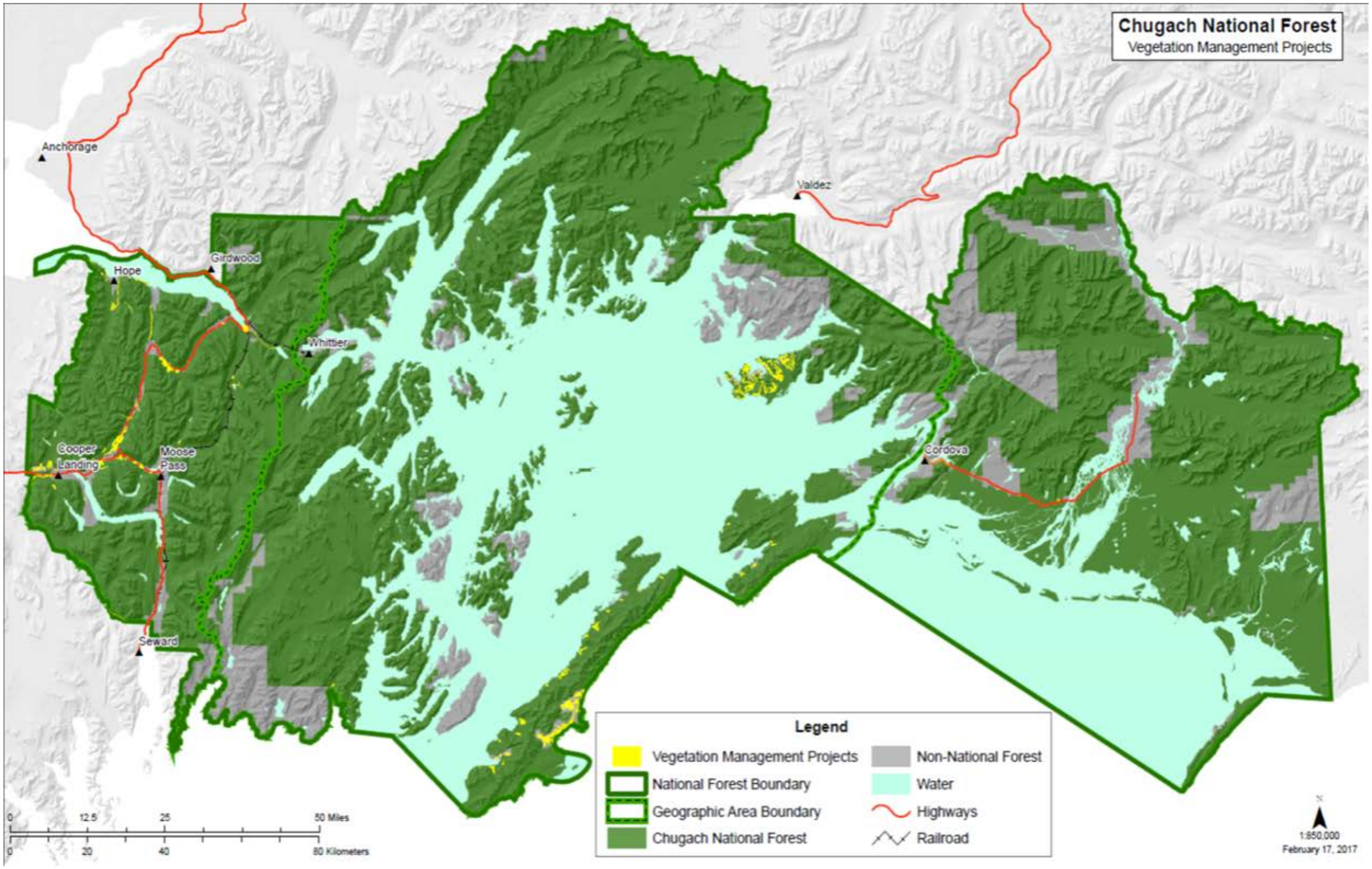
Approximately 10,000 acres of moose winter range was treated using prescribed fire between 1977 and 1997 within the Kenai Peninsula Geographic Area (Boucher 2003). Spruce beetle (*Dendroctonus rufipennis*) infestations, a major natural disturbance of spruce forests in the sub-boreal region, have also affected vegetation within the Kenai Peninsula with two severe infestations occurring in the 1870s and 1880s and from 1987 to 2000 (Berg and Anderson 2006; Berg et al. 2006). The beetle outbreak that began in 1987 on the Kenai Peninsula killed over 1.3 million acres of spruce (USDA 2002), but while the damage was extensive, this level of outbreak appears to be representative of past mortality events and indicates that beetles represent an important part of the ecological history of this region (Hayward et al. 2017).

Fire History

Natural fires on the national forest are infrequent, especially in the Prince William Sound and Copper River Delta geographic areas. Fire as a disturbance process has had little to no effect on vegetation conditions in these two geographic areas at this point in time. Low frequency/high intensity natural fire has been important in the Kenai Peninsula Geographic Area. Charcoal has been reported as present in most soil pits within the Kenai Peninsula forested zone suggesting the occurrence of widespread, yet infrequent, fires in prehistoric times. More recently, human caused fires have influenced the landscape.



Map 31. Fire history of the Chugach National Forest



Map 32. Vegetation management projects within the Chugach National Forest

As described in the climate change assessment (Hayward et al. 2017) for the Chugach National Forest and the Kenai Peninsula:

> During the past couple centuries, human ignitions have become more important in the western portion of the assessment area. Although Alaska Native peoples have been present in south-central Alaska for thousands of years, there is no evidence that they used fire as a land management tool. Gold miners set fires to clear land for prospecting, particularly in the Kenai Mountains, and seem to have unintentionally created extensive moose habitat. 12 Major fires occurred on the western Kenai during a number of years beginning in the late 1800s (Lutz 1960 as cited by Morton et al. 2006). The basic cause for these fires was attributed to railroad activity igniting 95 fires between 1932 and 1953. The drought conditions following the 1912 Katmai Volcano eruption also contributed to fire behavior by creating favorable weather for burning. Holbrook (1924) reported that "the region has been visited by numerous fires and most of the better grade of timber has been burned." He mapped about 12 000 ha of burned area on the forest. These large fires included the Resurrection Creek watershed covering 4050 ha. Following World War II, several large fires occurred in the western Kenai. Fires in 1947 and 1969 burned 125 000 and 34 800 ha, respectively.
>
> From 1990 through 2012, about 57 000 ha of forest burned. Near the end of the 20th century, an average of 66 wildfires occurred on the peninsula each year, most being very small (fig. 6-3). The historical influence of insects on forest structure and composition was more dramatic west of the Kenai Mountains—the boreal forest region rather than the coastal region. In the boreal forests, over time, defoliators periodically erupt and remove the majority of leaves across large areas. Similarly, in the recent past, spruce bark beetle represents a dominant disturbance in the boreal forest, with a mean return interval of around 50 years on the Kenai Peninsula (Berg and Anderson 2006). Based on tree-core evidence, Berg et al. (2006) found that an outbreak of spruce beetle occurred on the Kenai in the late 19th century. The late-20th-century outbreak appears to be representative of past spruce mortality events and indicates that beetles represent an important part of the ecological history of the western Kenai Peninsula.

The LANDFIRE mapping program used to describe vegetation, major disturbances, and fire/fuel characteristics for the U.S. was most recently updated for Alaska in 2014. According to LANDFIRE data, the national forest falls within Fire Regimes IV and V. Fire return interval for Fire Regime IV is 35 to 200 years and 200-plus years for Fire Regime V with stand replacing fires being typical within these fire regimes. While natural fire has been infrequent, human caused fire on the Kenai Peninsula Geographic Area has been common over the last 100 years. Recent studies have clearly demonstrated that fire activity in the U.S. is directly influenced by human caused changes on the landscape. Studies have demonstrated a direct correlation between human caused wildfire ignitions and road networks and wildland-urban interface. Increased wildfire can follow road networks providing ignitions that substantially change the distribution of fire across the United States (Balch et al. 2017).

A review of fire history of the Chugach National Forest supports these correlations, with a majority of wildfires within the Kenai Peninsula adjacent to existing roads, the railway, or within wildland-urban interface (see map 33).

From 1914 to 1997, approximately 1,400 fires burned within the Chugach National Forest (Potkin 1997), the majority of which were human caused. About 85 percent of these fires were smaller than one-quarter acre. Table 126 displays the number of fires and total acres burned per decade for fires that burned five or more acres. More than 99 percent of all the acres burned within the national forest were in the Kenai Peninsula Geographic Area and can be attributed to human causes.

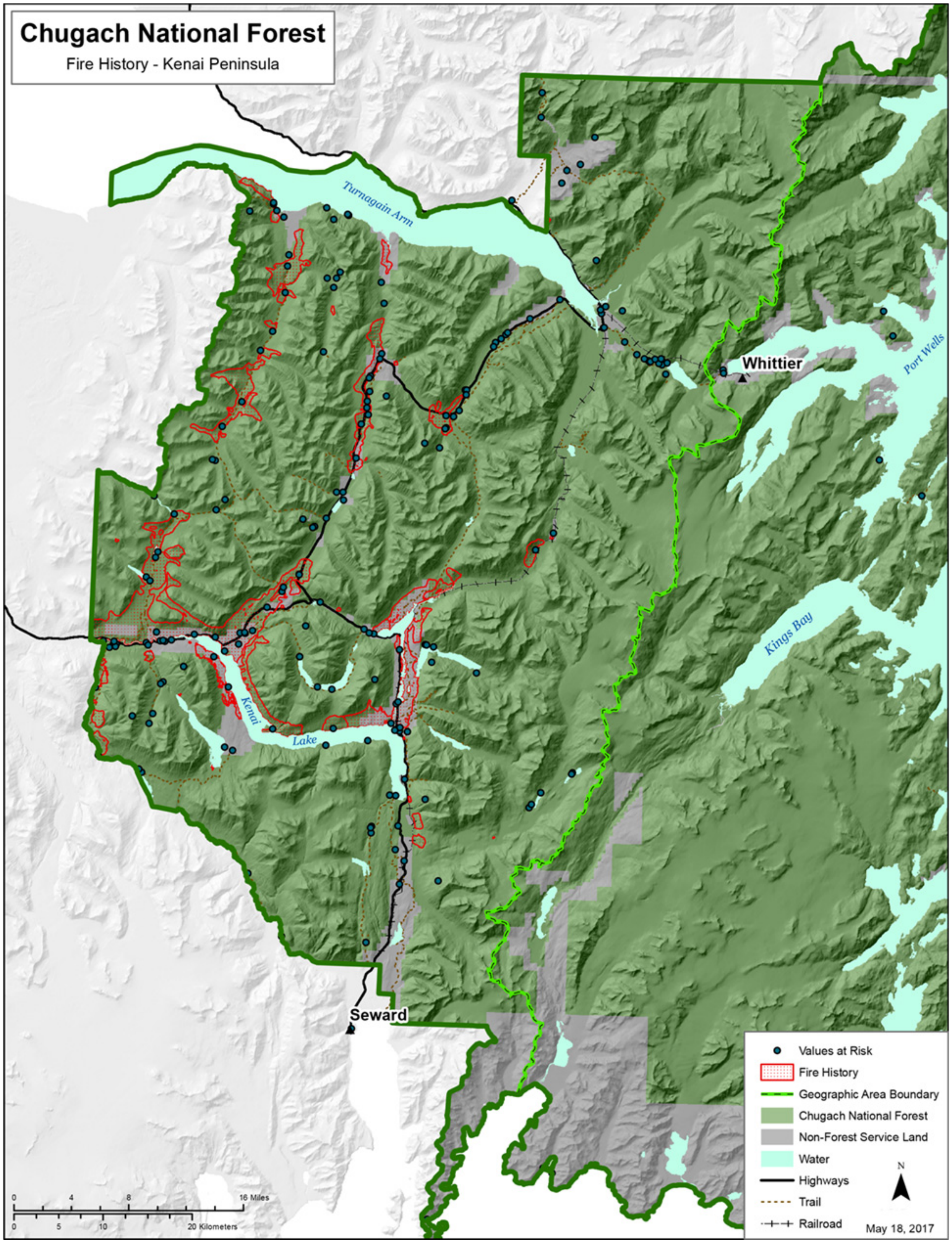
Table 126. Fire history by decade

Decade	Number of Fires	Total Acres Burned
Unknown	80	44,374
1890s	1	4,556
1900s	2	3,899
1910s	zero	zero
1920s	zero	zero
1930s	1	34
1940s	zero	zero
1950s	12	2,649
1960s	1	7
1970s	6	27
1980s	5	427
1990s	7	835
2000s	2	2,924
2010s	3	858
Totals	120	60,590

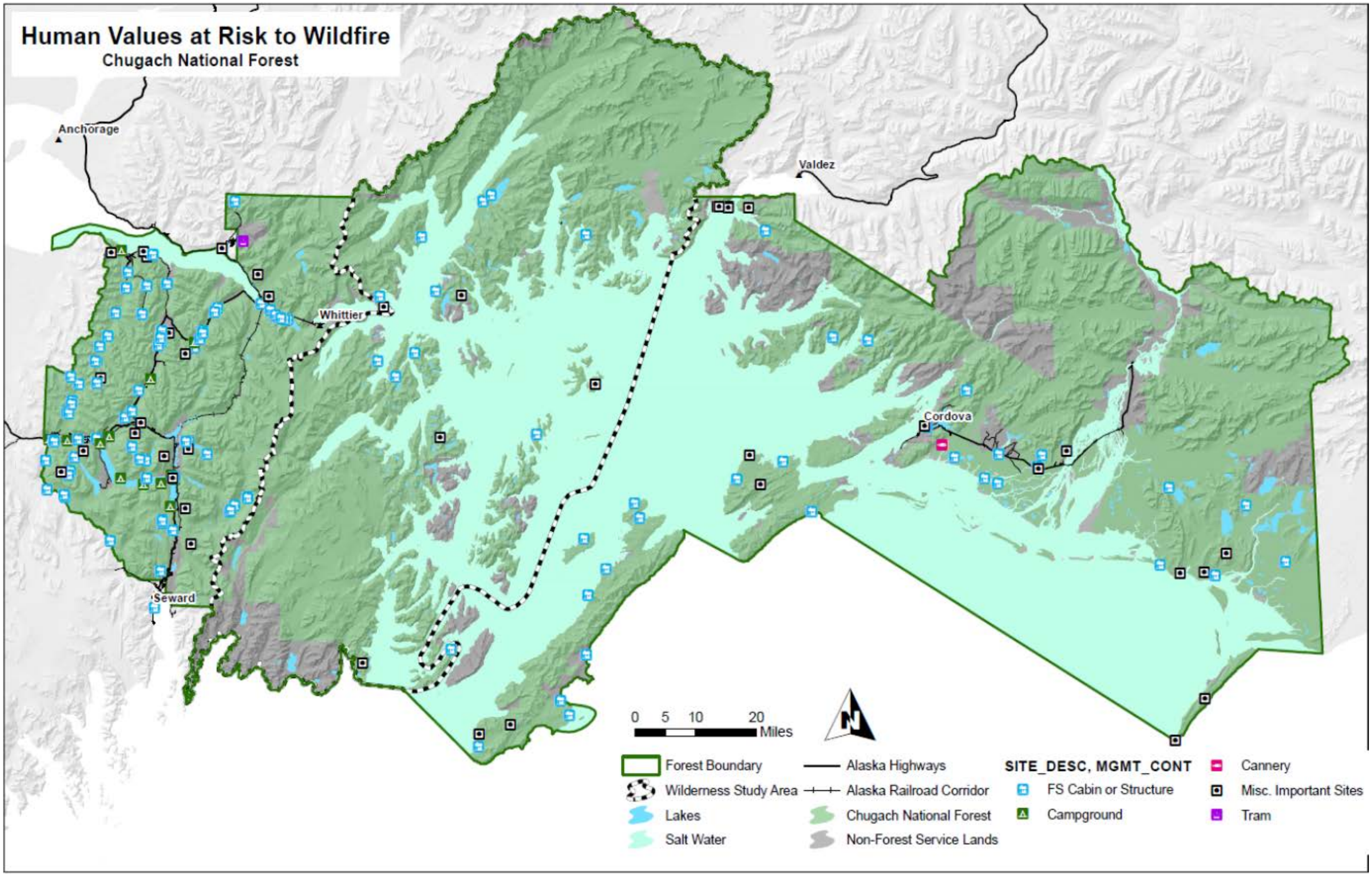
The recreation opportunity spectrum is a system for classifying and managing recreation opportunities, including roaded and unroaded opportunities, based on the physical setting, social setting, and managerial setting. Given the correlation of wildfire ignitions to road networks, the recreation opportunity spectrum can be used as a proxy for estimating relative risk for human caused wildfire ignitions. While almost 98 percent of the Chugach National Forest falls within IRAs, approximately 662,317 acres are open to some level of motorized use under current recreation opportunity spectrum classes.

The Kenai Peninsula Geographic Area has the most miles of roads and trails, which corresponds to having the largest area of roaded natural and rural recreation classes per geographic area (six percent) with very little primitive class (one percent) and the remaining area in one of the semi-primitive classes (93 percent). The Prince William Sound Geographic Area, which encompasses the wilderness study area and large, remote islands has a much higher percentage of primitive and semi-primitive non-motorized classes (96 percent). The Copper River Delta Geographic Area has the highest acreage of primitive class (80 percent) per geographic area across the national forest with large, remote areas west and east of the Copper River. Table 128, table 129 and table 130 display acres by recreation opportunity spectrum classes by geographic area for the Chugach National Forest.

Wildfires within the Chugach National Forest have and will continue to be managed through a master cooperative agreement that ties land management agencies together at local, State, and Federal levels (AIWFMP 2016). This greatly aids in a cohesive wildland fire management strategy since fire can cover multiple jurisdictions that involve complex values, social concerns, and varying agency policies, missions, and goals. A risk based approach serves as the foundation for all fire management activities. To restore and maintain resilient landscapes, risks and uncertainties relating to fire management must be understood, analyzed, communicated, and managed as they relate to the cost of doing or not doing an activity (A National Cohesive Wildland Fire Management Strategy 2011). Map 34 illustrates human values at risk from wildfire across the national forest. It is safe to assume that any private/tribal land located within or surrounding the national forest boundary has structure and/or development associated with it.



Map 33. Distribution of the location fires that were initiated on the Kenai Peninsula from 1980 through 2002, illustrating the strong relationship between the road system and fires and also the low number of occurrences east of the Kenai Mountains (KPBOEM 2004)



Map 34. Human values at risk within the Chugach National Forest

Environmental Consequences

Effects Common to All Alternatives

Wildland fires are a natural process and serve an important, irreplaceable ecological function in ecosystems. Burning of organic matter results in direct nutrient mineralization. Increased soil temperature and increased microbial activity post fire, results in heightened nutrient release through organic matter decomposition for several years post burn (Bourgeau-Chavez et al. 2000). These processes would continue to occur under all alternatives.

As discussed in the affected environment section, the majority of wildland fires within the Chugach National Forest result from human activities and occur near communities, public concentration areas (e.g., campgrounds), along roads, trails, and waterways. With an increasing number of people using the national forest, human-caused fire is expected to increase (American Institute of Biological Sciences 2008). Fire prevention programs are in place and are somewhat effective when making contact with the public. However, because of the Chugach National Forest’s cool, wet climate, fire prevention has limited success due to a complacency amongst users (that fires will not spread).

The effects of wildland fire are the same under all alternatives. Wildland fire would continue to be managed as it currently is and fuels treatment objectives, including acres of hazardous fuels treated annually, are the same for all alternatives. Acres not treated (with fire, mechanical, chemical, or combinations of treatments) will continue to advance toward climax successional stages, and understory seral species (shrubs and herbs) may decline or become more decadent. Coarse and fine-scale landscape patterns will become more homogenous as succession advances (Hessburg et al. 2000).

Because of the relatively low number of acres treated annually, hazardous fuels are expected to continue to propagate more fuels that are uniform and continuous. While the risk of naturally caused fire is expected to remain low across the national forest, within the Kenai Peninsula the risk of human caused fires originating from the wildland-urban interface and spreading to NFS lands will continue to increase. Human caused fires often occur during burning conditions that are more extreme than those associated with natural ignitions. As a result, these fires can be more destructive and more expensive to suppress and result in increased concerns for firefighter and/or public safety.

Effects of Indicator One by Alternative

Issue

Wilderness area designation would result in reduced flexibility and options for vegetation and fuels management to achieve desired conditions.

Indicator One

Acres of recommended wilderness area affecting treatment options (prescribed fire treatment, mechanical, etc.) by alternative.

Analysis

It is assumed that the recommended wilderness area would be designated by Congress at some point in the future. Use of prescribed fire and other vegetation/fuels treatments are typically not allowed within designated wilderness areas thereby limiting the ability for fire managers to use this tool for larger landscape fuels management. Under all of the alternatives, the only lands recommended for wilderness area designation are within Prince William Sound. Wildfires are extremely rare in Prince William Sound and while limiting the use of various treatment types can affect risk for future wildfire, overall the risk of wildfire in areas recommended for wilderness area designation remains very low. Table 127 displays the number of acres recommended for wilderness area designation by alternative.

Table 127. Acres recommended for wilderness area designation by alternative

Measurement Indicator	Alternative A No Action	Alternative B	Alternative C	Alternative D
Number of acres recommended for wilderness area designation	1,387,510	1,387,510	1,819,700	1,884,200

Effects of Indicator Two by Alternative

Issue

Motorized access increases risk for human caused wildfires.

Indicator Two

Acres of recreation opportunity spectrum class by alternative.

Analysis

Human started wildfires constitute the majority of undesired ignitions (greater than 80 percent) in the U.S. Humans have expanded the spatial and temporal fire niche by introducing ignitions into landscapes when fuels are sufficiently dry enough to ignite and carry fire, but when lightning is rare. Overall, human ignitions have dramatically expanded the wildfire season in the U.S. and represent a substantial driver of overall fire risk to ecosystems and economies. Humans primarily alter fire regimes in three ways: changing the distribution and density of ignitions, shifting the seasonality of burning, or altering available fuels. Studies have demonstrated a direct correlation between human caused wildfire ignitions and road networks and wildland-urban interface (Balch et al. 2017). A 2007 study found that 88 percent of all wildfires nationwide are caused by humans. Of these human caused wildfires, 95 percent occurred within one-half mile of a road and more than 90 percent of all wildfires from all causes occurred within one-half mile of a road (Morrison 2007).

As described in the affected environment section, review of fire history of the Chugach National Forest supports these correlations, with a majority of wildfires occurring adjacent to existing roads, the railway, or within the wildland-urban interface of the Kenai Peninsula. Given the correlation of wildfire ignitions relative to development on the national forest, recreation opportunity spectrum classes can be used as a proxy for estimating relative risk for human caused wildfire ignitions. In general, those areas assigned to recreation opportunity spectrum recreation opportunity spectrum classes that allow for motorized uses (semi-primitive motorized, roaded natural, and rural) can be assumed to be at greater risk for human caused wildfires.

Table 128, table 129 and table 130 display acres by recreation opportunity spectrum class, geographic area, and alternative. For the Kenai Peninsula where the majority of wildfires occur within the national forest, alternative A presents the highest risk for human caused wildfire ignitions based on acres open to motorized use, followed closely by alternative B. For the Copper River Delta, alternatives C and D presented the highest risk for human caused ignitions, although that risk is still considered to be very low given fire history. For Prince William Sound, the risk for human caused wildfire ignitions in relation to motorized access is the same for all alternatives and remains very low considering fire history.

Table 128. Kenai Peninsula Geographic Area recreation opportunity spectrum recreation opportunity spectrum class acres

ROS Class	Alternative A acres (percent)	Alternative B acres (percent)	Alternative C acres (percent)	Alternative D acres (percent)
Primitive	5,945 (1%)	5,944 (1%)	84,644 (7%)	84,644 (7%)
Semi-primitive Non-motorized	704,895 (62%)	714,172 (63%)	837,194 (73%)	837,194 (73%)
Semi-primitive Motorized	360,965 (31%)	352,221 (30%)	151,662 (13%)	151,662 (13%)
Roaded Natural	67,560 (6%)	67,542 (6%)	72,004 (6%)	72,004 (6%)
Rural	6,624 (1%)	6,109 (1%)	457 (zero)	457 (zero)

Table 129. Prince William Sound Geographic Area recreation opportunity spectrum class acres

ROS Class	Alternative A acres (percent)	Alternative B acres (percent)	Alternative C acres (percent)	Alternative D acres (percent)
Primitive	1,162,580 (45%)	1,162,580 (45%)	1,900,730 (73%)	1,943,800 (75%)
Semi-primitive Non-motorized	1,403,105 (54%)	1,403,105 (54%)	669,942 (26%)	626,874 (24%)
Semi-primitive Motorized	22,011 (1%)	22,011 (1%)	16,984 (1%)	16,984 (1%)
Roaded Natural	569 (<1%)	569 (<1%)	599 (<1%)	599 (<1%)
Rural	zero (zero)	zero (zero)	zero (zero)	zero (zero)

Table 130. Copper River Delta Geographic Area recreation opportunity spectrum class acres

ROS Class	Alternative A acres (percent)	Alternative B acres (percent)	Alternative C acres (percent)	Alternative D acres (percent)
Primitive	1,306,950 (80%)	1,306,950 (80%)	888,078 (54%)	888,078 (54%)
Semi-primitive Non-motorized	130,136 (8%)	130,136 (8%)	459,449 (28%)	459,449 (28%)
Semi-primitive Motorized	187,611 (11%)	187,611 (11%)	277,487 (17%)	277,487 (17%)
Roaded Natural	16,979 (1%)	16,979 (1%)	16,654 (1%)	16,654 (1%)
Rural	zero (zero)	zero (zero)	zero (zero)	zero (zero)

Cumulative Effects

Recognizing that wildland fire management issues cross all lands and jurisdictions and involve a complex matrix of land and resource values, social concerns, and varying agency missions, goals, and policies, the Federal Land Assistance, Management, and Enhancement Act of 2009 directed the Secretary of Agriculture to submit a report to Congress containing a cohesive wildfire management strategy. The report, A National Cohesive Wildland Fire Management Strategy 2011, describes a collaborative approach for Federal, State, tribal, local, and non-governmental partners to develop a comprehensive wildland fire management strategy. This collaborative effort seeks solutions to wildland fire management issues on all lands, with active involvement of all levels of government and non-governmental organizations, as well as the public. Because of this strategy, it can be expected that fuel reduction projects by state and private landowners will continue. If the scope and scale of these projects increase, the cumulative effect would be one that assists in achieving protection objectives where human values intermix with ecological processes. Collaboration with adjoining communities on community wildfire protection plans would continue to be acted upon with emphasis on cross boundary projects that include a multitude of partners and land jurisdictions regardless of alternative.

For the last several decades there has been more human development occurring around the edges of lands administered by the Forest Service. This trend is expected to continue and is likely to have a cumulative effect on forest vegetation. In addition, this development would create more contentious land use issues, which could increase costs because of associated social issues (i.e., effects of treatments on scenery, air quality, noise, wildlife viewing, etc.). This could be considered a cumulative effect because of higher public involvement, higher planning, and implementation expenses leading to fewer acres treated within a given budget level.

Working cooperatively with neighboring land owners on the management of fire and implementing fuels management strategies is effective; however, it is the small lot owner that becomes the focus of suppression resources when large wildfires occur. The future increase in small lot owners will continue to challenge wildfire management strategies during large fire events. To work individually with these property owners is costly and creates a patchwork of defendable properties among those that are not. With a greater number of people living and recreating in these WUI areas, there is a greater probability of more human-caused wildfire ignitions that could have cumulative effects on forest vegetation, in spite of fire prevention efforts.

Analytical Conclusions

Table 131 summarizes the consequences for the measurement indicators used in this analysis.

Table 131. Summary of consequences for wildfire and fuels based on the analysis indicators

Measurement Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Number of acres recommended for wilderness designation	No change	No change	Increase of 427,782 acres recommended for wilderness over current. These additional acres would not be available for fuels treatment if wilderness designation occurs. Overall, little to no change in effect of reducing potential risk for fire ignition as the recommended wilderness acreages all fall in the Prince William Sound where risk of wildfire is extremely low.	Increase of 492,296 acres recommended for wilderness over current. These additional acres would not be available for fuels treatment if wilderness designation occurs. Overall, little to no change in effect of reducing potential risk for fire ignition as the recommended wilderness acreages all fall in the Prince William Sound where risk of wildfire is extremely low.
Kenai Peninsula				
	38 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions	37 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions	19 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions	19 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions
Prince William Sound				
Percentage of national forest by geographic area open to motorized use based on ROS class	Less than 2 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history	Less than 2 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history	Less than 2 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history	Less than 2 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history

Measurement Indicator	Alternative A	Alternative B	Alternative C	Alternative D
Copper River Delta				
	12 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history	12 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history	18 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history	18 percent of the geographic area would be available for some form of motorized use. These areas would be at the highest risk for potential human caused wildfire ignitions although this risk would remain low given past fire history

Environmental Justice

As required by Executive Order 12898, all Federal actions must consider potentially disproportionate effects on minority or low-income communities. Proposed land management plans are strategic and programmatic in nature, providing guidance and direction to future site-specific projects and activities. These plans do not create, authorize, or execute any ground-disturbing activity, although they do provide for the consideration of certain types of activities. Site-specific activities will consider potential disproportionate effects on minority or low-income communities during project planning.

The Social and Economic Contribution analysis in this chapter did not identify any disproportionate impacts resulting from the proposed management direction for the Chugach National Forest because there are a wide range of opportunities, activities, and services offered. In addition, collaboration on the forest plan with local agencies and members of the public did not identify any concerns regarding disproportionate impacts to low income or minority populations.

Relationship of Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by Congress, this includes using all practicable means and measures (including financial and technical assistance), in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101).

The revised forest plan will govern management of the Chugach National Forest’s resources for the next 10 to 15 years. The EIS discloses the analysis of effects for a range of alternatives, including no action. It considers effects on the significant issues and other resources for this timeframe. Overall, under all alternatives, design and implementation of projects and activities consistent with the standards and guidelines and the use of BMPs would ensure the long term productivity, ecological integrity, and ecological diversity of NFS lands within the Chugach National Forest.

Unavoidable Adverse Impacts

The forest plan provides a programmatic framework that guides site specific actions but does not authorize, fund, or carryout any project or activity. Before any ground disturbing actions take place, they must be authorized in a subsequent site specific environmental analysis. Therefore none of the alternatives cause unavoidable adverse impacts.

Irreversible and Irretrievable Commitment of Resources

The forest plan provides a programmatic framework that guides site specific actions but does not authorize, fund, or carryout any project or activity. Because the forest plan does not authorize or mandate any site-specific project or activity (including ground disturbing actions), none of the alternatives cause an irreversible or irretrievable commitment of resources.

Chapter 4. Preparers, Consultation and Coordination

Responsible Official

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The following individuals and Forest Service staff groups contributed to development of this environmental impact statement.

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The interdisciplinary team was comprised of a core team and an extended team. While all interdisciplinary team members contributed to the development of the DEIS and draft forest plan, the interdisciplinary team members and primary authors of the statement are listed below.

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Consultation and Coordination

Alaska Native Tribes and Alaska Native Corporations

The following federally recognized Alaska Native Tribes and Corporations participated in government-to-government consultation and coordination meetings during the development of the draft land management plan revision and the draft environmental impact statement:

Chenega Bay IRA Council

Chickaloon Native Village

Native Village of Eyak

Kenaitze Indian Tribe

Native Village of Tatilek

Chenega Corporation

Chugach Alaska Corporation

Cook Inlet Region, Incorporated

Eyak Corporation

State, Federal, and Local Agencies and Organizations

The following State of Alaska agencies, federal agencies, local and non-government organizations, and businesses participated in coordination meetings and/or reviews of the draft land management plan revision and the draft environmental impact statement:

State of Alaska:

Alaska Department of Commerce, Community and Economic Development

Alaska Department of Environmental Conservation

Alaska Department of Fish and Game

Alaska Department of Natural Resources

Alaska Department of Transportation and Public Facilities

Federal agencies:

Bureau of Land Management

Environmental Protection Agency

National Oceanic and Atmospheric Administration

National Park Service

U.S. Fish and Wildlife Service

Local agencies and community organizations:

City of Seward, Alaska

City of Whittier, Alaska

City of Valdez, Alaska

Kenai Peninsula Borough, Alaska

Matanuska Susitna Borough, Alaska

Municipality of Anchorage, Alaska

Whittier Chamber of Commerce

Organizations:

Alaska Forest Association

Alaska Huts Association

Alaska Miners Association

Alaska Pacific University

Alaska Quiet Rights Coalition

Alaska Wilderness League

American Whitewater

Cascadia Wildlands

Center for Biological Diversity

Defenders of Wildlife

Eyak Preservation Council

Gulf of Alaska Keeper

International Mountain Bicycling Association

Jack Bay Landowners

National Outdoor Leadership School

Prince William Soundkeeper

Resource Development Council for Alaska, Inc.

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The Sierra Club

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The Wilderness Society

Wilderness Watch

Winter Wildlands Alliance

Businesses:

Alaska Bolt and Chain

Cordova Electric Cooperative, Inc.

Discovery Voyages

Exit Glacier Guides

Prince William Sound Eco-Charters

Distribution of the DEIS Document

This environmental impact statement has been distributed to, or made electronically available to, over 2,000 individuals and groups who specifically requested a copy of the document or commented during public involvement opportunities. In addition, copies have been sent (or in most cases made electronically available) to all agencies and organizations listed above, and other federal entities, including but not limited to federally recognized Alaska Native Tribes and Corporations, State of Alaska and local governments, federal agencies and other organizations that have requested to be involved in the development of this analysis, including the State of Alaska Department of Natural Resources, State of Alaska Department of Fish and Game, U.S. Environmental Protection Agency; U.S. Department of the Interior; Advisory Council on Historic Preservation; USDA National Agricultural Library. Due to the number of people, agencies, and organizations, a complete listing has been omitted from this draft environmental impact statement, but is available upon request.

This Draft Environmental Impact Statement is available for public review and comment at: https://www.fs.usda.gov/chugach.

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Appendix A. Chugach National Forest Wilderness Area Inventory and Evaluation

Overview of the Wilderness Area Recommendation Process

As part of plan revision, the responsible official, the forest supervisor, shall "identify and evaluate lands that may be suitable for inclusion in the National Wilderness Preservation System and determine whether to recommend any such lands for wilderness designation" (36 CFR 219.7(c)(2)(v), effective May 9, 2012).

Forest Service directives (FSH 1909.12, Chapter 70) for implementing the 2012 Planning Rule provide further guidance on how to complete this process in four steps:

1. Identify and inventory all lands that may be suitable for inclusion in the National Wilderness Preservation System
2. Evaluate the wilderness characteristics of each area based on a given set of criteria
3. Based on the evaluation and input from public participation opportunities, the forest supervisor determines which areas to further analyze in the NEPA process
4. The forest supervisor decides which areas, if any, to recommend for inclusion in the National Wilderness Preservation System

This report provides documentation for the first three steps of this process, and is divided into two sections. The first section provides information about the inventory process and results; and a description of the current conditions and management for vegetation, wildlife, fish, recreation, and access to the Chugach National Forest as they are related to wilderness characteristics. This description is intended to provide a big-picture view of national forest resources and serve as a foundation for the evaluation section. The second section provides an area by area evaluation of wilderness characteristics found in the inventoried lands, and describes the rationale for including or not including each inventory area in one or more of the alternatives.

Inventory

The first step in the wilderness recommendation process is to identify and inventory all lands that may be suitable for inclusion in the National Wilderness Preservation System. To be included in the inventory, lands must meet criteria pertaining to the size and developments within an area. The criteria are defined in Forest Service Handbook 1909.12, Chapter 70 and are listed in appendix A, but are summarized here.

1. Federal ownership and size

Areas included in the inventory must be Federal lands, and be at least 5,000 acres. A smaller area may be considered if it would be practicable to preserve the area in an unimpaired condition.

2. Roads

Exclude areas that contain national forest roads maintained to levels 3, 4, or 5, and maintenance level 2 roads that have received regular maintenance and will continue to be used by the public. Include areas with maintenance level 1 roads or roads that will be reclassified as a maintenance level 1 road, routes scheduled for decommissioning, or historical mining or wagon routes that are part of the cultural landscape of the area.

3. Other developments

In general, lands that meet the size and road development criteria but contain other developments are excluded. However, lands that contain other improvements or evidence of past human activities but are not substantially noticeable in the area as a whole (defined in Forest Service Handbook 1909.12, Chapter 70) are included in the inventory. Also, because ANILCA allows for public use cabins and fisheries enhancements in wilderness, these developed sites are not necessarily excluded.

Wilderness Inventory Methods

The Forest Service completed a wilderness inventory, evaluation, and analysis for the Chugach National Forest, culminating in a wilderness recommendation as described in the Revised Land and Resource Management Plan (forest plan) Record of Decision (2002) and Wilderness Recommendation Report (2002) as part of the previous plan revision process. The detailed analysis of each of the 16 IRAs can be found in appendix C of the 2002 forest plan final environmental impact statement. This process was guided by the 1982 Planning Rule.

The 16 IRAs described in appendix C of the 2002 final environmental impact statement were used as the starting point for the current wilderness inventory and evaluation process. Updates to non-Federal lands and developments were made based on information in the forest plan assessment (USDA 2014a) and the Forest Service geographic information system database. Inventory criteria was applied to refine the boundaries of the 16 IRAs and adjustments were made to account for land conveyances or developments that have occurred since 2002. Additional modifications may be made based on input from the forest supervisor and continued input from the public.

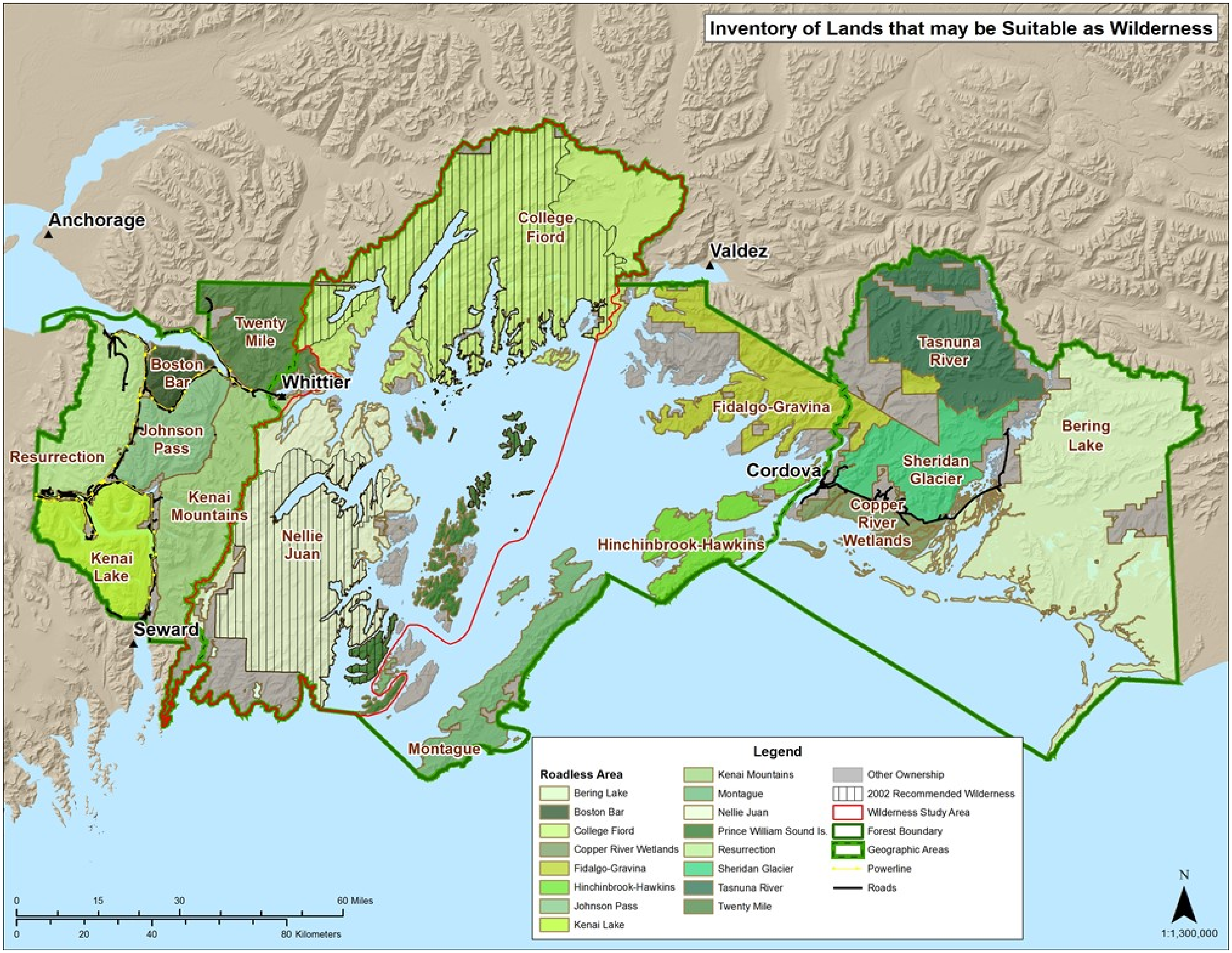
Chugach National Forest Inventory Results

More than 99 percent of the Chugach National Forest, or 5,367,280 acres, are included in this inventory. Their wilderness characteristics are described in the wilderness evaluation section. Table 132 and map 35 show lands included in the inventory. All areas within the Chugach National Forest included in the inventory are greater than 5,000 acres. No buffer was placed between inventoried areas and improvements. ANILCA authorizes public use cabins in Alaskan wilderness areas, so areas with cabins were also included in the inventory.

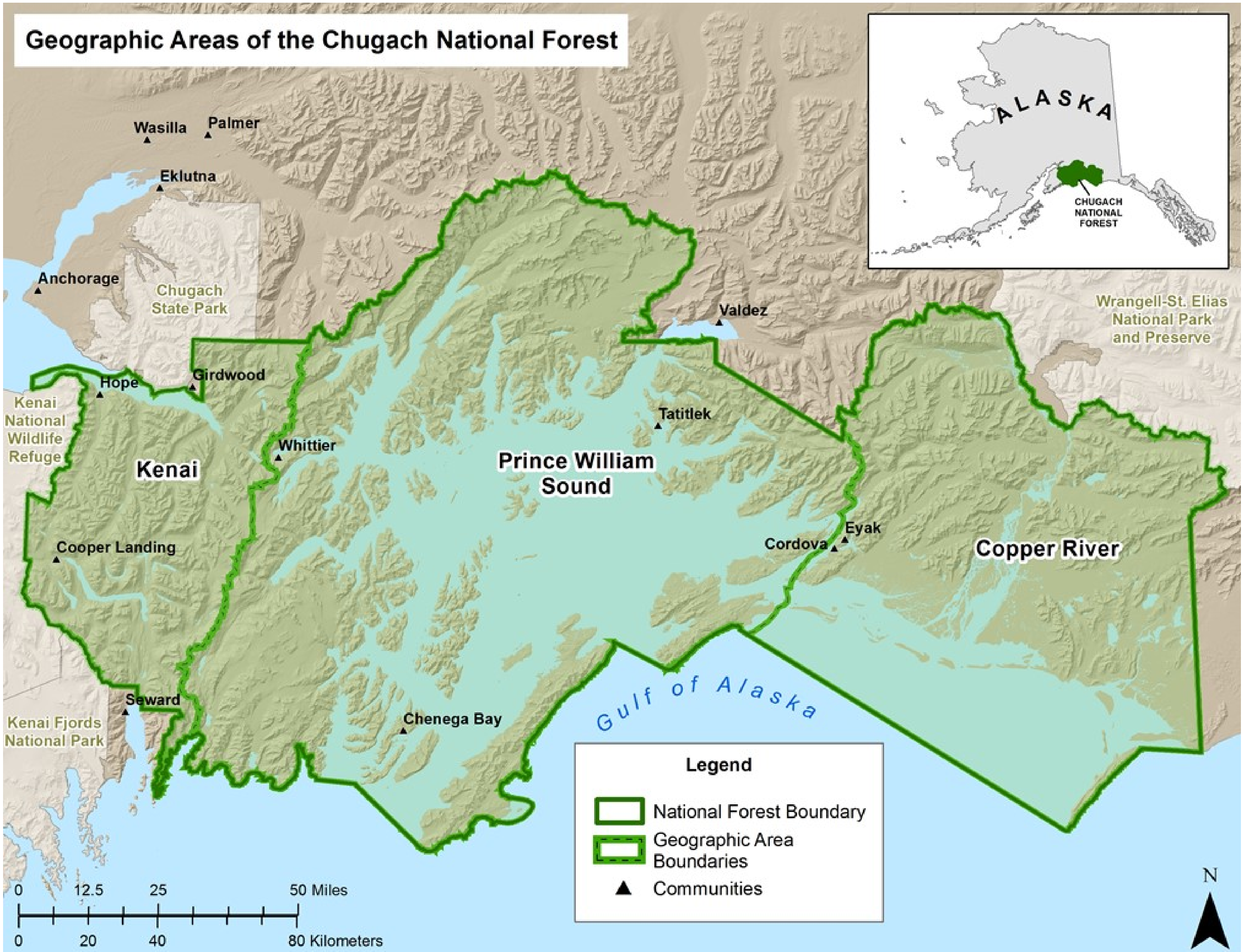
The lands excluded from the inventory include approximately 90 miles of roads (including all maintenance level 2 roads), developed utility corridors, and developed recreation sites accessible from the road system. Small areas completely or mostly surrounded by improvements, typically along the Kenai Peninsula road system, were also excluded.

Table 132. Inventory of NFS lands that may be suitable as wilderness

Inventoried Area	Geographic Area	Acres
Resurrection	Kenai Peninsula	224,630
Boston Bar	Kenai Peninsula	53,420
Johnson Pass	Kenai Peninsula	152,450
Kenai Lake	Kenai Peninsula	198,040
Kenai Mountains	Kenai Peninsula	306,670
Twentymile	Kenai Peninsula	198,780
Nellie Juan	Prince William Sound	712,820
Prince William Sound Islands	Prince William Sound	120,000
College Fiord	Prince William Sound	1,114,290
Fidalgo-Gravina	Prince William Sound	315,350
Montague Island	Prince William Sound	204,500
Hinchinbrook-Hawkins Islands	Prince William Sound	145,260
Copper River Wetlands	Copper River Delta	87,540
Sheridan Glacier	Copper River Delta	232,230
Bering Lake	Copper River Delta	957,460
Tasnuna River	Copper River Delta	342,920



Map 35. Chugach National Forest lands included in the wilderness inventory



Map 36. Chugach National Forest geographic areas

Inventoried Lands Resource Descriptions

Vegetation Distribution

Nearly 99 percent of the Chugach National Forest is managed to allow natural ecological processes to occur with limited human influence. The remainder of the national forest is in the front country management area, most of which is on the Kenai Peninsula, and includes areas of active management and the largest focused amount of human uses.

Vegetation composition and structure within the national forest is primarily the result of natural processes. Natural disturbances affecting vegetation include natural fire (ignited by lightning), native insect and disease outbreaks, earthquakes, volcanic ash fall, snow avalanches, landslides, windthrow, glacial action, floods, and beaver activity. Table 133 summarizes the distribution of National Land Cover Database (http://www.mrlc.gov/) class aggregates on NFS lands within the inventoried areas.

Table 133. Percentage distribution of National Land Cover Database class aggregates on NFS lands meeting wilderness inventory criteria

Inventoried Area	Snow/Ice/Barren	Shrubland	Forested	Freshwater	Herbaceous
Bering Lake	38.3	34.9	15.8	5.4	5.7
Boston Bar	17.4	66.4	15.2	0.4	0.6
College Fiord	67.5	16.3	14.5	1.5	0.3
Copper River Wetlands	3.8	62.4	6.8	8.3	18.7
Fidalgo-Gravina	28.5	31.9	37.5	0.9	1.1
Hinchinbrook-Hawkins Islands	1.8	36.5	59.6	1.6	0.4
Johnson Pass	24.8	61.3	12.6	0.7	0.6
Kenai Lake	18.2	54.5	18	8.5	0.8
Kenai Mountains	64.4	18.5	14.9	1.7	0.5
Montague Island	6.5	41.4	50.9	1	0.2
Nellie Juan	59	18.6	19.8	2.4	0.2
Prince William Sound Islands	2.6	26.6	68	2.7	0.1
Resurrection	10.2	73	15.8	0.7	0.2
Sheridan Glacier	60.9	22.7	13	2.7	0.7
Tasnuna River	80	15.1	3.1	1.3	0.4
Twentymile	52.5	32.7	12.9	1.3	0.6
Forestwide	46	30	19.7	2.7	1.6

Occurrences of non-native invasive plants are increasing, especially in areas of human disturbance (such as road edges, visitor facilities, trailheads, and trails). Forest Service inventory and monitoring data shows that 462 of the 1,594 sites sampled that have non-native plant species are on lands meeting wilderness inventory criteria. Most of these occurrences are near roads or along trails in the Kenai Peninsula and Copper River Delta geographic areas.

In the Copper River Delta Geographic Area, there is evidence of the invasive aquatic plant, *Elodea* spp., in several lakes and rivers. This species has the potential to crowd creeks and damage wildlife and fish habitat. It reproduces primarily from stem fragments and can survive when frozen in ice. Once established, *Elodea* spp. can be difficult to remove and is easily spread by floatplanes, anglers, recreational users, and wildlife. Non-native plants are relatively rare in the Prince William Sound Geographic Area.

Present forested vegetation in the Kenai Peninsula Geographic Area partly reflects human-caused fires that have occurred during the last 100 years or so. About 1,400 fires burned a combined 75,000 acres from 1914 to 1997 (Potkin 1997). Human-caused ignitions account for more than 99 percent of these fires.

Tree mortality associated with a spruce bark beetle outbreak on the Kenai Peninsula Geographic Area resulted in hazardous fuels accumulation in some areas. Management actions have been taken to reduce those accumulations. An average of about 875 acres of hazardous fuels is being treated within the national forest each year. Treatments consist of removal, thinning, pruning, piling, and prescribed burning primarily in the wildland urban interface, high use areas, and along transportation routes.

Wildlife habitat improvement, forest vegetation establishment and improvement, and invasive plant treatment projects also occur within the national forest. Based on data in the Forest Service Activity Tracking System (FACTS) and on file, forest vegetation establishment and improvement acreage ranged from about 200–680 acres and invasive plant control from 25–120acres per year from 2004 to 2013.

Very little timber harvest occurs within the national forest. Most of the recent logging occurred during the 1990s on private lands within the national forest boundary, along with salvage harvests following the bark beetle outbreak. Some of the private logged lands are now under Forest Service management, including the surface estate of the Knowles Head Peninsula in eastern Prince William Sound.

Wildlife Resource

This section provides an overview of the condition of wildlife populations by geographic area. A complete confirmation of occupancy and distribution of wildlife within the Chugach National Forest has not been conducted. More detailed information is provided on the condition of natural wildlife processes for a given area where applicable.

The Chugach National Forest provides some of the few places in the United States where all native wildlife species associated with the habitats in the IRAs are expected to be present in sustainable numbers. These include the dominant predators (AKNHP 2013; ADF&G 2015), game and nongame species, and resident and migratory birds (AKNHP 2013). Wildlife are expected to retain natural interactions with each other and their environment and experience the natural processes of competition, predation, migration, hibernation/wintering, breeding, feeding, and sheltering with minimal human interference, except where noted within the geographic area descriptions.

None of the native terrestrial wildlife species in these inventoried areas are currently proposed or listed in compliance with the ESA (61 U.S.C. sec 1531 et sec 107 1973, as amended). None of the State listed endangered wildlife species in Alaska occur in the inventoried areas. As of August 15, 2011, the Alaska Department of Fish and Game no longer maintains a species of concern list, instead relying on the Wildlife Action Plan (ADF&G 2015). Bald eagles, protected by the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d, 54 Stat. 250), are common in all inventoried areas, particularly along rivers and marine riparian areas. Golden eagles are occasionally present, but are much less common than bald eagles. Several rare birds can be found in inventoried areas within the national forest, including olive sided flycatchers, which are a U.S. Fish and Wildlife Service migratory bird species of management concern and an Alaska species of conservation concern. Other rare species occurring in inventoried areas of the national forest are mentioned in the individual inventory descriptions. The one bat species known to occur is the little brown myotis, which has been documented in the Kenai Peninsula Geographic Area and is likely to occur in other areas in low numbers. This bat species has been impacted by white nose syndrome across much of its range; however white nose syndrome has not yet been documented in Alaska. Little brown myotis was recently listed by the government of Canada as an endangered species and is being evaluated for listing by U.S. Fish and Wildlife Service.

Marine mammals are found in salt water adjacent to the national forest and are protected by the Marine Mammal Protection Act (MMPA) of 1972, as amended (16 U.S.C. Chapter 31). Whales, sea lions, seals, porpoises, and sea otters can be observed from many of the inventoried areas, especially in the Prince William Sound Geographic Area, and enhance the visitor’s experience even though their habitat is outside of NFS lands. The western distinct population segment of Steller sea lions is listed as endangered in compliance with the ESA (55 FR 49204, November 26, 1990), and critical habitat has been federally designated for specific haul outs and rookeries in the Prince William Sound Geographic Area (58 FR 45269).

Kenai Peninsula Geographic Area

In the inventoried areas of the Kenai Peninsula Geographic Area, wildlife species are currently expected to inhabit appropriate habitat types at sustainable levels. Historic extirpations occurred as a result of overharvest or human-caused habitat conversion, but animals that were extirpated were later re-introduced by humans (caribou), or recolonized naturally (wolves). The Kenai Peninsula now supports most of the native species found in southcentral Alaska. A few non-native species have been documented near the national forest, including garter snakes, earthworms, and house mice, although no definitive surveys have been conducted. These non-native species have not changed the overall function of native ecosystems.

Wildlife are expected to retain natural interactions with each other and their environment and experience the natural processes of competition, predation, migration, hibernation/wintering, breeding, feeding, and sheltering with minimal human interference. However, human development in or adjacent to these inventoried areas could further curtail wildlife movements and genetic interchange. There is a narrow land bridge between Portage Valley and the Kenai Mountains that has the potential to restrict migration and dispersal for some land mammals. Habitats and species in the Kenai Peninsula have particularly high value for scientific research as a result of this genetic bottleneck. Studies of endemism have been conducted on many wildlife species within the Kenai National Wildlife Refuge, indicating the restriction is having some effect on genetic interchange. The Seward Highway and Alaska Railroad are developments that, while outside of the inventoried areas, further constrain wildlife movement and could affect natural processes within the inventoried areas.

Wolves were extirpated from the Kenai Peninsula by 1915 but naturally recolonized by the 1960s and now occur in several areas. Caribou were extirpated from the Kenai Peninsula by 1912 and were reintroduced into two herd areas in 1965 (ADF&G et al. 2003). Ruffed grouse were introduced to the area, but had minimal success. The Kenai Peninsula Geographic Area provides excellent black and brown bear habitat.

Forest and wetland birds are abundant in this area. Trumpeter swans, terns, and native raptors, including bald eagles and goshawks, are common. The Kenai Peninsula Geographic Area allows visitors to experience wildlife seldom seen in other places, including both black and brown bears, wolverines, wolves, red fox, Canada lynx, moose, and caribou. Mountain goats and Dall sheep can be found in the Kenai Peninsula inventoried areas. Martens, marmots, mink, several weasels, and many small rodents are present. All three species of ptarmigan (willow, rock, and white-tailed) can be observed in the Kenai Peninsula Geographic Area.

Human activities have the potential of impacting wildlife in the inventoried areas of the Kenai Peninsula Geographic Area. Moose, caribou, brown and black bears, mountain goats, and Dall sheep are particularly vulnerable to winter recreational activity in the inventoried areas. Many animals in winter are less mobile, or may be confined to dens or are hibernating. Their food supplies may be limited, and they also are using energy to maintain body temperatures, avoid predators, and hunt prey. In some cases, additional disturbance from humans can increase wildlife energy requirements or cause displacement to the extent that natural survival or reproduction processes are compromised.

Prince William Sound Geographic Area

Wildlife in the inventoried areas of the Prince William Sound Geographic Area are expected to inhabit appropriate habitat types in sustainable levels. Some mammals are naturally absent on the more isolated islands. The lack of predatory mammals makes some of the islands a protected sanctuary for nesting birds. Most of the 220 species of birds, 30 species of land mammals, and a dozen marine mammals can be observed from the Prince William Sound inventoried areas. The marine islands and shoreline provide exceptional habitat for riparian, fresh water, and marine birds. Wildlife are expected to retain natural interactions with each other and their environment and experience the natural processes of competition, predation, migration, hibernation/wintering, breeding, feeding and sheltering with minimal human interference. Sea mammals are common in marine waters adjacent to the national forest, and Alaska Department of Fish and Game (2015a) states many of them reach their greatest numbers in the marine waters of Prince William Sound. Bald eagles are very common. Steller sea lion critical habitat (58 FR 4526 August 27, 1993) has been designated for specific rookeries and haulouts within the national forest in Prince William Sound (50 CFR 226.202). Islands and shorelines in this geographic area provide breeding and feeding habitat for several birds on the Regional Forester's Sensitive Species List, including Kittlitz's murrelets, which live at the base of glacial till and in other areas, and black oystercatchers that live on rocky beaches along the shoreline. The Prince William Sound Geographic Area is a major breeding area for black oystercatchers (Pacific Coast Joint Venture 2003).

Non-native blue and silver foxes and off-site native furbearers were introduced to the islands of the Prince William Sound in the late 1700s through the early 1900s for the purpose of eventual harvest. Rabbits and other prey species were also introduced to provide food for introduced fur-bearers. Most of the off-site furbearers and prey died out due to disease and overutilization of their habitat. Sitka deer, an important game species, were introduced to Hawkins and Hinchinbrook from southeast Alaska in several transplants between 1916 and 1923 and have swum to many islands throughout this geographic area. This population is at the species' most northern range, and periodically experience significant population declines due to snow and severe winters, so ecological impacts of these off-site mammals may be less than the off-site deer documented farther south. European black slugs (Arion spp.) have been expanding into the Prince William Sound Geographic Area, although no definitive surveys have been conducted. Identification of Arion slugs is difficult and some species interbreed. Arion rufus interbreeding with the more invasive and potentially damaging Arion vulgaris has resulted in increased tolerance to cold (at least in domestic crop areas where their impacts have been studied). All Arion have the potential to rapidly expand in new habitats and alter natural ecology.

The *Exxon Valdez* oil spill oiled the northwestern and western portions of this geographic area in 1986, but many of the affected wildlife have recovered or are recovering (EVOS TC 2014). Pigeon guillemots and marbled murrelets have not. Pigeon guillemot populations are far lower than historic levels (EVOS TC 2015). An *Exxon Valdez* oil-spill-funded U.S. Fish and Wildlife Service project to reduce mink on the Naked Island Group was initiated in 2014 to help restore pigeon guillemots and help restore a more natural balance. Some subsurface oil remains. Specific *Exxon Valdez* oil spill effects on the natural wildlife processes are noted in the individual inventoried areas.

Marine debris is a common issue in Prince William Sound, particularly along the southern coastal areas of Montague, Hinchinbrook, Hawkins, and Kayak Islands. In addition to a steady supply of fishing and other debris, the 2011 Japanese earthquake and tsunami swept an estimated 5 million tons of debris into the Pacific Ocean. An estimated 70 percent sank, but Alaska Division of Environmental Health reports that 1.5 million tons are moving across the ocean with winds and currents. Some of the materials are hazardous. Many bottles and drums are not labeled. Possibly the greatest impact to wildlife is the breakdown of plastics that are mistaken by sea birds and animals as food. Ingestion of plastics can cause wildlife to starve to death with a stomach full of indigestible plastic. Clean-up and storage of these materials will be difficult due to the high winds and rough coastline, but leaving them on site has the potential to alter natural processes and ecological functions. Changes to wildlife or natural processes from this are still unknown.

Human activities have the potential of impacting natural wildlife processes in the Prince William Sound Geographic Area. A Forest Service study identified 19 areas making up less than one percent of the coastline, as primary hot spots with a convergence of sensitive resources and high levels of recreational activity (Poe and Suring 2010). An additional 13 percent of the coastline was identified as secondary hot spots. The study suggested the potential for active recreation management may be needed to mitigate impacts to sensitive wildlife areas. Nesting seabirds and shorebirds are particularly vulnerable to human activities during their crucial breeding period. Human activities that displace sea mammals from haul outs or rookeries can reduce their survival and reproduction. Fishing, hunting, and recreational access has increased with the building and improvements to the Anton Anderson Memorial Tunnel, commonly referred to as the Whittier tunnel. Anecdotal reports from the public and staff indicate black bears are seldom seen in areas where they were formerly common. Black bear harvests levels and reducing skull sizes in Game Management Unit 6 suggest there may be concerns about population declines, possibly related to increased access and harvest.

Copper River Delta Geographic Area

Wildlife in the inventoried areas of the Copper River Delta Geographic Area are currently expected to inhabit appropriate habitat types in sustainable levels, although some mammals are naturally absent on some of the islands. The lack of predatory mammals makes some of the smaller islands a protected sanctuary for nesting birds and sea mammals. The marine islands and shoreline provide exceptional habitat for riparian, fresh water, and marine birds. Wildlife are expected to retain natural interactions with each other and their environment and experience the natural processes of competition, predation, migration, hibernation/wintering, breeding, feeding, and sheltering with minimal human interference.

The entire breeding population of dusky Canada geese occurs on or adjacent to the Copper River Delta. Research on dusky Canada geese has been conducted for decades and documents this subspecies response to earthquake habitat changes, overhunting, and successional change, making a significant contribution to the scientific literature. Their numbers and distribution were severely decreased by overhunting in the early 1900s and they lost the majority of their breeding habitat during the 1964 earthquake and coastal uplift. The Forest Service has partnered with many agencies for several decades to install and maintain artificial nesting islands to improve their numbers.

Boreal toads, one of only two amphibian species native to southcentral Alaska, have been documented in the Copper River Delta and scattered locations in the Prince William Sound Geographic Area. Rusty black birds are a common species that is apparently declining in Alaska and range-wide (D. Tessler, personal communication February 18, 2015). A significant decline in common species can have a greater ecological effect than similar percent declines in rarer animals. It is currently not known if these declines are related to human or natural causes.

Moose are native to southcentral Alaska, but much of the Copper River Delta Geographic Area was inaccessible to moose due to geographic barriers. Moose from elsewhere in southcentral Alaska were introduced to Cordova and now comprise a resident population that sustains a regular hunting harvest. European black slugs (*Arion* spp.) were first noted within the boundaries of the national forest in Cordova, where they are becoming more common, and have also been incidentally documented in scattered locations of Prince William Sound. Identification of *Arion* slugs is difficult and some species interbreed, but all *Arion* have the potential to rapidly expand in new habitats and alter natural ecology.

The Copper River Delta is fed by six glacial river systems and is known as one of the world's most important estuaries. Millions of shorebirds, predominantly spotted sandpipers and dunlins, migrate north through the Copper River Delta in spring. They migrate across a wider swath in the fall when they move south. Although these migrating birds are in the area for a short period of time, the migration stops are essential for their successful breeding season and to sustain their long journey to their wintering areas in South and Central America. The lakes and wetlands support hundreds of wintering trumpeter swans. Sea mammals are present in the Gulf of Alaska waters making up the western boundaries of the Copper River Delta Geographic Area. Sea otters are commonly observed adjacent to NFS lands. There are seal and Steller sea lion haul outs on these uplands but no formally designated critical habitat in this geographic area. Bald eagles are extremely common. Human activities in the roadless areas of the Copper River Delta Geographic Area have the potential to displace migratory birds during important feeding bouts and displace beach nesting species from their young during rearing periods. Human activities in winter can increase energy requirements for moose. Activities near mountain goats in winter can deter them from predator-safe areas and increase energy requirements during the season when food is limited. It is unknown whether current recreational use has altered natural wildlife processes in this area.

Fish Resource

The naturalness of a particular inventoried area is influenced by the diversity of the salmon populations and also the level of nutrients they supply to both aquatic and terrestrial ecosystems. Fish species other than salmon also play a major role in the natural state of Chugach National Forest watersheds. Dolly Varden char, rainbow trout, and cutthroat trout occur in various watersheds. In some cases these species occur alongside salmon, and in other locations, they exist in isolation above waterfalls that salmon cannot pass.

The Forest Service has developed a provisional list of salmon populations for Chugach National Forest watersheds. In this evaluation, the number of populations for each species has been summarized by inventoried study area (table 134). From this summary it is evident that there is considerable variation in species composition among the inventoried areas. There is also much variation in the number of populations among inventoried areas. While other fish species are present in all of these areas, salmon are probably the best general indicator of inventoried area condition and character from the aquatic standpoint.

Table 134. Number of salmon populations estimated for each inventoried study area, by species

Inventoried Area	Chinook	Coho	Sockeye	Pink	Chum	Totals
Bering Lake	3	20	19	8	4	54
Boston Bar	1	3	1	3	2	10
College Fiord	2	10	7	62	48	129
Copper River Wetlands	0	6	3	5	4	18
Fidalgo-Gravina	0	12	3	64	50	129
Hinchinbrook-Hawkins Islands	0	15	3	45	34	97
Johnson Pass	2	3	3	0	0	8
Kenai Lake	7	11	9	4	3	34
Kenai Mountains	1	6	6	1	0	14
Montague	0	17	3	59	40	119
Nellie Juan	2	10	16	57	42	127
Prince William Sound Islands	0	5	3	27	14	49
Resurrection	3	3	1	2	1	10
Sheridan Glacier	0	6	6	2	3	17
Twentymile	2	5	5	3	4	19
Tasnuna	2	3	2	0	0	7

While variable among different areas, the primary human-caused impacts on inventoried area ecosystems can be categorized as: land use, indirect fishery effects, and indirect effects of hatchery fish. These factors have impacted the condition of fish populations and their associated habitats and thereby the degree of inventoried area naturalness. A general summary is provided here with more detail added in the area specific sections that follow.

Land Use Impacts

In general, the impact of human activities on the habitats of the Chugach National Forest has been light compared to other national forests. However, there are locations where former gold mining operations had adverse impacts on channel and watershed function. In addition, other problems exist with regard to destruction of riparian vegetation from off-highway vehicles and foot traffic, fragmentation of watersheds due to road crossings, and hydropower development.

Indirect Fishery Impacts

Salmon, char, and trout are all caught in sport and commercial fisheries. As a result, a portion of each year’s production is removed prior to spawning. It is not clear what the long-term ecological impact may be of fewer salmon carcasses on the spawning grounds as a result of these fisheries. However, one consequence is a reduction in the level of marine derived nutrients into aquatic and terrestrial ecosystems compared to historical times.

Indirect Effects of Hatchery Fish

Hatchery fish are common in Prince William Sound and the lower Kenai Peninsula. A number of studies on coho, Chinook, and steelhead have demonstrated that hatchery and wild fish spawning under natural conditions differ considerably in their relative ability to produce surviving offspring (Araki et al. 2008; Buhle et al. 2009; Chilcote 2011; Leider et al. 1990). Although similar studies have yet to be conducted in Alaska, it is likely the same impacts exist. Naturally spawning hatchery fish have the potential to alter the genetic diversity of wild populations and lower their overall productivity. To conserve the long-term genetic character and productivity of natural populations, several authors have suggested that hatchery fish should comprise no more than five to 10 percent of the spawners in natural streams (the remaining 90 to 95 percent being wild fish) (Ford 2002; Mobrand et al. 2005).

In addition to salmon, hatchery rainbow trout (non-anadromous) are released into Carter and Rainbow Lake within the Kenai Lake study area and Vagt Lake within the Kenai Mountain study area. Hatchery fish are released into other small lakes in the Kenai Peninsula Geographic Area; however, these lakes occur within the developed corridor and therefore are excluded from this evaluation. These hatchery trout are released to enhance recreational fisheries, and, in most cases, they are genetically sterile (triploid), thus they are cannot reproduce nor establish self-sustaining populations that might compete with wild species.

Recreation

The inventoried areas offer a wide range of recreation opportunities and settings, ranging from developed trails near highways to remote locations where access is limited to boat or plane. More than 500 miles of trails facilitate access into the undeveloped backcountry of the Chugach National Forest. With the exception of 42 cabins across the national forest, there are very few developed recreation sites outside of the road system; nearly 99 percent of the national forest falls into the primitive or semi-primitive recreation opportunity spectrum classes (table 135). Very little of the inventoried area is open to summer motor vehicle use, while in the winter more than half of the national forest is open to motor vehicle recreational use. Helicopter-assisted skiing occurs on portions of the Kenai Peninsula and Copper River Delta inventoried areas. Air traffic is common over much of the landscape, with greater activity along common flight paths on the Kenai Peninsula and upper Prince William Sound.

Table 135. Recreation opportunity spectrum classes by geographic area, in acres

Recreation Opportunity Spectrum Class	Kenai Peninsula	Prince William Sound	Copper River Delta	Total
Primitive	5,952	1,166,189	1,334,973	2,507,114
Semi-primitive non-motorized	198,008	1,335,090	19,818	1,552,916
Semi-primitive non-motorized (winter motorized allowed)	523,588	83,341	112,760	719,689
Semi-primitive motorized	365,329	22,011	189,702	577,042
Roaded natural	70,611	569	17,164	88,344

Recreation settings in the Kenai Peninsula inventoried areas range from areas of development and higher concentrations of people near roads that make up area boundaries and along trail corridors where solitude is less common, to remote, undeveloped areas in the backcountry with little use and no development. Compared to the other two geographic areas, the Kenai Peninsula has a substantial infrastructure and sees the most guided and non-guided recreational use. There is also the greatest variety of recreational activities here, including mountain biking, hiking, fishing, hunting, camping, horseback riding, backcountry skiing, and snowmachining.

Prince William Sound inventoried areas provide primitive and semi-primitive recreation settings. Access is by watercraft from nearby towns, floatplane or helicopter, and recreation settings are generally undeveloped and dispersed. The western half of Prince William Sound includes the 2.1 million acre Nellie Juan-College Fiord Wilderness Study Area designated in 1980, which is managed to maintain the area's wilderness character, including providing opportunities for solitude and primitive-style recreation. Motorized boating comprises the majority of use in Prince William Sound, though it is also a destination for day and multi-day sea kayaking trips. Cabins are found along the shoreline and near freshwater lakes. For many, the marine waters serve as a setting for recreation, with uplands used by hunters, campers, researchers, educators, and more than 30 outfitters and guides. Locations closer to gateway communities of Whittier, Valdez, and Cordova see more recreational use than the more remote areas of Prince William Sound. Commercial vessel traffic is extensive during the summer, including the commercial fishing fleet, ferries, and cruise ships.

The Copper River Delta is much like Prince William Sound in that it is undeveloped and remote with extensive primitive and semi-primitive recreation opportunities. Vast areas in the Copper River Delta are only accessed by boat or float plane. Developed facilities include six public use cabins spread out across the area, with only three cabins accessible by trail. Trails and easements beginning along the road system and along the Copper River provide access to the backcountry, and the national forest's largest area open to recreational summer motor vehicle use is found in this area.

Table 136. Trail miles and public use cabins by geographic area

Geographic area	Trail miles	Cabins
Kenai Peninsula	401	20
Copper River Delta	88	6
Prince William Sound	28	16
Total	517	42

The Chugach National Forest Access Management Plan, which is included in the 2002 forest plan, defines where motor vehicles of different kinds are allowed within the national forest, including off highway vehicles, helicopters, and airplanes. In general, the national forest is open to motor vehicle access in the winter unless specifically closed through a special order, while it is closed to motor vehicle access in the summer unless specifically allowed and displayed on the national forest MVUMs. As directed by ANILCA, motor vehicle access for subsistence is generally allowed anywhere on the Chugach National Forest, summer or winter, except for the Power Creek area near Cordova. Snowmachines are also allowed in the wilderness study area for subsistence and traditional activities. Table 137 and table 138 provide further detail on lands open to motor vehicle use by season.

Table 137. Acres of summer motor vehicle access within the Chugach National Forest, by geographic area

Type of Access – Summer	Kenai Peninsula	Prince William Sound	Copper River Delta	Total
Open to all motor vehicle use	0	94	163,323	163,417
Open to helicopters, closed to off-highway vehicles	257,264	5,022	421,052	683,338
Open to motor vehicle use in non-vegetated areas only	0	6,607	27,356	33,963
Open to motor vehicle use on designated routes only, open to helicopters	156,662	10,287	52	167,001
Total	413,926	22,010	611,783	1,047,719

Table 138. Acres of winter motor vehicle access within the Chugach National Forest, by geographic area

Type of Access – Winter	Kenai Peninsula	Prince William Sound	Copper River Delta	Total
Open to all motor vehicle use	691,864	237,163	1,175,772	2,104,799
Open to snowmachines, closed to helicopters	0	0	389,602	389,602
Open to all motor vehicle use until March 31 (closed after March 31)	9,216	0	0	9,216
Open to helicopters, closed to snowmachines	23,340	0	0	23,340
Season on/season off; alternating year motor vehicle/non-motorized use	153,661	0	0	153,661
Total	878,081	237,163	1,565,374	2,680,618

Evaluation

The purpose of the evaluation step is to evaluate the wilderness characteristics of all of the lands included in the inventory. Information gathered in the evaluation is used to help determine which lands to carry forward as recommended wilderness in one or more alternatives in the forest plan environmental impact statement. The criteria are defined in Forest Service Handbook 1909.12, Chapter 70 and are summarized below. To determine potential suitability for inclusion in the National Wilderness Preservation System, the interdisciplinary team evaluated each area using the following outline.

1. Apparent naturalness.

- Do overall ecological conditions appear to be functioning in a way where human intervention and developments are substantially unnoticeable?
- Determine if plant and animal communities appear natural. Included are descriptions of fish, wildlife, and vegetation for each area.

2. The degree of outstanding opportunities for solitude or for a primitive and unconfined type of recreation.

- Identify impacts that influence opportunities for solitude. Considered are the amount and distance from developments and high use areas, topography, screening, and sights and sounds from outside the area.
- Opportunity for primitive or unconfined recreation. The evaluation includes an overview of recreation setting, types of development, diversity of primitive-type recreation opportunities, and current management direction for motor vehicle recreation within the area.

3. The degree to which the area may contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

- Qualities correspond to the other purposes of wilderness as described in the Wilderness Act.

4. Ability to manage the area as wilderness, including:

- Shape and configuration of the area
- Management of adjacent lands

- The presence and amount of non-Federal land in the area
- Legally established rights or uses within the area, including mining activity
- Specific Federal or State laws that may be relevant to availability of the area for wilderness or the ability to manage the area to protect wilderness characteristics

To facilitate the evaluation, the inventoried lands were divided into the same areas used in the previous wilderness evaluation in 2002 (table 139). The boundaries of these areas, however, changed slightly due to removal of a buffer between the inventoried areas and developments, as well as land conveyances and new developments since 2002. The amount of detail varies from area to area based on the amount of available information in the assessment and other studies completed since the previous wilderness evaluation. For example, lands within the Nellie Juan-College Fiord Wilderness Study Area are the only areas that have specifically been monitored for trends in wilderness character as part of forest plan monitoring, so the description provided for three inventoried areas within the wilderness study area—Nellie Juan, Prince William Sound Islands, and College Fiord—is relatively more thorough (table 139). Because this evaluation includes more than five million acres, it is necessarily broad in scope. For more detailed information on any of the resources, refer to the forest plan assessment (USDA 2014a) available on the Chugach National Forest website.

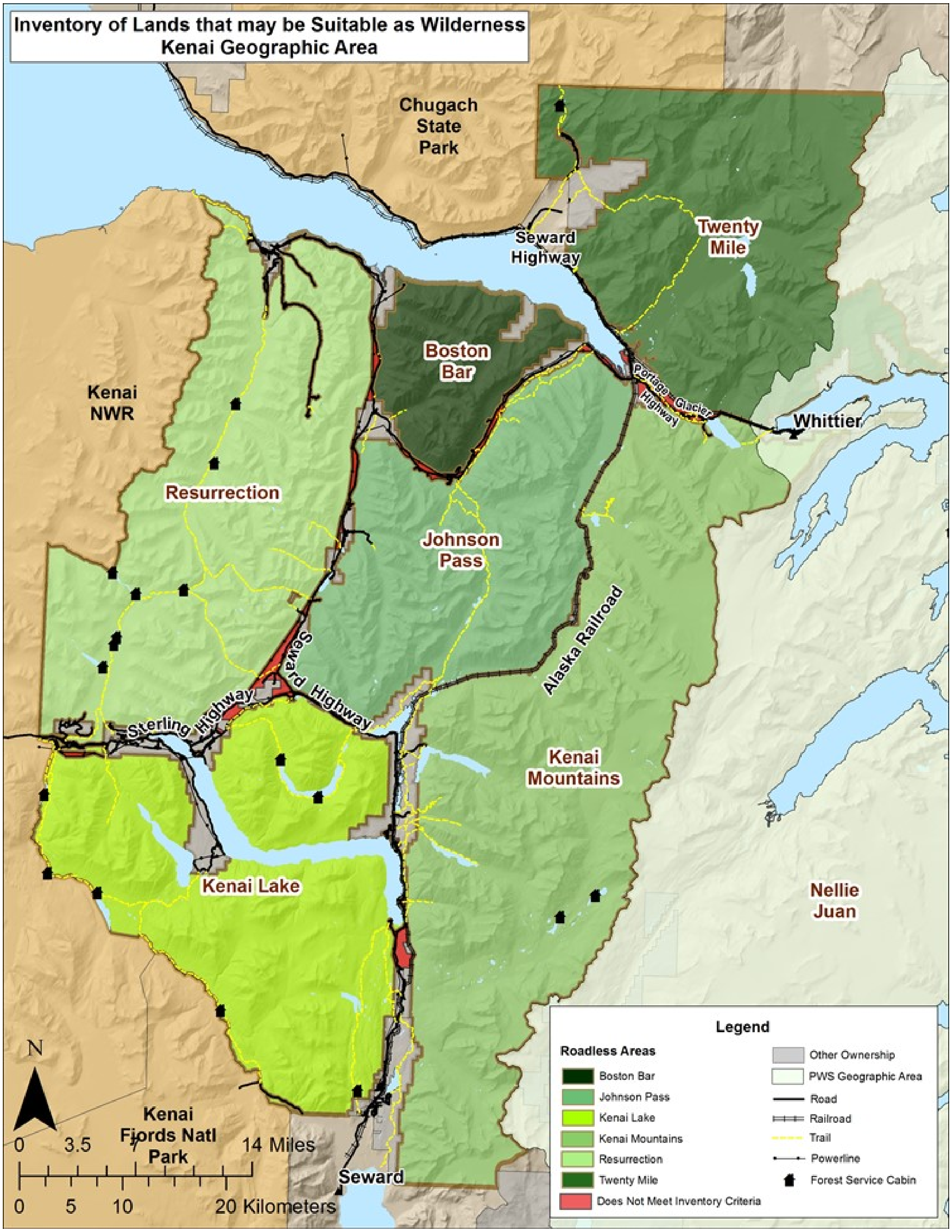
Rationale for Determining Which Areas to Analyze in the NEPA Process

The information in the Inventory and Evaluation sections was reviewed for pertinent information concerning the suitability of lands across the forest for inclusion in the National Wilderness Preservation System. Information within the Assessment of Ecological and Socio-Economic Conditions and Trends (USDA 2014) was considered. A thorough evaluation and review of land status within the designated Wilderness Study Area was completed to understand current land ownership status as well as remaining State, Regional Native Corporations and Village Native Corporation land selections. Information shared during the consultation meetings with the two regional native corporations, Chugach Alaska Corporation and Cook Inlet Region, Incorporated, and the two village native corporations, the Tatitlek Corporation and the Chenega Corporation was considered. The most current mineral potential information was reviewed across the forest. Finally, any other proposed land uses that would be inconsistent with wilderness recommendation was also considered.

Table 139. Summary of Chugach National Forest wilderness evaluation, by inventoried area

Inventoried Area	Geographic Area	Acres of NFS Land	Attributes Supporting Wilderness Suitability	Limitations or Challenges to Wilderness Suitability
Resurrection	Kenai Peninsula	224,630	Natural appearance and ecological conditions, cultural sites, adjacent to designated wilderness	Palmer Creek Road penetrates the area, recreation developments in and adjacent to area, motor vehicle and mechanized recreation patterns, mining activity, competitive events
Boston Bar	Kenai Peninsula	53,520	Natural appearance and ecological conditions, recommended wild and scenic river (recreational)	Motor vehicle recreation patterns at Turnagain Pass, small area
Johnson Pass	Kenai Peninsula	152,450	Natural appearance and ecological conditions, historical sites	Mining activity, motor vehicle/mechanized recreation patterns
Kenai Lake	Kenai Peninsula	198,040	Natural appearance and ecological conditions, ecological diversity, large lakes, research natural area, cultural sites, adjacent to designated wilderness	Snug Harbor Road, recreation developments and use patterns in and adjacent to area, human influence on fish and wildlife populations
Kenai Mountains	Kenai Peninsula	306,670	Natural appearance and ecological conditions, ecological diversity, recommended wild and scenic river (wild), adjacent to wilderness study area	Winter motor vehicle recreation patterns, mining activity
Twentymile	Kenai Peninsula	198,780	Natural appearance and ecological conditions, Ecological diversity, recommended wild and scenic river (scenic), adjacent to wilderness study area and State wilderness	Motor vehicle recreation patterns including power boats and helicopter-assisted activities, established competitive event
Nellie Juan	Prince William Sound	712,820	Natural appearance and ecological conditions, tidewater glaciers, part of wilderness study area, research natural area and other science, recommended wild and scenic river (wild), remoteness	Amount of private land, opportunities for solitude along coastline impacted by activities on adjacent intertidal zone and marine waters, hatchery and set net developments
Prince William Sound Islands	Prince William Sound	118,400	Natural appearance and ecological conditions, cultural sites, part of wilderness study area	Communication site, opportunities for solitude impacted by size of islands and activities on adjacent intertidal zone and marine waters
College Fiord	Prince William Sound	1,114,290	Natural appearance and ecological conditions, scenery, glaciers, part of wilderness study area, cultural and historical sites, size of area, scientific studies, remoteness	Opportunities for solitude impacted by size of islands and activities on adjacent intertidal zone and marine waters

Inventoried Area	Geographic Area	Acres of NFS Land	Attributes Supporting Wilderness Suitability	Limitations or Challenges to Wilderness Suitability
Fidalgo-Gravina	Prince William Sound	256,890	Natural appearance and ecological conditions, research natural area	Amount of State, private and EVOS lands (split estate), opportunities for solitude along coastline impacted by activities on adjacent marine waters
Montague Island	Prince William Sound	204,500	Natural appearance and ecological conditions, research natural area, endemic species, remoteness	Amount of private land
Hinchinbrook-Hawkins Islands	Prince William Sound	136,950	Natural appearance and ecological conditions, cultural sites, low development	Amount and location of State and private land, motor vehicle use patterns
Copper River Wetlands	Copper River Delta	83,690	Natural appearance and ecological conditions, research natural area and other science, large intact wetland system, low development	ANILCA 501(b) management direction, size of area, opportunities for solitude impacted by activities on adjacent marine waters, motor vehicle recreation patterns on rivers, sloughs, and barrier islands
Sheridan Glacier	Copper River Delta	222,830	Natural appearance and ecological conditions, glaciers, scenery, low development	Amount of State and private land, ANILCA 501(b) management direction, winter and summer motor vehicle recreation patterns
Bering Lake	Copper River Delta	957,460	Natural appearance and ecological conditions, cultural sites, large intact wetland system, size of area, low development, remoteness	ANILCA 501(b) management direction, access mostly by power boat and float plane, road easement to private land (currently undeveloped)
Tasnuna River	Copper River Delta	342,920	Natural appearance and ecological conditions, scenery, cultural sites, remoteness, low development	Amount and location of private land, ANILCA 501(b) management direction, access mostly ANILCA by motor vehicles



Map 37. Inventory of lands that may be suitable as wilderness in the Kenai Peninsula Geographic Area

Kenai Peninsula Geographic Area

Resurrection Inventoried Area

Gross acres: 228,030
NFS acres: 224,630

Apparent Naturalness

Appearance and Developments

Most of the area appears unmodified. Minor inclusions, such as the recreation cabins and trails, are evident when one is close to them. The timber salvage operations that have occurred within and adjacent to the southern end of the unit near Cooper Landing are evident from a distance.

The area exists in a predominantly natural condition. Overall, the area provides spectacular scenery. Prescribed burning for moose habitat occurred in the 1980s in the valley bottoms and lower slopes of Resurrection Creek and Juneau Creek. Also, several large, probably human caused fires swept through large parts of the area in about 1924. These events do not detract from the natural condition. Previous mining along Resurrection Creek near Hope altered the stream channel. Part of the creek has been restored, with plans for restoration of an additional two miles. The rest of the area is unmodified except for nine existing recreation cabins and trails. The majority of this inventoried area, 97 percent, is natural appearing where only ecological change has occurred.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are common in areas of human disturbance, especially near roads and along trails. Areas of historic logging and hazardous fuels reduction are common near roads along the margins of the area. Areas of human-caused burning, both accidental and intentional, are also common in the forests.

Fish Resource

All five species of Pacific salmon (Chinook, coho, sockeye, pink, and chum) occur in this inventoried area as well as Dolly Varden char and rainbow trout. In addition, the only known population of burbot on the Chugach National Forest occurs in Juneau Lake. Although partially restored, a section of lower Resurrection Creek flows in an artificially straightened channel as a result of past gold mining. This is an unnatural condition and adversely impacts fish resources.

The annual number of spawning salmon is believed to fluctuate in natural patterns with a modest proportion of the run removed each year in fisheries. All watersheds contain Chinook salmon, a species which is currently in low abundance for unknown reasons. No hatchery fish are found in this area. Overall, the fish resources in this area are classified as being in a “slightly impacted” condition with regard to baseline natural conditions.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). The tide-influenced Resurrection Creek provides wetland habitat for native birds and mammals that functions unimpeded by human development. There is both winter and summer range for the Kenai Mountain caribou herd in this area (ADF&G et al. 2003). The Kenai Mountain caribou herd was extirpated in the early 1900s due to overhunting and loss of habitat from human-caused fires and was re-established in a 1965 translocation (ADF&G et al. 2003). Moose, mountain goats, black and brown bears, wolves, and lynx, ptarmigan, and other wildlife are present.

Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference, although garbage and human foods on the southern boundary and concentrations of fish waste near Russian River have the potential to change the natural behavior of bears, raptors, and corvids such that habituation and adverse population impacts could result. None of the native terrestrial wildlife in this area are proposed or listed in compliance with the ESA.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

There is a moderate opportunity for solitude within the area. The area is bounded on three sides by heavily used highways. Small communities of Hope/Sunrise and Cooper Landing are next to the north and south boundary of the unit respectively. The sounds of highway traffic and residential and commercial activities can be heard for several miles up the Resurrection Pass Trail near Cooper Landing. There are numerous access points and trailheads into the area. Access to the larger lakes in the area is also provided by floatplane. The present recreation use along the Resurrection Pass, which runs down the middle of the area, and Devil’s Pass Trails are high, with relatively high use levels occurring year round. These trails are increasingly a destination for mountain bikers and recreation events. Other trails leading into parts of the unit are the Gull Rock Trail and the Hope Point Trail. A person traveling or camping along the trail system is likely to see other people, especially during high use periods. The opportunity for solitude substantially increases away from the trail system.

Opportunity for Primitive Recreation

Opportunities for primitive recreation are moderate as there is a high diversity of opportunities, but due to a relatively high amount of recreation-related development, there is only a moderate challenge to the recreation user.

Recreation opportunity spectrum class:

- Semi-primitive non-motorized – 18,700 acres
- Semi-primitive non-motorized (winter motorized allowed) – 131,900 acres
- Semi-primitive motorized – 58,400 acres
- Roaded natural – 13,400 acres
- Rural – 2,200 acres

There are 65 miles of trail in the area and nine recreation cabins; eight of the cabins are accessed via the Resurrection Pass Trail. There is also a no amenity, non-fee campground accessible by the Palmer Creek Road in the northeast section of the area.

Motor Vehicle Recreation

From May 1 to November 30, the northern part of the area is open to off-highway vehicles on designated routes and helicopter landings. The rest of the area is closed to recreational motor vehicle use. Most of the area, including the Resurrection Pass Trail, is open to snowmobiles every other winter, snow cover permitting, from December 1 to April 30. Motor vehicle use has been regulated here since the mid-1970s.

Other Values

Ecological, Geological, or Scenic Features

There are opportunities to see a spectacular waterfall at Juneau Falls. Trout, Juneau, and Swan lakes are easily accessible glacially carved alpine and sub-alpine lakes. Populations of the Alaska Region sensitive plant Eschscholtz's little nightmare (*Aphragmus eschscholtzianus*) occur in the area.

Opportunities to view and study mountain goats and Dall sheep in a small area are noteworthy. The Kenai Mountain caribou herd, which occurs across a broad area of the northern Kenai Peninsula, is one of the few caribou herds that occur on NFS lands in the United States.

Cultural and Historic Features of Value

There are 30 known cultural sites within the unit. The Resurrection Creek and Palmer Creek drainages were the site of extensive prospecting and placer mining starting in 1888. The community of Hope was originally a mining community, and placer mining still occurs. Several old lode mines exist as well. This area is also part of the Kenai Mountains Turnagain Arm National Heritage Area.

Features of Scientific or Educational Value

None identified.

Manageability

Shape and Configuration of the Area

The area is bounded by paved road and saltwater to the north, paved road on the east and south, and designated wilderness or proposed wilderness on the west. The feasibility of managing as recommended wilderness is high. The Federal Highway Administration and State of Alaska Department of Transportation and Public Facilities have released a Final Environmental Impact Statement which analyzes route alternatives for the Sterling Highway in the Cooper Landing area. Three alternatives cross through the southern portion of this area. If one of these alternatives is implemented, the land between the new route and existing developments would be excluded from the area.

Management of Adjacent Lands

The unit is adjacent to the eastern edge of the Kenai Wilderness Area in the Kenai National Wildlife Refuge. The northwest edge, from the Chickaloon River drainage north, borders proposed wilderness currently being managed for its wilderness values by the U.S. Fish and Wildlife Service. To the east and south, across the Hope and Sterling highways, are NFS lands within the Boston Bar, Johnson Pass, and Kenai Lake Inventoried Areas. Management area prescriptions in these areas are similar.

Non-Federal Lands

There are 3,400 acres of State and private lands within the inventoried area. All of these lands are adjacent to major roads along the boundaries of the area. Wilderness designation would have no effect on access to these adjacent, private lands.

Legally Established Rights or Uses within the Area

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for hiking, camping, mountain biking, ski touring, horseback rides, and hunter transport. There is a Recreation Event Permit for a mountain bike race held annually in August. There is one communication site authorized that is accessible by helicopter on the Hope Mountain.

Minerals

There are dozens of placer mining claims in this area or near the boundaries. Substantially noticeable operations that were excluded from the inventory include Hope Mining Company operations on lower Resurrection Creek, one or more mechanical placer operations on Bear Creek, at least two operations on Quartz Creek, and a recently reclaimed location near the Coeur d'Alene campground on Palmer Creek. Other sites in the inventoried area include several creeks near the Seward Highway and several scattered lode claims. The Forest Service currently has 19 plans of operations for mining activities within or near this area and additional mining activity is also likely occurring that does not require authorization. Several lode claims also exist on the headwaters of area drainages.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

Resurrection Pass National Recreation Trail travels through the middle of the area from the south end to the north end and is one of the more popular long distance trails (38 miles) within the forest. The opportunity for solitude is moderate due to higher use by hikers and mountain bikers in the summer and snow machiners and backcountry skiers in alternating winters. Infrastructure development consists of 65 miles of trail and nine recreation use cabins. Current travel management for much of the area would not be compatible with a wilderness designation. Motorized travel in the summer months is allowed in the northern section of the area on Palmer Creek Road and winter motorized travel is allowed throughout most of the area every other year. The Resurrection Pass Trail system is utilized by a competitive event every summer and placer mining activity is common on the north end of Resurrection Pass Trail on Resurrection Creek, along Palmer Creek, and along Bear Creek which adds motorized noise influences, authorized OHV use by miners, and modifies the naturalness of the area. Smaller portions of this inventoried area were not considered for wilderness recommendation due to the widespread winter motorized use every other winter along the Resurrection Pass Trail and adjacent areas along the trail system, and the relative importance of this area to providing a motorized winter experience as described in the Kenai Winter Access environmental documentation (USDA 2007).

Boston Bar Inventoried Area

Gross acres: 57,280
NFS acres: 53,520

Apparent Naturalness

Appearance and Developments

Most of the area appears unmodified. The area exists in a predominantly natural condition. Overall, the area provides spectacular scenery. The majority of this inventoried area, 96 percent, is natural appearing, where only ecological change has occurred. The area is essentially unmodified, except for minor changes from mining.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are present in a few areas near roads and along trails.

Fish Resource

All five species of salmon are found in this study area as well as Dolly Varden char. Coho salmon are the primary species through much of the area, although none of the area watersheds are believed to contain large numbers of fish. Past gold mining has impacted the productivity of the lower reaches of these watersheds, possibly depressing fish numbers from historic levels. Fishery impacts are likely modest and no hatchery fish occur in the area. Compared to baseline natural conditions, the fish resources in this area warrant a “slightly impacted” classification.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference. Extensive winter recreational use in this area, including backcountry skiing, snowmachining, and heli-skiing, has the potential to displace alpine wildlife, such as mountain goats and sheep.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

There is a moderate opportunity for solitude within the area. Low flying aircraft normally bypass the area flying either up Resurrection Pass or Turnagain Pass. Present recreation use levels are low, except immediately adjacent to the area along Turnagain Pass and Sixmile Creek. Although there is considerable topographic screening and the distance from the perimeter to the core is between three and five miles, the area is relatively small with limited vegetation screening and some permanent off-site intrusions. Highway sounds are evident along the unit’s edge but drop off rapidly where topographic barriers exist.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is moderate as there are few developments but only a moderate amount of recreation diversity and few challenges to the recreation user. Much of the recreation use is by motor vehicles.

Recreation opportunity spectrum class:

- Semi-primitive motorized – 58,400 acres
- Roaded natural – 13,400 acres

There are no established summer trails or recreation cabins in the area. There is one winter snowmachine trail that is part of the INHT Southern Trek, generally running parallel to the Seward Highway along most of the eastern boundary of the area.

Motor Vehicle Recreation

From May 1 to November 30, the area is open to helicopter landings and closed to off-highway vehicles. From December 1 to April 30, it is open to all motor vehicle uses, snow cover permitting. The west side of Turnagain Pass is the most popular snowmachining area within the national forest. Also, motor vehicle use in the Seattle Creek area has increased as snowmachine technology has improved over the past two decades.

Other Values

Ecological, Geological, or Scenic Features

East Fork Creek and Sixmile Creek, along the southern and western border of the area are recommended for Wild and Scenic River classification under the Wild and Scenic Rivers Act. Six hundred acres are tentatively classified as scenic and 200 acres as wild. Sixmile Creek is a destination for whitewater rafting in southcentral Alaska.

Cultural and Historic Features of Value

There are no inventoried cultural sites within the area. This area is part of the Kenai Mountains Turnagain Arm National Heritage Area.

Features of Scientific or Educational Value

None identified.

Manageability

Shape and Configuration of the Area

The area is bounded by the Seward Highway, Hope Highway, and the Turnagain Arm. The feasibility of managing as recommended wilderness is high unless the State decides to develop its land within the Seattle Creek drainage.

Management of Adjacent Lands

The Resurrection and Johnson Pass Inventoried Areas are within one-half mile of this area, across the Hope and Seward highways, respectively. The Kenai Wilderness Area in the Kenai National Wildlife Refuge is about 25 miles to the southwest.

Non-Federal Lands

There are 3,760 acres of State and private lands within the inventoried area. All of these lands are adjacent to major roads, except State lands along Seattle Creek. Wilderness designation would have no effect on access to private lands along the road system, but could affect access to the State lands along Seattle Creek.

Legally Established Rights or Uses within the Area

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for rafting, heli-skiing, avalanche education, ski touring, and snow machining. There are recreation event permits for dog trials held annually in July and August.

Minerals

Placer mining claims cover most of Gulch Creek in this area and the Forest Service currently has three plans of operations for mining activities within this area and additional mining activity is also likely occurring that does not require authorization. The operations in this area are not substantially noticeable.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

The opportunity for solitude is moderate on the northern part of this area due to low flying aircraft of all sizes using Turnagain Arm for a flight corridor to and from Anchorage. Winter motorized use of Seattle Creek is extensive during most winters and the northern part of the inventoried area is also used by a company currently permitted for guided heli-skiing operations. Current travel management for the area would not be compatible with a wilderness designation due to helicopter landings being allowed year round in the entire area and winter motorized travel allowed from December 1 through April 30 each year depending on snow levels. A section of the Iditarod National Historic Trail designated for winter motorized travel is on the eastern edge of the area. Several placer mining operations using motorized suction dredges are authorized along Gulch Creek on the south side of the area which add motorized noise influences as well as modifying the naturalness of the immediate area.

Johnson Pass Inventoried Area

Gross acres: 156,910
NFS acres: 152,450

Apparent Naturalness

Appearance and Developments

This area has a moderately high degree of natural integrity. Most long-term ecological processes are intact and operating. Some of the processes in the valley bottoms have been interrupted by mining and mineral development. These activities have also affected the apparent naturalness of the area and result in a moderately low level of apparent naturalness in some places. The majority of this inventoried area, 97 percent, is natural appearing where only ecological change has occurred.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are common in areas of human disturbance, especially near roads and along trails. Areas of historic logging and hazardous fuels reduction are common near roads along the margins of the area. Areas of human-caused burning, both accidental and intentional, are also common in the forests.

Fish Resource

Chinook, Coho, and sockeye salmon occur in this area but chum and pink salmon do not. Dolly Varden char are present. It is believed this was probably the natural condition. There has likely been some impact on Chinook from the effects of gold mining that took place in Canyon Creek during the past century. Fishery impacts are likely minor and no hatchery salmon are present. The fish resources in this area are rated as being in a “nearly natural” condition.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference. Summit Lakes and other riparian habitat support beavers, loons, moose, and trumpeter swans. Mountain goats and Dall sheep can be observed in this area. Heli-skiing and other types of winter recreation has the potential to alter the natural behavior of mountain goats and Dall sheep in this inventoried area and could influence natural behavior of wolverines and denning bears, depending on timing, extent, and duration. The large amount of dead wood from past spruce beetle infestations support cavity-nesters and insectivorous birds, but these populations may change as the dead wood decays. Moose and black bears are common, and brown bears can be observed occasionally.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in this area is high, especially moving away from the Seward Highway. Exceptions to this are Johnson Pass Trail throughout the year and Turnagain Pass in the winter, which are both popular recreation destinations. The area is relatively large with a high level of topographic screening. In winter, the Turnagain Pass area is one of the most popular backcountry skiing destinations in southcentral Alaska. Highway and railroad sounds are evident along the unit’s edge but drop off rapidly where topographic barriers exist. The distance from the perimeter to the core is between 7 and 10 miles.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is moderate as a result of a moderate diversity of recreation opportunities and few challenges to the recreation user. There are approximately 60 miles of trails, but no developed public use cabins in the area. Several dispersed campsites are located along Johnson Pass Trail.

Recreation opportunity spectrum class:

- Semi-primitive non-motorized – 36,000 acres
- Semi-primitive non-motorized (winter motorized allowed) – 93,300 acres
- Semi-primitive motorized – 13,900 acres
- Roaded natural – 8,500 acres
- Rural – 900 acres

Motor Vehicle Recreation

From May 1 to November 30, the area is closed to motor vehicle uses. From December 1 to April 30, approximately half of the area is open to snowmachines. Johnson Pass Trail is a popular snowmachine route, and the Placer River is commonly used by jet boats and airboats.

Other Values

Ecological, Geological, or Scenic Features

Small hanging glaciers can be seen high on rugged mountainside slopes. Intriguing glacial topography is evident everywhere.

Cultural and Historic Features of Value

The Johnson Pass Trail is part of the Iditarod National Historic Trail. There are nine known cultural sites within this area. This area is also part of the Kenai Mountains Turnagain Arm National Heritage Area.

Features of Scientific or Educational Value

None identified.

Manageability

Shape and Configuration of the Area

The area is bounded by the Seward Highway and the Alaska Railroad. The feasibility of managing as recommended wilderness is high.

Management of Adjacent Lands

The Resurrection, Boston Bar, Kenai Lake, and Kenai Mountains Inventoried Areas surround the area and are all within one-half mile of this area. The Kenai Wilderness Area in the Kenai National Wildlife Refuge is about 20 miles to the west.

Non-Federal Lands

There are 4,520 acres of State land and 38 acres of private land within the inventoried area. All of these lands are adjacent to major roads or the railroad. Wilderness designation would have no effect on access to these adjacent lands.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for hiking, camping, mountain biking, fly in fishing, guided big game hunting, horseback rides, ski touring, snow machining, and heli-skiing.

Minerals

There are dozens of placer mining claims in this area including Canyon, Silvertip, Lynx, Lyon, Tincan, Bertha, Mills, and Bench creeks. The Forest Service currently has 15 plans of operations for mining activities within this area and additional mining activity is also likely occurring that does not require authorization. Evidence of past operations can be found in small areas on Lynx and Mills creeks.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

The Johnson Pass Trail which is part of the Iditarod National Historic Trail system travels north and south through the entire area and is a popular trail for mountain biking and hiking in the summer months and snow machining in the winter months. There are no cabins along this trail system. The Turnagain Pass area on the east side of the Seward Highway is also one of the most popular backcountry skiing destinations in southcentral Alaska resulting in parking lots filled to capacity on weekends when the snow levels are adequate for skiing access. Current travel management for the winter would be incompatible with a wilderness designation for about half of the area due to winter motorized travel being allowed from December 1 through April 30th each year along Johnson Pass Trail. Air boats are also popular on Placer River in the summer months. Placer mining is common on a number of creeks within the area and has modified the appearance of these areas adjacent to the creek in addition to adding motorized noise to the area near the creeks when the suction dredges are being operated. Smaller portions of this inventoried area were not considered due to the winter motorized use in areas adjacent to Johnson Pass Trail system and railroad noise on the eastern boundary of the area.

Kenai Lake Inventoried Area

Gross acres: 220,700
NFS acres: 198,040

Apparent Naturalness

Appearance and Developments

The area has a high degree of natural integrity. Most long-term ecological processes are intact and operating. Some evidence of human activity exists (e.g., cabins, trails, and mining operations), but these activities have had little or no effect on the natural integrity of the area. Prescribed burning has had little effect on the natural integrity. Wildfires have swept through portions of the area, especially the area around Russian Lake. The most recent large fire was in 1989. There are 1.4 miles of private road within the area. Most of this inventoried area, 97 percent, is natural appearing, where only ecological change has occurred. A new road accessing the Cooper Lake dam and Stetson Creek diversion from the Sterling Highway was constructed. This development, along with the dam and diversion, is excluded from the inventoried area, and affects the naturalness of the Cooper Creek and lower Stetson Creek.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are common in areas of human disturbance, especially near roads and along trails. Areas of historic logging and hazardous fuels reduction are common near roads along the margins of the area. Areas of human-caused burning, both accidental and intentional, are also common in the forests.

Fish Resource

This area contains a large diversity of habitats and has a greater number salmonid species than any other inventoried area. Present are all five salmon species, Dolly Varden char, and rainbow trout. In addition, the only known Chugach National Forest population of lake char (lake trout) and arctic char occur within this area. Many of the species in this area rely on Kenai Lake for a portion of their life history. The Quartz Creek drainage is an important spawning and rearing area for the early run of Chinook salmon that return to the Kenai watershed.

Past gold mining operations have adversely impacted the Cooper Creek watershed and, to a lesser extent, the Quartz Creek watershed. A hydropower development in the upper Cooper Creek watershed diverts a large portion of the natural flow through a power station and into a different drainage. As a result, flows in Cooper Creek are substantially less than they were historically. These changes have had an adverse impact on species diversity and fish abundance. Human foot traffic associated with an extremely popular fishery has damaged the riparian vegetation and stream complexity in the lower reaches of the Russian River. Downstream commercial, personal use, and sport fisheries have reduced the number of sockeye salmon in the Kenai watershed portion of this inventoried area compared to historical times. As a result, the annual supplement of marine derived nutrients to the Kenai watershed ecosystem is less than under natural, pre-fishery conditions (approximately 100 years ago).

Although no hatchery salmon occur in the Kenai watershed portion of this study area, hatchery reared Chinook, coho, and sockeye salmon occur in the Salmon Creek watershed and likely stray into the Resurrection River as well. The degree of mixing between hatchery and wild fish on the spawning grounds is not known nor is the impact of this mixing on wild populations; however, based on studies elsewhere, the impacts are likely negative. Hatchery produced rainbow trout are released into Carter Lake, located west of Upper Trail Lake, and Rainbow Lake, located east of Cooper Lake, to enhance recreational fishing opportunities. Overall, the fish resources in this area could be classified as having been “moderately impacted” by human influences.

Wildlife Resource

All native wildlife associated with the habitats in this area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). None of the native terrestrial wildlife are proposed or listed in compliance with the ESA. Some exceptional wildlife habitat for moose, black bear, Dall sheep, mountain goats, trumpeter swans, mergansers, arctic terns, and beaver occurs in the Kenai Lake area. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference, with the exception of the Russian River, an area that contributes to the habituation of bears due to large numbers of anglers, fish waste, and human food accumulations. A recent monitoring report found that up to 30 percent of visitors did not comply with food storage and fish waste guidelines (Skibo, personal communication, January 21, 2015). The adjacent Russian River management area gets up to 110,000 visitors a year or more, which impacts natural wildlife movements and behavior (USDA et al. 2013).

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the northern portion of the unit is generally moderate. The sounds of highway traffic and residential and commercial activities can be heard until topographic breaks drown out the sound. The rolling alpine along the ridges and high passes provide long viewing distances, making people visible from a distance. At lower elevations, especially away from established trails, a person camped or traveling is unlikely to see others.

The Russian River, near the northwest boundary of the area, is one of the most popular fishing destinations in the State. The first three miles of the Russian Lakes trail, which accesses the Russian River Falls, is one of the most highly used trails within the national forest in the summer. The opportunity for solitude south of Kenai Lake is high. The area is relatively large with a high level of topographic screening. One exception is the Lost Lake area and trail near Seward, which is a highly-used trail in both summer and winter reaching an alpine area with lower levels of topographic screening. The distance from the perimeter to the core is between four and 12 miles.

Opportunity for Primitive Recreation

There are many opportunities for primitive recreation in the area. There is a high diversity of recreation opportunities and moderate challenge to recreation users, with more infrastructure providing support than some other areas within the national forest.

Recreation opportunity spectrum class:

- Primitive – 5,900 acres
- Semi-primitive non-motorized – 50,800 acres
- Semi-primitive non-motorized (winter motorized allowed) – 104,800 acres
- Semi-primitive motorized – 26,100 acres
- Roaded natural – 9,300 acres
- Rural – 1,100 acres

There are 102 miles of trail in the area and five recreation cabins. Three small campsites are located along the shores of Kenai Lake.

Motor Vehicle Recreation

From May 1 to November 30, the area is closed to motor vehicle use except in the area around Cooper Lake, which is open to motor vehicle use on designated routes only. Most of the area is open to over the snow vehicle use from December 1 to April 30, with the exception of the lands west of Cooper Lake to the national forest boundary. Powerboats are allowed on Kenai Lake, though use is relatively low.

Other Values

Ecological, Geological, or Scenic Features

Several large spectacular lakes, including Crescent and Kenai lakes, are found within the area. The Russian River is recommended as scenic (200 acres) and wild (2,800 acres) under the Wild and Scenic Rivers Act. The area also features high ecological diversity including two provinces, two sections, and three subsections. Populations of the Alaska Region sensitive plant pale poppy (*Papaver alboroseum*) occur in the area.

As noted, this watershed contains the largest salmonid diversity of any inventoried area within the Chugach National Forest, including the only natural populations of lake char and arctic char. In addition, the Kenai Lake watershed provides a clean headwater source of water for Kenai River, a system that produces the largest freshwater fisheries in Alaska for sockeye, Coho, and Chinook salmon and rainbow trout.

Cultural and Historic Features of Value

There are 21 known cultural sites within the unit. It is also part of the Kenai Mountains Turnagain Arm National Heritage Area. The land along the Russian River includes much of the Sqilantnu Archeological District, a feature of high cultural, prehistoric, and historical value. Connecting trails of the Iditarod National Historic Trail generally parallel the Seward Highway in the southeast corner of the area.

Features of Scientific or Educational Value

The area contains the Kenai Lake-Black Mountain Research Natural Area, featuring a representative range of Sitka spruce-white spruce-Lutz spruce forest and a wide diversity of vegetation types (USDA 2007b).

Genetic analysis of Chinook salmon populations in this area demonstrates there is a substantial degree of genetic variation among populations in this area. Similar analysis of the other salmon species would likely get the same result. The diversity of area habitats is likely one of the reasons for this pattern of genetic differentiation. Because of this high degree of diversity, this area provides an excellent laboratory to study how genetic structuring among populations develops and is related to habitat types.

Manageability

Shape and Configuration of the Area

The area is bounded by Sterling and Seward Highways on the north and east, respectively. The Kenai Wilderness Area in the Kenai National Wildlife Refuge forms the southern and western boundary. The Snug Harbor road extends into the center of the area, terminating at Cooper Lake. The feasibility of managing as recommended wilderness is high.

Management of Adjacent Lands

The area lies immediately to the east of wilderness areas administered by the Kenai National Wildlife Refuge and the Kenai Fjords National Park. To the north and west of the unit, within one-half mile, are the Resurrection, Johnson Pass, and Kenai Mountains Inventoried Areas.

Non-Federal Lands

There are 22,660 acres of State land and private land within the inventoried area. All of these lands are adjacent to major roads. Wilderness designation would have no effect on access to these adjacent private lands.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for hiking, camping, mountain biking, fly-in, boat and hike-in fishing, big game hunting, horseback rides, ski touring, and heli-skiing. The Lost Lake Run is held annually under a recreation event permit. There are two other recreation events, a kayak and run race on Kenai Lake and Lost Lake Trail, and another run involving Primrose and Grayling Trails. There are helicopter access communication site leases authorized on Cooper Mountain, Cecil Rhode Mountain, and Tern Peak.

Minerals

Much of Stetson and Cooper creeks are overlain with placer mining claims. Additional placer mining claims exist on Marten and Crescent creeks and several lode claims are located on Primrose Creek. The Forest Service currently has six plans of operations for mining activities within this area and additional mining activity is also likely occurring that does not require authorization. Evidence of past operations are present on Crescent Creek. The lode deposit along Primrose Creek has the potential to be developed.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

The Kenai Lake inventoried area is characterized by a diversity of uses and levels of human influence. The area includes 102 miles of trail and five recreation cabins. The Russian Lakes Trail is one of the most heavily used trails on the Forest in the summer months and Lost Lake Trail is also very popular both for non-motorized activities in the summer and for snow machining in the winter. The area around Cooper Lake is open to motor vehicle use on designated routes only in the summer months and snow machine use over most of the area from December 1 to April 30, with the exception of the lands west of Cooper Lake to the national forest boundary. Powerboats are allowed on Kenai Lake, though use is relatively low. This area also includes the road into the Cooper Lake Dam and a new connecting road for the Stetson Creek diversion project east of Stetson Creek which affects the naturalness of the drainage. Three recreation events are currently permitted and heli-skiing guided operations are permitted near Lost Lake. Nearly all of Stetson Creek and Cooper Creek are overlain with placer mining claims with active suction dredging operations occurring during summer months. Smaller portions of the inventoried area were not considered due to the winter motorized use of most of the inventoried area and higher recreation use, including bicycling, in the remaining sections of the inventoried area.

Kenai Mountains Inventoried Area

Gross acres: 319,600
NFS acres: 306,670

Apparent Naturalness

Appearance and Developments

The majority of this inventoried area is natural appearing, where only ecological change has occurred. While some evidence of human activity exists (e.g., mining operations, trails, and cabins), these activities have had little or no effect on the natural appearance of the area away from developments near the boundaries. Previous mineral material operations and current recreation development in the Spencer Glacier area form a small window of approximately 350 acres that are excluded from the area as well. The majority of this area, more than 97 percent, is natural appearing, where only ecological change has occurred. The areas with lower scenic integrity occur near the boundaries, including Portage Valley and along the Alaska Railroad.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are present in a few areas near roads and along trails.

Fish Resource

With the exception of several Placer River tributaries, the highly glacial and turbid water conditions common to this area are generally less favorable to fish production compared to other areas of the

Chugach National Forest. However, four of the five salmon species occur in this area (chum salmon are missing) as do Dolly Varden char. The existing railroad grade has resulted in an unnatural restriction in water flow across the eastern Placer River valley floor. The highway from Portage to Whittier creates a hydrologic barrier that has caused what is known as Explorer Creek to become part of the Placer River watershed, where formerly it had been part of the Portage Valley watershed. Sockeye that occur in the Snow River system have been impacted by intensive freshwater fisheries that take place downstream of Kenai Lake. Hatchery salmon are present in the Bear Lake system, although all but a small portion of this watershed is outside of the inventoried area. Hatchery rainbow trout are also released into Vagt Lake, a small water body less than a mile east of Lower Trail Lake. Overall, the fish resources in this area have been “slightly impacted” by human activities.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference. None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. The combination of natural wetlands and upland mixed forest support spruce grouse, great horned and boreal owls, trumpeter swans, several species of ducks, Arctic terns, and several species of woodpeckers, in addition to moose, bear, wolves, Canada lynx, mountain goats, and Dall sheep.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is high away from the boundaries of the Spencer and Portage Valley Developed Recreation Complexes. The sounds of highway traffic and residential and commercial activities can be heard until topographic breaks drown out the sound. The area is very large with a high level of topographic screening. The distance from the perimeter to the core is between six and 18 miles. Recreation use is heaviest adjacent to the developed recreation sites outside the unit at Portage and Ptarmigan Creek. Recreation use is light throughout the rest of the area, including limited guided recreation, particularly in the southeastern section of the area, which includes Upper and Lower Paradise lakes.

Opportunity for Primitive Recreation

Opportunities for primitive recreation are high with a diversity of recreation opportunities and moderate to high levels of challenge to the recreation user, and much of the area is remote from developments.

Recreation opportunity spectrum class:

- Semi-primitive non-motorized – 29,200 acres
- Semi-primitive non-motorized (winter motorized allowed) – 141,200 acres
- Semi-primitive motorized – 132,500 acres
- Roaded natural – 3,300 acres
- Rural – 500 acres

There are approximately 19 miles of maintained trail and 30 miles of unmaintained trail in the area. The unmaintained trail connects Ptarmigan Lake to Paradise Lake. There are three recreation cabins:

one at Upper Paradise Lake, one at Lower Paradise Lake, and a new cabin that was built near Spencer Glacier in 2014.

Motor Vehicle Recreation

From May 1 to November 30, there is a small area around Grant Lake open to off-highway vehicle use only on designated routes, with the rest of the area closed to off-highway vehicles. About 30 percent of the area is open to helicopter landings and helicopter skiing is permitted in the area. Most of the area is open to winter motor vehicle recreation from December 1 to April 30, snow conditions permitting, except the northern section of Placer River valley, which is open to use until March 31. A corridor through a closed area along the South Fork of the Snow River is also open to winter motor vehicle use. Snowmachining is popular in these open areas.

Other Values

Ecological, Geological, or Scenic Features

There are several spectacular lakes including Ptarmigan, Lower and Upper Paradise, and Grant lakes. Snow River is an eligible as a wild river under the Wild and Scenic Rivers Act. The glacial outburst flooding associated with the Snow Glacier is a long-term and significant event of geologic and educational value. Enough water can be released to raise the level of Kenai Lake.

The area features high ecological diversity, including three provinces, three sections, and five subsections. Populations of the Alaska Region sensitive plant pale poppy (*Papaver alboroseum*) occur in the area. A population of the Alaska Region sensitive plant spotted lady's slipper (*Cypripedium guttatum*) also occurred in the area but was lost to gravel pit development.

Cultural and Historic Features of Value

There are 26 known cultural sites within the area. This area is part of the Kenai Mountains Turnagain Arm National Heritage Area. Segments of the INHT generally run parallel to the Seward Highway between milepost 18 of the highway and Moose Pass.

Features of Scientific or Educational Value

The area contains a small portion of the Wolverine Glacier Research Natural Area, at Wolverine Glacier near Paradise Lake.

Manageability

Shape and Configuration of the Area

The area is bounded by paved road or railroad on the north and west. The southern boundary, which abuts State land, is not well defined. The eastern boundary is, for the most part, the topographic divide between the Kenai Peninsula and Prince William Sound. The feasibility of managing as recommended wilderness is high, particularly in the eastern section of the area.

Management of Adjacent Lands

This area is immediately to the west of the Nellie Juan-College Fiord Wilderness Study Area identified by Congress in ANILCA. The Kenai Lake and Johnson Pass inventoried areas are within one-half mile to the west of this area. The Twentymile inventoried area is to the north. The Kenai Wilderness Area in the Kenai National Wildlife Refuge is about 20 miles to the west. The Kenai Fjords National Park is about 15 miles to the west.

Non-Federal Lands

There are 12,930 acres of State and private land within the inventoried area. Most of these lands are adjacent to major roads. Wilderness designation would have no effect on access to these adjacent private lands. State lands border the inventoried area to the south. A portion of Grant Lake is under a hydropower withdrawal. There are three parcels of private lands on the southeast border of the area.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for hiking, camping, mountain biking, hike-in and boat fishing, rafting, big game hunting, ice climbing, ski touring, and heli-skiing. Homer Electric submitted a Draft License Application that was accepted by the Federal Energy Regulatory Commission in March 2015 for a proposed hydropower development at Grant Lake.

Minerals

There are dozens of lode mining claims in this area, including at Falls Creek, Crown Point, Grant Lake, and other locations off the Seward Highway. Victor Creek also has some placer mining activities. The Forest Service currently has four plans of operations for mining activities within this area and additional mining activity is also likely occurring that does not require authorization. Some evidence of past operations along Falls Creek, Crown Point, and Grant Lake are noticeable.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

The Kenai Mountains inventoried area includes some of the more remote areas accessible from the highway system. There are approximately 19 miles of maintained trail and 30 miles of unmaintained trail in the inventoried area. There are three recreation cabins: one at Upper Paradise Lake, one at Lower Paradise Lake, and a new cabin that was built near Spencer Glacier in 2014. From May 1 to November 30, there is a small area around Grant Lake open to off highway vehicle use on two designated routes, with the rest of the area closed to OHVs. About 30 percent of the area is open to helicopter landings, and helicopter skiing is permitted in the area. Most of the area is open to winter motor vehicle recreation from December 1 to April 30, snow conditions permitting, except the northern section of Placer River valley, which is open to use until March 31. A corridor through a closed area along the South Fork of the Snow River is also open to winter motor vehicle use. Snow machining is popular in these open areas.

The southern section of this inventoried area was considered for inclusion in an alternative for recommended wilderness because of the remote nature of the area, adjacency to the Wilderness Study Area, and public comments supporting wilderness recommendation. This area was eliminated from further analysis because it has a winter motorized corridor which is used to access the south fork of Snow River and the Godwin Glacier area near Seward. This route is very popular with winter snow machine enthusiasts as documented in the Kenai Winter Access Record of Decision (USDA 2007). A wilderness recommendation in these areas would necessitate different plan components to protect wilderness characteristics and would eliminate winter motorized access in these areas. In addition, potential access needs for land development for Chugach Alaska Corporation private parcels in the Nellie Juan Lake and River area was considered.

Twentymile Inventoried Area

Gross acres: 213,840
NFS acres: 198,390

Apparent Naturalness

Appearance and Developments

This area has a very high degree of natural integrity. Most long-term ecological processes are intact and operating. Some evidence of human activity exists (e.g., cabins and old logging activity) but these activities have little effect on the natural integrity of the area. A few isolated private cabins are located in the Twentymile River valley. Apparent naturalness is highest in the remote northern section of this area.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are present in a few areas near roads and along trails.

Fish Resource

All five species of salmon occur in this area, although pink salmon are quite rare. Dolly Varden char are common. In addition, the lower Twentymile River is one of the few places within the Chugach National Forest where large numbers of eulachon (also known as hooligan) are known to occur. The Twentymile River system is the largest watershed in this study area and contains aquatic habitat that is largely in its native state. Although Portage Valley has been heavily impacted by gravel mining and road and rail infrastructure, most of this has taken place outside the of the area boundaries. Fishery impacts on salmon returning to this area probably are low and hatchery reared salmon are not present. Within the inventoried area boundaries, human influence is minimal and the fish ecosystem is probably in a “nearly natural” condition.

Wildlife Resource

All native wildlife associated with the habitats in this inventoried area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013) The wildlife are expected to retain natural interactions with each other and their environment with minimal human interference although heli-skiing and other winter recreation has the potential to influence the natural behavior of mountain goats and Dall sheep. None of the native terrestrial wildlife in this area are proposed or listed in compliance with the ESA, although the threatened beluga whale can be observed in the salt water adjacent to this inventoried area. Belugas rely on the Twentymile River especially in the spring to feed on eulachon and small salmon. The Seward Highway and Alaska Railroad occur outside the Twentymile inventoried area but affect the inventoried area by curtailing natural movement of water and wildlife between the upslope areas and the ocean.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is high. Most activity occurs along the Twentymile River or in the Crow Pass area along the Crow Pass Trail. Backcountry skiing, mountaineering, and hiking takes place in the glaciers and mountains near Crow Pass. The area provides a high level of topographic screening. The distance from the perimeter to the core is 7 to 10 miles. Motor boats are common in the late summer and fall during the Coho salmon run, and helicopter and small plane overflights are common during the summer season.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is very high as a result of highly diverse recreation opportunities, a high level of challenge for the recreation user, and few or no developments in the area. The area provides primarily semi-primitive opportunities. There are approximately 11 miles of developed trails in the area.

Recreation opportunity spectrum class:

- Semi-primitive non-motorized – 75,500 acres
- Semi-primitive non-motorized (winter motorized allowed) – 37,500 acres
- Semi-primitive motorized – 84,700 acres
- Roaded natural – 800 acres
- Rural – 200 acres

Motor Vehicle Recreation

From May 1 to November 30, almost all of the area is closed to off-highway vehicles, while approximately half of the area is open to helicopter landings. Most of the area is open to winter motor vehicle recreation from December 1 to April 30, except for the areas along the Seward Highway. Access to the open area is by a corridor along Twentymile River. Jet boats, air boats, and hover craft use the Twentymile River.

Other Values

Ecological, Geological, or Scenic Features

The area features high ecological diversity including three provinces, three sections, and five subsections. Populations of the Alaska Region sensitive plant pale poppy (*Papaver alboroseum*) occur in the area.

The presence of eulachon in the Twentymile River is unique. As noted, this species exists in high numbers at this location alone on the Chugach National Forest, with the exception of a presence in Copper River Delta. Cook Inlet beluga whales, utilize eulachon from the Twentymile population as an important food source (Hobbs et al. 2006).

Dead trees inland from the Seward Highway in Twentymile River valley are evidence of the 9.2 magnitude 1964 earthquake when salt water flooded the forested wetlands, killing the trees and changing the habitat. The marsh serves as a natural classroom of the power of natural disturbance events. The Twentymile River is also recommended as a scenic river under the Wild and Scenic Rivers Act.

Cultural and Historic Features of Value

There are four known cultural sites within the area. This area is part of the Kenai Mountains Turnagain Arm National Heritage Area, and segments of connecting trails for the INHT cross through these lands.

Features of Scientific or Educational Value

The diversity of aquatic and terrestrial features in the Three Rivers area of Twentymile River, Portage Creek, and Placer River valleys at the head of Turnagain Arm, combined with the proximity and access of this inventoried area to the University of Alaska, provides an opportunity for place-based research, education, and outreach opportunities (Welker et al. 2012).

The northern glade of ice worms, adapted to life on ice, have been studied on Byron Glacier in this inventoried area, although they also occur sporadically in some, but not all, of the Chugach National Forest inventoried areas.

Manageability

Shape and Configuration of the Area

The State land boundaries adjacent to the area are not well defined on the ground. State land below the mean high tide line is also poorly defined. The southern border is the Alaska Railroad, which runs parallel to the Seward Highway. The western boundary is the watershed dividing line with the College Fiord Inventoried Area. The feasibility of managing as recommended wilderness is high.

Management of Adjacent Lands

This unit is immediately to the west of the College Fiord Inventoried Area and Nellie Juan-College Fiord Wilderness Study Area. Boston Bar and Kenai Mountains inventoried areas are within one-half mile south of the unit. The Kenai Wilderness Area in the Kenai National Wildlife Refuge is about 50 miles to the west. Chugach State Park is north of the area, including an adjacent section that is managed as State wilderness area.

Non-Federal Lands

There are 15,450 acres of State and private land within the inventoried area. Most of these lands are adjacent to major roads or salt water. Wilderness designation would have no effect on access to these lands. Some State lands border the inventoried area to the south. Wilderness designation would limit access to lands in Prince William Sound to salt water.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for hiking, camping, fishing, jet boat tours, pack rafting, rafting, ski touring, snow machining, helicopter supported dog sled tours on Punchbowl Glacier, and heli-skiing. There is an annual race on Crow Pass Trail in June under a recreation event permit. An education center is authorized for Nordic ski training on Eagle Glacier to the Alaska Pacific University. There are two isolated cabins under special use permits within the Twentymile drainage. There is one communication site accessible by helicopter on the mountain adjacent to Portage Valley.

Minerals

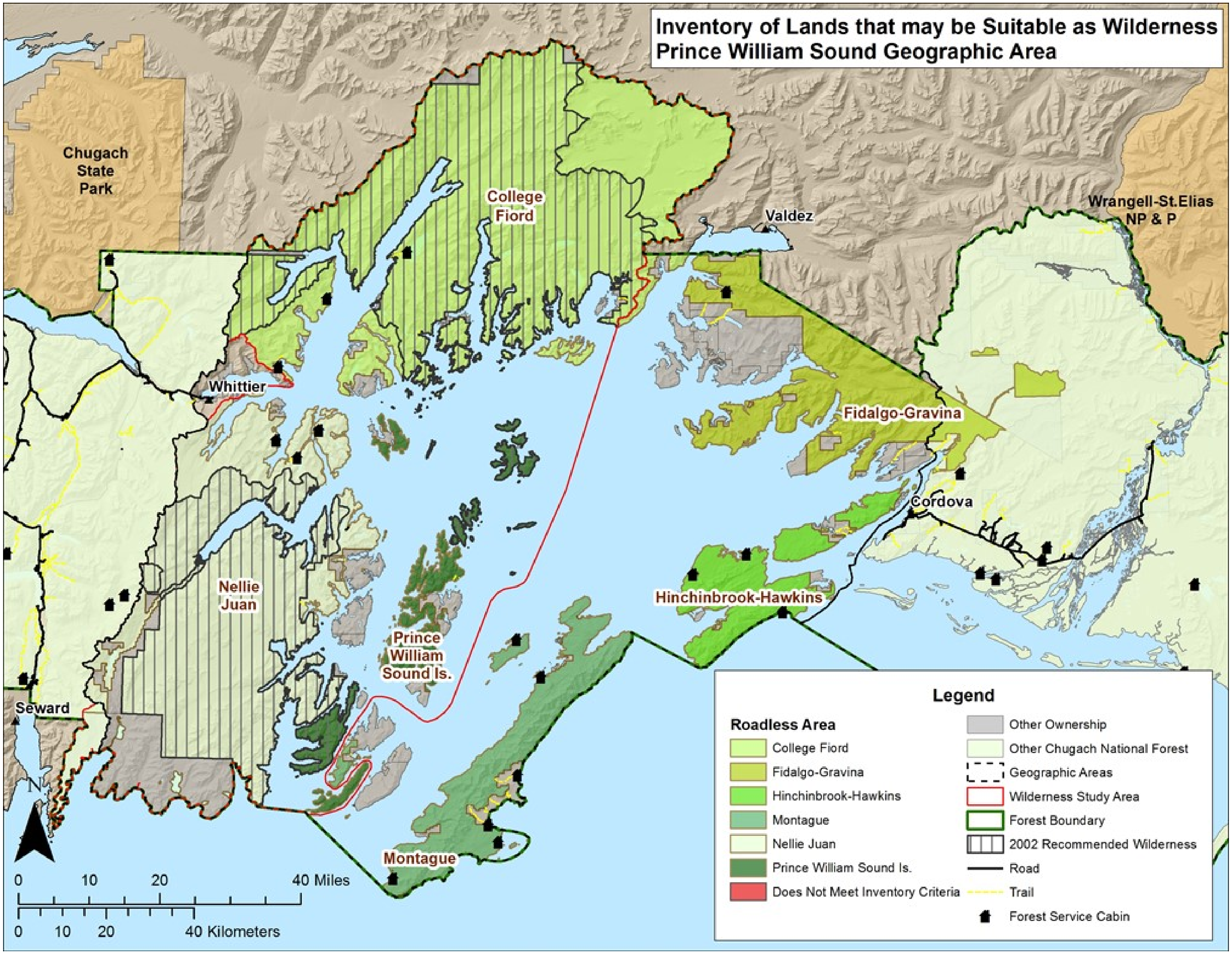
There are placer mining claims in this area on Crow and Peterson creeks. The Forest Service currently has one plan of operations for mining activities within this area and additional mining activity is also likely occurring that does not require authorization.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

This inventoried area has a number of higher quality wilderness characteristics such as primitive recreation opportunities and high sense of solitude. However, there are a number of special use authorizations in the area, including outfitter/guide permits for hiking, camping, fishing, jet boat tours, pack rafting, rafting, ski touring, snow machining, helicopter supported dog sled tours on Punchbowl Glacier, and heli-skiing. There is an annual race on Crow Pass Trail in June under a recreation event permit. An education center is authorized for Nordic ski training on Eagle Glacier to the Alaska Pacific University. There are two isolated cabins under special use permits within the Twentymile drainage and there is one communication site accessible by helicopter on the mountain adjacent to Portage Valley. In addition, motor boats are common in the late summer and fall during the Coho salmon run, and helicopter and small plane overflights are common during the summer season. For all of these reasons, none of this area was included in an alternative for wilderness recommendation.



Map 38. Inventory of lands that may be suitable as wilderness in the Prince William Sound Geographic Area

Prince William Sound Geographic Area

Nellie Juan Inventoried Area

Gross acres: 924,870
NFS acres: 712,820

Apparent Naturalness

Appearance and Developments

The majority of this inventoried area is natural appearing, where only ecological change has occurred; along with the Prince William Sound Islands and College Fiord Inventoried Areas, this area has been managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System as part of the Nellie Juan-College Fiord Wilderness Study Area since being designated in 1980. There are 0.7 miles of private road within the unit. While the area appears primarily affected by the forces of nature, with minimal imprints from modern human activity, certain exceptions exist. The Main Bay Fish Hatchery in Main Bay is the only area of modern development in this inventoried area. It is limited to approximately ten acres and includes a fish hatchery, diesel generator system, short road, and several buildings. The hatchery and related developments are managed according to ANILCA 1315(b), which states the site must be “constructed, managed, and operated in a manner that minimizes adverse impacts on the wilderness character of the area.” Eighteen set-net commercial fishing camps are located in and near Main Bay. They generally consist of one or two plywood platforms and a privy. A few include cabins. They are occupied for six to eight weeks during the peak of commercial fishing season in June and July. Evidence of past mining, fox farming, homesteading, and other activities is present in various locations throughout the area. Among the largest is the former Nellie Juan Cannery in McClure Bay, which was destroyed in the 1964 earthquake.

Recreational impacts are present along popular shorelines in Blackstone Bay, Culross Passage, Derickson Bay, and other areas, but are generally limited to small areas of disturbed vegetation. Most of the area shows little or no development or impacts related to recreation. Popular anchorages and beaches used by boaters and kayakers provide entry points to the uplands and may show signs of visitor use.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area.

Fish Resource

Salmon are abundant in this area with 127 total populations identified and all five species of Pacific salmon represented. Dolly Varden char and cutthroat trout also occur in this area, although Dolly Varden are more common. There has been very little disturbance to the natural condition of the freshwater habitat. However, commercial fisheries catch a substantial portion of the wild pink and chum salmon each year with 1990 to 2011 average interception rates of 40 percent and 27 percent, respectively. Therefore, the number of fish reaching the spawning grounds has been reduced from the natural historical condition as has been the rate of infusion of marine derived nutrients to the watershed ecosystems from decomposing salmon carcasses.

Four large fish hatcheries are located in Prince William Sound and although most of the returning fish they produce are either caught or return to the facilities, a significant number stray into natural production areas and mix with wild salmon. Brenner et al. (2012) found that streams in southwestern Prince William Sound were particularly vulnerable to large numbers of stray hatchery fish. It is likely that many of the pink salmon populations in this area are mixtures of hatchery strays and wild fish, with hatchery fish comprising 10 percent to 25 percent of the spawning population. Such levels likely risk the natural genetic character of wild pink salmon and reduce their productivity. Overall, human influence on the fish resource that relies on habitats within the borders of this area has probably had a “slight impact” on its natural character.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the resident and migratory shore and seabirds (AKNHP 2013) common along Prince William Sound. The Nellie Juan Inventoried Area has many islands in addition to mixed conifer forests and wetlands, and therefore a wider variety of shorebirds and marine mammal haul outs occur than in the inland roadless areas. Federally listed Steller sea lions haul out in several off-shore rocks in this area. Specific haul outs are buffered from disturbance as federally designated critical habitat for Steller sea lions. The Nellie Juan Inventoried Area has many beaches used by nesting black oystercatchers and other shoreline birds. The larger islands and inland areas support black and brown bear populations. Black bear harvest has increased in this area since the Anton Anderson Memorial Tunnel was built. The tunnel provides easier access for hunters and fishermen and recreational boaters, and may have contributed to higher black bear harvest in Game Management Unit 6, an area that overlaps much of this area. Decreased harvest and reduced skull size in recent years suggest a concern for the black bears population in Game Management Unit 6.

Some of the islands are free of large mammals, such as wolves, bears and other fur-bearers, making them excellent bird sanctuaries. Fur bearers and prey were introduced to many of the islands from the late 1800s through the early 1900s to provide a fur source. Most of these animals over-utilized their habitat and starved or died of disease. A few still remain on the islands and may affect breeding bird habitat. Human activities have the potential of impacting nesting sea and shore birds during their crucial breeding period, as well as resting seals and sea lions. The 1989 *Exxon Valdez* oil spill affected some of the islands in the Nellie Juan Inventoried Area. European black slugs (*Arion* spp.) have been noted in the inventoried areas near beaches and recreational areas and appear to be spreading.

Except where noted, wildlife are expected to retain natural interactions with each other and their environment with minimal human interference.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is high, with many outstanding opportunities in upland areas. Sights and sounds of vessels are common along shorelines during summer. The area near the shore is popular with boat or kayak based recreation users. The distance from the perimeter to the core is between 18 and 30 miles. The area includes some of the most remote lands within the Chugach National Forest. Access is only possible by aircraft, snow machine, or boat. Virtually all aircraft access is by floatplane to saltwater or large lakes. Limited landings also occur on the glaciers by aircraft fitted with skis. There are no established aircraft landing sites in the area.

Forest Service studies and wilderness character monitoring have provided information on areas where certain activities diminish opportunities for solitude in the inventoried area, primarily during the peak summer season (Poe et al. 2010). The Main Bay Fish Hatchery and set net camps in Main Bay provide the most persistent impacts on solitude. Along popular shorelines throughout the inventoried area, the presence of boats on adjacent marine waters represents another common impact to solitude. In some areas, especially where commercial fishing occurs, visitors may commonly hear or see marine vessels during the peak summer months while along shore. Tour vessels and private recreation boats, motorized and non-motorized, are common on waterways closest to Whittier and in popular areas such as Blackstone Bay and Culross Passage. Commercial airline traffic associated with the Ted Stevens International Airport in Anchorage also affects solitude. Jets traveling to and from the airport often fly between 12,000 and 18,000 feet over western Prince William Sound. The majority of the impacts originate outside NFS lands and during the peak summer months. Outside of the peak summer months, commercial fishing and vessel traffic is greatly reduced. Forest Service monitoring shows visitors may spend several days in the area between October and May without experiencing any sights or sounds of marine vessels.

Forest Service monitoring shows opportunities for solitude are particularly outstanding in Port Bainbridge, Icy Bay, Whale Bay, Kings Bay, Kings River, around Nellie Juan Lake, and in various other locations. These are some of the best near-shore opportunities for solitude in summer.

Opportunity for Primitive Recreation

Forest Service wilderness character monitoring shows the area offers outstanding opportunities for primitive and unconfined recreation. This inventoried area contains some of the best opportunities for primitive recreation within the Chugach National Forest. Kayaking, camping, hunting, fishing, skiing, and other non-motorized activities that rely on physical skills and self-reliance are popular in the area. Opportunities for rescue, shelter, and motor vehicle assistance are generally rare, especially away from popular shorelines and outside of the peak summer season. Many of the same factors that affect solitude also affect primitive recreation. They include development, motor vehicle transport, and regular human presence, which detract from self-reliance, challenge, solitude, and other qualities associated with primitive recreation.

Recreation opportunity spectrum class:

- Primitive – 459,500 acres
- Semi-primitive non-motorized – 168,000 acres
- Semi-primitive non-motorized (winter motorized allowed) – 85,200 acres
- Semi-primitive motorized – 100 acres

There are two recreation cabins and two miles of trail at the head of Long Bay and from Three Finger Cove. Many anchorages and beaches used by boaters and kayakers provide entry points to the uplands. Areas where opportunities for primitive recreation are particularly outstanding include Port Bainbridge, Icy Bay, Whale Bay, Kings Bay, Kings River, and the Nellie Juan Lake area. In these and other areas, topography, ice, recently deglaciated landscapes, and an almost total lack of development require skill, challenge, and endurance.

Motor Vehicle Recreation

This area is closed to motor vehicle uses year-round except for subsistence and traditional activities. Historic motor vehicle use of the uplands within this area is generally limited to occasional aircraft landings on icefields, lakes, and gravel bars. In recent years, snowmachine use has grown in the Kenai Mountains above Whittier and via the South Fork of the Snow River including areas adjacent to and within the Nellie Juan inventoried area. The snowmachine use is often focused in late winter and varies with snow depth, especially in the South Fork of the Snow River. Use of snowmachines and airplanes in the wilderness study area are allowed through ANILCA Section 1100(a). Extensive motor vehicle use in the form of power boats and aircraft occurs adjacent to the uplands.

Other Values

Ecological, Geological, or Scenic Features

The area offers spectacular scenery with tidewater glaciers and large granite protrusions climbing out of the ocean. The Nellie Juan River valley is one of only two low passes into Kenai Peninsula from western Prince William Sound and includes unique watershed, wildlife, and ecological features. The Nellie Juan River is recommended for wild river classification under the Wild and Scenic Rivers Act.

Western Prince William Sound has more tidewater glaciers than any other geographic region in North America. This inventoried area includes examples in Blackstone Bay, Port Nellie Juan, Icy Bay, and Nassau Fiord. Tebenk of Glacier is the longest valley glacier in Prince William Sound and is located near Cochrane Bay. Examples of glacial retreat and post-glacial plant and animal succession can be found at the Nellie Juan Glacier, Contact Glacier, Chenega Glacier, and Tiger Glacier.

The wildlife in the Nellie Juan Inventoried Area includes habitat for a spectacular mix of northern mammal species, sea/water/upland birds and mammals, forested habitats, and alpine species that offers many opportunities for study and viewing. The marine/upland/glacier interface provides exceptional birding and wildlife viewing.

Cultural and Historic Features of Value

The area has a variety of heritage sites, including mining ruins, cabin ruins, culturally modified trees, and the ruins of the Nellie Juan Cannery in McClure Bay.

Features of Scientific or Educational Value

The area contains the Wolverine Glacier Research Natural Area, representing a mid-elevation glacier with a diversity of tundra plant communities. Extensive glaciology research has occurred at the site since the mid-1960s (USDA 2007d). Blackstone Bay research natural area was proposed in the 1984 forest plan but was not designated. The area proposed encompasses the termini of three glaciers, two of which, Beloit and Blackstone, are relatively stable tidewater glaciers.

Portions of the Nellie Juan inventoried area were oiled during the *Exxon Valdez* oil spill, and much research has been conducted on the effects of the spill on wildlife and habitats and how those species have recovered over time. Some of the most notable wildlife population work in Alaska has been conducted in *Exxon Valdez* oil-spill-affected areas.

Manageability

Shape and Configuration of the Area

The State and private land boundaries within the area are not well defined. State land below the mean high tide line is also poorly defined. The eastern boundary is the watershed dividing line between the Nellie Juan Inventoried Area and the Kenai Mountains Inventoried Area. The Kenai Mountains Inventoried Area is immediately to the west, and the College Fiord Inventoried Area is to the north. The

Prince William Sound Islands Inventoried Area is just east of the area. The area is currently managed according to the precepts of the 1964 Wilderness Act, with ANILCA provisions, and has high manageability potential as designated wilderness. Its size, shape and configuration allow for maintenance of wilderness character over a broad area. On all sides, the land is undeveloped, rugged, and heavily glaciated. The marine waters bordering the area provide additional buffering from development.

Management of Adjacent Lands

Intertidal lands bordering the area are managed by Alaska Department of Natural Resources to be consistent with the Nellie Juan-College Fiord Wilderness Study Area management intent. Marine State Parks in the area are managed to maintain the area as wildlands.

Non-Federal Lands

There are 212,160 acres of State and private land within the inventoried area. Very few State and private lands are adjacent to major roads. Most non-NFS lands would require access from Prince William Sound or from the west through the Kenai Mountain Inventoried Area. Wilderness designation would affect land access to State and private lands.

The surface estate of 20,235 acres was purchased using EVOS restitution funds. The result is a split estate: the Federal government owns the surface estate on these lands, while the subsurface estate is retained by the CAC and may be developed.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for boat based hiking, kayak supported camping, freshwater fishing, big game hunting, and boat based ski touring. There are upland support camps under special use permit for ANILCA setnet fishing in Main Bay. There are two private cabins and one warehouse authorized through ANILCA. The Main Bay Fish Hatchery is under special use permit. There are also research buildings, equipment, and installations within the Wolverine Glacier Research Natural Area. Rock anchors have been authorized on Evans Island. Legally established rights or uses in the area are generally consistent with wilderness character. The authorization with the highest potential to impact wilderness character is the Main Bay Fish Hatchery. All legally established rights or uses in this area are managed to maintain the area’s presently existing character and potential for inclusion in the National Wilderness Preservation System in accordance with regional policy and ANILCA.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization.

Federal or State Laws Affecting Availability as Wilderness

The Alaska National Interest Lands Conservation Act (ANILCA) added a portion of this area to the Chugach National Forest in 1980 and included it in the designation of the Nellie Juan-College Fiords Wilderness Study Area. This area has been managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System as part of its designation.

Rationale for Further Analysis

This area has high manageability potential as designated wilderness because it has been managed for its presently existing character and potential for inclusion in the National Wilderness Preservation System since the designation of the Nellie Juan – College Fiord Wilderness Study Area by ANILCA in 1980.

The wilderness study area continues to provide long term economic benefits from tourism that relies on its wilderness characteristics (guided kayak, hiking, and hunting excursions, unguided recreation activities, tour boat excursions, general public using port towns to access the wilderness study area, sport fishing opportunities provided by intact ecosystems and abundant fish populations, and subsistence use of resources for rural residents of communities in the Prince William Sound area.

A majority of public comments submitted during the scoping period for the forest plan revision process supported recommending all or most of the wilderness study area for wilderness designation. A few commenters did not support any recommendation of wilderness across the forest.

Size of Recommended Wilderness:

Most of the Nellie Juan inventoried area was included for recommended wilderness in one or more alternatives.

Acres of recommended wilderness by alternative within the Nellie Juan inventoried area:

- Alternative A: 543,969 Acres
- Alternative B: 543,969 Acres
- Alternative C: 636,845 Acres
- Alternative D: 682,341 Acres

Boundary Descriptions

Boundaries for areas recommended for wilderness in one or more alternatives include the following:

- Wilderness study area eastern boundary from Whittier south to Chugach Alaska Corporation lands near Nellie Juan River
- Chugach Alaska Corporation land and State land boundaries on east and southern part of inventoried area
- Coastline (above mean high tide) on the western edge of the inventoried area
- Boundary along western edge of EVOS acquired parcel near Jackpot Bay and Ewan Bay

Several areas were excluded from all alternatives:

- All national forest system lands around Nellie Juan Lake and each side of Nellie Juan River between the western edge of the Wilderness Study Area boundary and the Chugach Alaska Corporation lands on the south west side of the inventoried area. These lands were excluded due to long term development plans of Chugach Alaska Corporation and potential to utilize national forest system lands to access their parcels. In addition, the National Forest System lands in this area are overlain with Public Land Order 3665 withdrawing the lands for power site uses.
- Split estate lands where Chugach Alaska Corporation has the dominate ownership of the subsurface (includes the area around Jackpot Bay and Ewan Bay near Chenega Island and the small island just north of Chenega Island). These lands were excluded due to the potential for development of the

subsurface lands and the difficulty in managing for wilderness character during and after such development.

Additonal areas excluded from alternative C:

- The area around Blackstone Bay was excluded due to high recreational use and adjacency to the town of Whittier and the Whittier Tunnel, as described above in the *Opportunities for Solitude* section.

Prince William Sound Islands Inventoried Area

Gross acres: 139,790
NFS acres: 120,000

Apparent Naturalness

Appearance and Developments

The majority of this inventoried area is natural appearing, where only ecological change has occurred; along with the Nellie Juan and College Fiord Inventoried Areas, this area has been managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System since being designated in 1980. This area has a very high degree of natural integrity. Overall, the area appears primarily affected by the forces of nature, with limited modern human development. There are no recreational cabins, hardened campsites, or trails in this inventoried area. Knight Island, the largest island in the area, has the greatest natural appearance and least amount of modern development.

There is a Forest Service fisheries improvement project at Solf Lake including a dam and fishway. The Naked Island Communication Site is at approximately 1,200 feet elevation and consists of buildings, antennas, generators and helicopter pads. An oyster farm and associated buildings are on State lands adjacent to the inventoried area on Perry Island. An abandoned FAA communication site with buildings is located on the Dutch Island Group. Recreational impacts are present along popular shorelines and near common anchorages, especially along Perry Island, Naked Island Group, and Knight Island. They are generally limited to small areas of disturbed vegetation. Most of the area shows little or no impacts related to recreation.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area.

Fish Resource

While four of the five Pacific salmon species occur in this area (Chinook are not present), pink salmon are the most abundant and widely distributed. Dolly Varden char and cutthroat trout also occur in this area, although Dolly Varden are more common. There has been very little disturbance to the natural condition of the freshwater habitat. However, commercial fisheries catch a substantial portion of the wild pink and chum salmon each year with the 1990 to 2011 average interception rates of 40 percent and 27 percent, respectively. Therefore, the number of fish reaching the spawning grounds has been reduced from the natural historical condition as has been the rate of infusion of marine derived nutrients to the watershed ecosystems from decomposing salmon carcasses.

Four large fish hatcheries are located in Prince William Sound, and, although most of the returning fish they produce are either caught or return to the facilities, a significant number stray into natural production area and mix with wild salmon. Brenner et al. (2012) found that streams in southwestern Prince William Sound were particularly vulnerable to large numbers of stray hatchery fish. It is likely that many of the pink salmon populations in this area are mixtures of hatchery strays and wild fish, with hatchery fish comprising from 10 percent to 25 percent of the spawning population. Such levels likely risk the natural genetic character of wild pink salmon and reduce their productivity. Overall, human influence on the fish resource that relies on habitats within the borders of this study area has probably had a “slight impact” on its natural character.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the resident and migratory shore and seabirds (AKNHP 2013). Dominant predators, such as brown bears and wolves, may be absent from some of the more isolated islands, making those islands protected bird sanctuaries. Foxes and other furbearers were introduced to the islands of the Prince William Sound inform the late 1700s through the early 1900s. Most of the foxes and non-native furbearers died out due to disease and overutilization of their habitat. The *Exxon Valdez* oil spill oiled major portions of this group of islands. Many of the affected wildlife species have been classified by the EVOS Trustee Council as recovered or appear to be recovering (EVOS TC 2014). Pigeon guillemots and marbled murrelets have not recovered and pigeon guillemot populations remain far below historic levels. An *Exxon Valdez* oil-spill-funded project to reduce mink on the Naked Island Group was initiated in 2014 by the U.S. Fish and Wildlife Service to help restore pigeon guillemots and help restore a more natural balance. Federally listed Steller sea lions haul out in several off-shore rocks. Haul outs are buffered from disturbance as federally designated critical habitat. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference. Human activities have the potential of impacting nesting sea and shore birds during their crucial breeding period.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is generally high, and is outstanding away from shorelines and outside of the peak visitation months of June through August. Along popular shorelines throughout the inventoried area, the presence of boats on adjacent marine waters represents another common impact to solitude. In some areas, especially where commercial fishing occurs, visitors may commonly hear or see marine vessels during the peak summer months while along shore. The majority of these impacts originate outside of NFS lands and during the peak summer months. These effects are most common along shorelines closest to Whittier and the fish hatchery on Esther Island, including the Dutch Group, Bald Head Chris, and Perry Island. Knight Island, the most distant part of the inventoried area from Whittier and Valdez, is unique for the low level or absence of marine traffic. An exception is Lower Passage along northern Knight Island, where commercial fishing vessels may be present during fishing season.

Forest Service monitoring shows the sights and sounds of vessels quickly diminish with distances of a quarter mile or less from the shoreline boundaries of the wilderness study area (USDA 2012; USDA 2013). Topography, forest screening, and distance from the wilderness study area boundary often eliminate impacts to solitude originating on marine waters. This is particularly true on Knight Island, the largest island in the area. Knight Island is mountainous and comprised of twelve primary bays. The steep shores and complex geography of coves and inlets offer a reprieve from vessel noise that is unique in western Prince William Sound, even during the peak summer season of visitation. Drier Bay, Lower Herring Bay, Mummy Bay, and Johnson Bay are examples.

The village of Chenega Bay is within seven air miles and 15 boating miles of the area. Whittier is about 25 miles from the northwestern edge of the area. Both of these communities provide boating access to the inventoried area. There are no established landing sites within the area. All aircraft access is by floatplane to saltwater or large lakes.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is moderate to high, with very little recreation development and a high level of challenge for users, but also a limited diversity of recreation opportunities. Areas near the shore are popular with boat or kayak based recreation users. Commercial fishing is present but not as heavy as near the fish hatcheries. The NFS lands within the area are surrounded by Prince William Sound and are influenced by the marine based recreation and commercial activities that take place there. There are no recreation cabins or trails within the area. Knight Island offers numerous slopes comprised of muskeg and subalpine meadows, enabling hiking, skiing, hunting, and wildlife viewing opportunities greater than the area's other islands.

Recreation opportunity spectrum class:

- Primitive – 12,700 acres
- Semi-primitive non-motorized – 105,700 acres

Motor Vehicle Recreation

This area is closed to motor vehicle uses year-round except for subsistence and traditional activities. There is essentially no historic motor vehicle use of the uplands within this area. Extensive motor vehicle use in the form of powerboats and, to a lesser degree aircraft, occurs adjacent to the uplands.

Other Values

Ecological, Geological, or Scenic Features

The area has high scenic values with islands, mountains, and rain forest, along with ocean views that include both small bays and open expanses. Islands near Naked Island and Perry Island are known for parakeet auklet, pigeon guillemot, and other birdlife. Knight Island was uplifted during the 1964 earthquake. Its shores are bordered by Sitka alder and young spruce, evidence of the area's seismic history.

Cultural and Historic Features of Value

There are 101 known cultural sites within the area. They include mining ruins, cabin ruins, culturally modified trees, a former military installation on Smith Island, and others.

Features of Scientific or Educational Value

Knight Island and nearby islands were heavily oiled during the *Exxon Valdez* oil spill and an estimated 16,000 gallons of oil remain in intertidal areas. Extensive oil spill research has occurred. Many wildlife studies in southcentral Alaska have occurred in the EVOS area in order to evaluate impacts from the spill and species recovery. This contribution to science on baseline wildlife and trends is significant. Also, shorebirds on islands in this area have been surveyed for decades. The data contributes to evaluating the status of populations and the ocean systems that sustain them.

Manageability

Shape and Configuration of the Area

All of the area falls within the Nellie Juan-College Fiord Wilderness Study Area established by ANILCA and is being managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System until congressional action is taken. The primary land management goal is preservation of wilderness character pending a determination by Congress. The State and private land boundaries within the area are not well defined.

Management of Adjacent Lands

The Nellie Juan inventoried area is to the west. The College Fiord inventoried area is to the north. West of the Prince William Sound Islands inventoried area are the Montague and Fidalgo-Gravina inventoried areas. They are separated from this inventoried area by 10 to 30 miles of water. Intertidal lands and State Marine Parks bordering the area are generally managed by Alaska Department of Natural Resources to be consistent with the Nellie Juan-College Fiord Wilderness Study Area management intent (ADNR 1995).

Non-Federal Lands

There are 21,490 acres of State and private lands within the inventoried area. All State and private lands would require access from Prince William Sound. Wilderness designation could affect access to some of these lands.

The surface estate of 1,600 acres was purchased using the EVOS restitution funds. The result is a split estate; the Federal government owns the surface estate on these lands, while the subsurface estate is retained by the CAC and may be developed.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for boat-based hiking, kayak-supported camping, freshwater fishing, big game hunting, and boat based ski touring. Naked Island Communication Site and various research permits occur for oil spill related projects, bird habitat, seismic activity, whales, and other projects. All legally established rights or uses in this area are managed to maintain the area’s presently existing character and potential for inclusion in the National Wilderness Preservation System in accordance with regional policy, the precepts of the 1964 Wilderness Act, and ANILCA provisions.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization.

Federal or State Laws Affecting Availability as Wilderness

The Alaska National Interest Lands Conservation Act (ANILCA) included this area in the designation of the Nellie Juan-College Fiords Wilderness Study Area. This area has been managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System since 1980 as a result of its designation.

Rationale for Further Analysis

This area has high manageability potential as designated wilderness. The wilderness study area continues to provide long term economic benefits from tourism that relies on its wilderness characteristics (guided kayak, hiking, and hunting excursions, non-guided recreation activities, tour boat excursions, general public using port towns to access the wilderness study area, sport fishing opportunities provided by intact ecosystems and abundant fish populations, and subsistence use of resources for rural residents of communities in the Prince William Sound area.

A majority of public comments submitted during the scoping period for the forest plan revision process supported recommending all or most of the wilderness study area for wilderness designation. A few commenters did not support any recommendation of wilderness across the forest.

Size of Recommended Wilderness

Acres of recommended wilderness by alternative within the Prince William Sound inventoried area:

- Alternative A: 46,900 Acres
- Alternative B: 46,900 Acres
- Alternative C: 104,976 Acres
- Alternative D: 114,447 Acres

Boundary Descriptions

Boundaries for areas recommended for wilderness in one or more alternatives include the following:

- All the larger islands within Western Prince William Sound (Bainbridge, Knight, Naked, Lone, Perry, Ingot, Bald Head Chris, Peak, Dutch Group, Smith, Squire, Mummy)

Several areas were excluded from all alternatives:

- Split estate lands where Chugach Alaska Corporation has the dominant ownership of the subsurface (includes the area surrounding Hogan Bay on southern tip of Knight Island and the southeast side of Drier Bay on Knight Island). These lands were excluded due to the potential development of the subsurface lands and the difficulty in managing for wilderness character during and after such development.
- A small parcel at the head of Marsha Bay on the eastern side of Knight Island that is completely surrounded by Chugach Alaska Corporation lands. This parcel would be difficult to manage for wilderness character being surround by lands of other ownership.

Additonal area excluded from alternative C:

- Erlington Island was excluded in consideration of the native and traditional values of this island to the Native Village of Chenega.

College Fiord Inventoried Area

Gross acres: 1,149,570
NFS acres: 1,114,290

Apparent Naturalness

Appearance and Developments

Forest Service wilderness study area monitoring indicates an overall absence of development throughout the area and the adjacent landscape. Overall, the area appears primarily affected by the forces of nature, with minimal imprints from modern human activity. However, certain exceptions exist.

The Cannery Creek Fish Hatchery in Unakwik Inlet is the only area of modern development in this inventoried area. It is limited to approximately five acres and includes a fish hatchery, dam, diesel generator system, short road, and several buildings. The hatchery and related developments are managed according to ANILCA 1315(b), which states the site must be “constructed, managed, and operated in a manner that minimizes adverse impacts on the wilderness character of the area.” Evidence of past mining activity is present in various locations throughout the area. The largest site is Granite Mine, along western Port Wells. Two vintage trucks, a dilapidated stamp mill, remnants of a corduroy road, and other associated ruins are present. As a National Register Eligible Site, it is part of the cultural and historical landscape of the area.

Some timber harvesting, totaling about 250 acres, has occurred in the Port Wells, Esther Passage, and lower College Fiord areas. Logging and road construction related to the harvests is substantially unnoticeable and are reverting to natural forest conditions.

Recreational improvements are limited to three recreation cabins with trails providing access to one of these from saltwater. Recreational impacts are present along popular shorelines in Harriman Fiord, Barry Arm, Port Wells, and other areas, but are generally limited to small areas of disturbed vegetation. Most of the area shows little or no development or impacts related to recreation.

The northern and eastern edge abuts State land, which is essentially undeveloped. The eastern boundary is along Valdez Arm and undeveloped land. Numerous glaciers surround the northern, eastern, and western boundary of the area making it unlikely any development will encroach. This area has a very high degree of natural integrity. Most long-term ecological processes are intact and operating. While some evidence of human activity exists (e.g., mining operations, trails, and cabins), these activities have had little or no effect on the natural appearance of the area.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area.

Fish Resource

Salmon are abundant in this area with 129 total populations identified and all five species of Pacific salmon represented. Dolly Varden char and cutthroat trout also occur in this area. Although pink and chum salmon are the dominant species, several of the sockeye salmon populations are quite large. There has been very little disturbance to the natural condition of the freshwater habitat. However, commercial fisheries catch a substantial portion of the wild pink and chum salmon each year with 1990 to 2011 average interception rates of 40 percent and 27 percent, respectively. Fishery impact rates on wild sockeye salmon populations were not available. Removing returning salmon via fisheries means that the number of fish reaching the spawning grounds has been reduced from the natural historical condition. To some extent this has reduced the food supply for fish eating species, such as bears and bald eagles, as well as lessened the rate of infusion of marine derived nutrients into the watershed ecosystems from decomposing salmon carcasses.

Four large fish hatcheries are located in Prince William Sound, and, although most of the returning fish they produce are either caught or return to the facilities, a significant number stray into natural production areas and mix with wild salmon. Brenner et al. (2012) found that streams in proximity to Wally Noerenberg Hatchery (Ester Island) and Cannery Creek Hatchery (Unakwik Sound) are likely to contain mixtures of hatchery and wild fish, with hatchery fish comprising from five percent to 25 percent of the spawning population. Such levels may risk the natural genetic character of wild fish and reduce their productivity. Overall, human influence on the fish resource that relies on habitats within the borders of this study area has probably had a “slight impact” on its natural character.

Wildlife Resource

All native wildlife associated with the habitats in this area are expected to be present in sustainable numbers. Dominant predators, such as brown bears and wolves, and smaller fur bearers are absent from some of the more isolated islands (AKNHP 2013), providing excellent breeding habitat for sea birds. There is a concentration of black oystercatcher habitat in this area. None of the native terrestrial wildlife are proposed or listed in compliance with the ESA, but there is designated critical habitat for Steller sea lions. The ecological processes and some of the shoreline habitat in College Fiord were affected by the *Exxon Valdez* oil spill, but most of the bays were not directly oiled. Nonetheless, some lingering oil may still be buried. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference, although human activities have the potential of impacting natural behaviors of nesting sea and shore birds and sea mammals.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

Monitoring shows outstanding opportunities for solitude exist throughout much of the area. Using as a measure the distance from roads, trails, town sites, and other development, the area includes some of the most remote lands within the Chugach National Forest. Access is only possible by aircraft or boat. Virtually all aircraft access is by floatplane to saltwater or large lakes. Limited landings also occur on the glaciers by aircraft fitted with skis. There are no established aircraft landing sites in the area. The area is large with a high degree of topographic screening. The distance from the perimeter to the core is more than 25 miles. Valdez is about 15 air miles and 30 boat miles from its eastern edge. Whittier is about 14 miles by air and boat from its southern edge. Forest Service monitoring show opportunities for solitude are particularly outstanding in upper College Fiord, upper Unakwik Inlet, Cedar Bay, Wells Bay, much of Columbia Bay north of Heather Island, and in various other locations.

Along popular shorelines throughout the inventoried area, the presence of boats on adjacent marine waters represents another common impact to solitude. In some areas, especially where commercial fishing occurs, visitors may commonly hear or see marine vessels during the peak summer months while along shore. Tour vessels and private recreation boats are common on waterways closest to Whittier and in popular areas such as Port Wells, Esther Passage, and Harriman Fiord. The majority of the impacts originate outside of NFS lands and during the peak summer months. Outside of the peak summer months, commercial fishing and vessel traffic is greatly reduced. Forest Service monitoring shows visitors may spend several days in the area between October and May without experiencing any sights or sounds of marine vessels. Forest Service monitoring shows the sights and sounds of vessels quickly diminish with distances of a quarter mile or less from the shoreline boundaries of the wilderness study area. Topography, forest screening, and distance from the wilderness study area boundary often eliminate impacts to solitude originating on marine waters.

Recreational activities can also impact opportunities for solitude, especially during the peak summer months. Harriman Fiord and some locations along western Port Wells are among the most popular camping and kayaking sites in the inventoried area. Visitors there may encounter on-shore recreationists.

Opportunity for Primitive Recreation

Forest Service wilderness study area monitoring shows the area offers outstanding opportunities for primitive and unconfined recreation. Using distance from roads and towns as a measure, this inventoried area contains some of the best opportunities for primitive recreation within the Chugach National Forest. Kayaking, camping, hunting, fishing, skiing and other non-motorized activities that rely on physical skills and self-reliance are popular in the area. Opportunities for rescue, shelter, and motor vehicle assistance are generally rare, especially away from popular shorelines and outside of the peak summer season.

Recreation opportunity spectrum class:

- Primitive – 600,400 acres
- Semi-primitive non-motorized – 513,900 acres

There are seven miles of trail and three recreation cabins in the area. Areas where opportunities for primitive recreation are particularly outstanding include upper College Fiord, upper Unakwik Inlet, Cedar Bay, Wells Bay, and especially Columbia Bay north of Heather Island, where topography, ice, recently de-glaciated landscapes and lack of development require skill, challenge, and endurance.

Motor Vehicle Recreation

This area is closed to motor vehicle uses year-round except for subsistence and traditional activities.

Other Values

Ecological, Geological, or Scenic Features

Mt. Marcus Baker, the highest mountain in the Chugach Range, is located at the northern edge of the unit. The terrain is extremely rugged with barren rock cliffs rising from saltwater to over 7,000 feet in elevation. Numerous tidewater and hanging glaciers can be seen from saltwater. Western Prince William Sound has more tidewater glaciers than any other geographic region in North America. Columbia Glacier, located in the northeastern part of the inventoried area, is among the largest tidewater glacier systems in North America. It has been undergoing rapid retreat since the early 1980s and is one of the largest contributors of fresh water to the marine environment in Alaska. The Eaglek area includes Cascade Falls and the head of Cascade Bay. The falls drop 75 to 100 feet directly into saltwater. The long protected bays offer excellent habitat for shorebirds and marine mammals.

The recently de-glaciated area near Columbia Glacier offers an early successional landscape that is of interest to botanists, geologists, and fish and wildlife, and climate change researchers. The glacier, ice field and fresh water discharge are of interest to climate, glacier, and other researchers. The area’s glacial history and high scenic qualities are valued by recreationists, tourists, and outfitters and guides.

Cultural and Historic Features of Value

There are 96 known cultural sites within the area. Historic mining activity includes lode mines at Harrison Lagoon, Portage Mine near Poe Bay, and Mineral King Mine at Bettles Bay. There are 109 old mines within the area and 54 old mining claims, most within the Bettles Bay and Hobo Bay area.

Features of Scientific or Educational Value

Three potential research natural areas have been identified in the area. The 1984 forest plan proposed the establishment of research natural areas (RNAs) in the Columbia Glacier-Granite Cove and Harvard Glacier areas. To date, neither has been designated. The 2002 forest plan proposed research natural areas at Columbia Glacier-Granite Cove and Cedar Bay. Cedar Bay was not designated, but there is continued interest in its research natural area potential. Yellow-cedar (*Callitropis nootkatensis*) die-off in British Columbia and within the Tongass National Forest in southeast Alaska has heightened interest in Cedar Bay where the species is thriving (Hennon and Trummer 2001). The northern-most extension of yellow-cedar is in Wells Bay, Cedar Bay, Unakwik Inlet, Glacier Island, and lower Columbia Bay.

Manageability

Shape and Configuration of the Area

The area is part of the Nellie Juan-College Fiord Wilderness Study Area identified in ANILCA and is being managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System until congressional action is taken. The primary land management goal is preservation of wilderness character pending a determination by Congress. The area is adjacent to the Twentymile inventoried area to the west, the Nellie Juan and Prince William Sound Island inventoried areas to the south and the Fidalgo-Gravina inventoried area to the east. Except for the Twentymile inventoried area, the upland portions of the adjacent inventoried areas are separated by the waters of Prince William Sound. The eastern boundary is along Valdez Arm, two State parks, and other undeveloped lands. The State and private land boundaries within the area are not well defined. Numerous glaciers surround the northern, eastern and western boundary of the unit making it unlikely development will encroach on the area. About 771,610 acres were recommended for wilderness area designation in 2002 as part of the previous forest plan revision.

Management of Adjacent Lands

The northern and eastern edges adjoin State land that is presently undeveloped. Intertidal lands bordering the area are managed by Alaska Department of Natural Resources to be consistent with the Nellie Juan-College Fiord Wilderness Study Area management intent. State Marine Parks in the area are generally managed as wildlands with limited development.

Non-Federal Lands

There are 35,280 acres of State and private lands within the inventoried area. All State and private lands would require access from Prince William Sound.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for boat based hiking, kayak-supported camping, freshwater fishing, big game hunting, and boat based ski touring. Cannery Creek Fish Hatchery is under special use permit, with improvements including buildings, road, pipeline and other infrastructure. Glacial and seismic research is conducted in Columbia Bay, and there are also two communication sites in Valdez Arm that monitor tanker traffic in Prince William Sound.

Minerals

There are dozens of lode mining claims in this area at Hobo Bay in two blocks including the historic Granite Mine. The Forest Service currently has no plans of operations for mining activities within this area but additional mining activity may be occurring that does not require authorization.

Federal or State Laws Affecting Availability as Wilderness

The Alaska National Interest Lands Conservation Act (ANILCA) added a portion of this area to the Chugach National Forest in 1980 and included it in the Nellie Juan-College Fiords Wilderness Study Area. This area has been managed to maintain its existing character and potential for inclusion in the National Wilderness Preservation System since 1980as a result of its designation.

Rationale for Further Analysis

This area has high manageability potential as designated wilderness because it has been managed for its presently existing character and potential for inclusion in the National Wilderness Preservation System since the designation of the Nellie Juan – College Fiord Wilderness Study Area by ANILCA in 1980.

The wilderness study area continues to provide long term economic benefits from tourism that relies on its wilderness characteristics (guided kayak, hiking, and hunting excursions, non-guided recreation activities, tour boat excursions, general public using port towns to access the wilderness study area, sport fishing opportunities provided by intact ecosystems and abundant fish populations, and subsistence use of resources for rural residents of communities in the Prince William Sound area.

A majority of public comments submitted during the scoping period for the forest plan revision process supported recommending all or most of the wilderness study area for wilderness designation. A few commenters did not support any recommendation of wilderness across the forest.

Size of Recommended Wilderness

Most of the College Fiord inventoried area was included for recommended wilderness in one or more alternatives.

Acres of recommended wilderness by alternative within the College Fiord inventoried area:

- Alternative A: 796,642 Acres
- Alternative B: 796,642 Acres
- Alternative C: 1,077,796 Acres
- Alternative D: 1,087,322 Acres

Boundary Descriptions

Boundaries for areas recommended for wilderness in one or more alternatives include the following (see maps in Appendix C of Wilderness Specialist Report):

- Wilderness study area eastern boundary from Whittier north and east to state lands near Valdez
- Coastline (above mean high tide) on the southern side of the inventoried area
- Boundary along western edge of EVOS acquired parcel near Jackpot Bay and Ewan Bay

Area excluded from alternative C:

- Glacier Island was excluded in consideration of potential limitations for access of State of Alaska selected lands and native and traditional values important to the Native Village of Tatitlek.

Fidalgo-Gravina Inventoried Area

Gross acres: 530,310
NFS acres: 315,350

Apparent Naturalness

Appearance and Developments

This area has a very high degree of natural integrity. The majority of this inventoried area is natural appearing, where only ecological change has occurred. Most long-term ecological processes are intact and operating. While some evidence of human activity exists, these activities have had little or no effect on the natural appearance of the area, and very few developments remain.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area. In the 1990s when the land was privately owned, about 7,340 acres of forest on the Knowles Head Peninsula was logged. The Forest Service now manages the surface estate of these lands and is currently developing a plan to restore habitat in this area.

Fish Resource

Pink and chum salmon are the most abundant salmon species in this area; however, several sockeye and coho populations also occur. In total, 129 salmon populations were identified in this area, many occurring in relatively short and small stream systems. Dolly Varden char and cutthroat trout also occur in this area. With the exception of past logging that has occurred on Knowles Head, the majority of the aquatic habitat is in natural condition. However, this is the immediate vicinity of the *Exxon Valdez* oil spill and impacts may be still be occurring on the natural ecosystems.

Commercial fisheries catch a substantial portion of the wild pink and chum salmon each year with 1990 to 2011 average interception rates of 40 percent and 27 percent, respectively. Removing returning salmon via fisheries means that the number of fish reaching the spawning grounds has been reduced from the natural historical condition. To some extent this has reduced the food supply for fish eating species, such as bears and bald eagles, as well as lessened the rate of infusion of marine derived nutrients into the watershed ecosystems from decomposing salmon carcasses.

Four large fish hatcheries are located in Prince William Sound and although most of the returning fish they produce are either caught or return to the facilities, a number stray into natural production area and mix with wild salmon. Brenner et al. (2012) reported for the streams in this inventoried study area that hatchery origin pink salmon typically comprised from two percent to 10 percent of the spawning population. Such levels have the potential to risk the natural genetic character of wild fish and reduce their productivity. Overall, human influence on the fish resource that relies on habitats within the borders of this study area has probably had a “slight impact” on its natural character.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including resident and migratory shore and seabird, and dominant predators. Mountain goats are common in the alpine areas. None of the terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. It is suspected that the European black slug (*Arion* spp.) which is well-established in Cordova, may be moving into this into this inventoried area, although no definitive surveys have been conducted. If they become established in the area, natural ecological processes may be altered. The thinning of logged lands at Knowles Head could benefit harlequin ducks, marbled murrelets, and other wildlife when that forested land is treated to encourage the restoration of the old growth forest conditions that were present before the logging. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

Opportunities for solitude in the area are moderate to high, although where the edge of the unit abuts Prince William Sound it is influenced by marine based recreation and commercial activities. The area, however, provides a high degree of topographic screening. Access is almost exclusively by floatplane or boat. There are several anchorages and beaches used by boaters and kayakers that provide entry points to the uplands. The distance from the perimeter to the core is three to five miles.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is high, with a high level of challenge for the recreation user and few or no developments in most of the area.

Recreation opportunity spectrum class:

- Primitive – 17,900 acres
- Semi-primitive non-motorized – 213,900 acres
- Semi-primitive non-motorized (winter motorized allowed) – 25,000 acres

There are 31 miles of trail with a low level of development and one recreation cabin in the unit at the head of Jack Bay.

Motor Vehicle Recreation

The area is closed to motor vehicle use year-round, except for subsistence use. However, unauthorized snowmachine use in the northern section of this area has been documented, and Valdez residents have expressed a desire to open this area to over-snow motor vehicle use.

Other Values

Ecological, Geological, or Scenic Features

Populations of the Alaska Region sensitive plant sessileleaf scurvygrass (*Cochlearia sessilifolia*) occur in the area. The *Cochlearia sessilifolia* plant association is considered of conservation concern by the Alaska Natural Heritage Program (Boggs et al. 2014).

Cultural and Historic Features of Value

There are four known cultural sites within the area. The town of Elamar, near Tatitlek, flourished as a copper, gold, and silver mining center during the early 1900s. The area produced a large amount of copper in the early 1900s.

Features of Scientific or Educational Value

The area contains the Olsen Bay Creek Research Natural Area where non-manipulative anadromous fisheries research was conducted for more than 50 years (USDA 2007c).

Manageability

Shape and Configuration of the Area

The boundaries of the management area are poorly defined where Forest Service land abuts State or private land. The northern edge of the unit, which is the national forest boundary with BLM land, is also poorly defined on the ground. There are several portions of the unit that are completely surrounded by other ownership. Several small parcels in this unit are adjacent to the Tasnuna River inventoried area but are separated from the rest of the unit by State land.

Management of Adjacent Lands

The Sheridan Glacier inventoried area abuts the eastern boundary of the unit and the Hinchinbrook-Hawkins inventoried area is to the south. The national forest boundary forms the northern boundary of the unit. Private land takes up most of the coastline and the community of Tatitlek is within the exterior boundary of the area. Cordova lies just to the east of the area across Orca inlet. Valdez is five miles to the north by boat across Valdez Narrows. The Wrangell-Saint Elias National Park and Preserve Wilderness Area is about 20 miles to the northeast.

Non-Federal Lands

There are 275,010 acres of State and private lands within the boundaries of this area. Another 58,460 acres are EVOS acquired lands, where the surface estate was purchased and is managed by the Forest Service. Chugach Alaska Corporation retained the subsurface estate, which may be developed.

Easements across private land are provided at strategic locations to provide access to NFS lands away from the shore. There are several parcels within this unit that are completely surrounded by private land. Almost all State and private lands would require access from Prince William Sound. Wilderness designation could affect access to some State and private lands, and isolated parcels would be difficult to manage.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for boat based hiking, freshwater fishing, and big game hunting. There is a communication site lease issued on Jack Peak, accessible only by helicopter only.

Minerals

Chugach Alaska Corporation is developing its subsurface estate in the Port Gravina area, which could create substantially noticeable impacts. Except for this development, there is no or low mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

The amount of state and private lands within the boundaries of this area (275,010 acres) would make it more difficult to maintain wilderness character in this area. In addition, another 58,460 acres are lands acquired through funding from the *Exxon Valdez* oil spill settlement, where the surface estate was purchased and is managed by the Forest Service. Chugach Alaska Corporation retained the subsurface estate, which may be developed. Chugach Alaska Corporation is developing its subsurface estate in the Port Gravina area, which would increase the difficulty of maintaining wilderness character.

Easements across private land are provided at strategic locations to provide access to National Forest System lands away from the shore. There are several parcels within this unit that are completely surrounded by private land. Almost all state and private lands would require access from Prince William Sound. Wilderness designation could affect access to some state and private lands, and isolated parcels would be difficult to manage. No smaller portions of the inventoried area were considered due to difficulty of managing with adjacent borders to acquired lands, state lands, and private lands and potential access needs of other land owners.

Montague Island Inventoried Area

Gross acres: 254,310
NFS acres: 204,500

Apparent Naturalness

Appearance and Developments

The majority of this inventoried area is natural appearing, where only ecological change has occurred. While some evidence of human activity exists (e.g., old logging operations and cabins), these activities have had little or no effect on the natural appearance of the area. No inventory of scenic integrity has been conducted to date.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area. About 2,420 acres of logging has occurred on NFS lands on Montague Island.

Fish Resource

The streams of Montague Island are major producers of salmon, particularly pink and chum salmon. No Chinook salmon populations occur within this area, although coho salmon and a few sockeye populations exist, as well as Dolly Varden char and cutthroat trout. With exception of approximately 2,500 acres of logging, there has been very little disturbance to the natural condition of the freshwater habitat. However, commercial fisheries catch a substantial portion of the wild pink and chum salmon each year with 1990 to 2011 average interception rates of 40 percent and 27 percent, respectively. It should be noted these impact estimates are for the entire Prince William Sound region and probably overestimate the impact of these fisheries on populations from these outside locations. Regardless, as a result of this fishing impact, the number of fish reaching the spawning grounds has likely been reduced from the natural historical condition, as has been the rate of infusion of marine derived nutrients to the watershed ecosystems from decomposing salmon carcasses.

Four large fish hatcheries are located in Prince William Sound and, although most of the returning fish they produce are either caught or return to the facilities, a significant number stray into the natural production area and mix with wild salmon. Brenner et al. (2012) found that streams in southwestern Prince William Sound were particularly vulnerable to large numbers of stray hatchery fish. For streams on the west side of Montague Island, the level of mixing between wild fish and stray hatchery fish on the spawning grounds was quite high, with hatchery fish comprising from 10 percent to 25 percent of the spawning population. Such levels likely risk the natural genetic character of wild pink salmon and reduce their productivity. However, these levels are much lower on the eastern side of the island, with hatchery fish comprising less than two percent of the natural spawning population. Overall, human influence on the fish resource that relies on habitats within the borders of this study area has probably had a “slight impact” on its natural character.

Wildlife Resource

All native wildlife associated with the habitat in this inventoried area are expected to be present in sustainable numbers (AKNHP 2013), except possibly the Montague Island marmot, black bears and wolves. The Montague Island marmot was first described in the early 1900s (Howell 1914, cited in Lance 2002b), but has not been seen since, with some limited searches were conducted in 1985 and 1999. The more common hoary marmot is present on several of the islands and the low number of collections of Montague Island marmots leaves their taxonomic status (and therefore any protections) in limbo. The bays on the north end of Montague Island are some of the most productive for marine wildlife in the sound and have been listed by the National Oceanographic and Atmospheric Administration as a sensitive biological area for forage fish, seabirds, waterfowl, and sea mammals. Another animal, the Montague Island tundra vole (*Microtus oeconomus amakensis*) is thought to be endemic to the island. Sitka deer and mink were introduced in the 1950s. Brown bears occur on the island and have experienced periods of overharvest, but harvest is currently authorized in low numbers. Several species of owls and raptors are present, including short eared and boreal owls, which only occur in high latitudes. Montague Island is in important stop-over for geese and sand hill cranes.

Montague Island is a popular wildlife hunting destination for deer, brown bear and mountain goats. Hunting access is by boat and plane. Planes can use beaches for runways, but since much hunting occurs in the fall, impacts to nesting shorebirds may be limited. None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA, but the federally listed Steller sea lions haul out in several off-shore rocks in this area and one rookery occurs on a marine rock outcrop east of the island. Designated haul outs and rookeries are designated critical habitat and sea lions are protected from disturbance by ESA buffers.

Montague Island was impacted by the *Exxon Valdez* oil spill, altered by the 1964 earthquake, and accumulates marine debris, including a large amount from the 2011 Japanese earthquake and tsunami. Overall, wildlife are expected to retain natural interactions with each other and their environment with minimal human interference, especially away from the coastline.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is high. While the influence of marine activities is present, it is often several miles away. Fishing and hunting are the primary recreational uses of the area. Montague Island is the largest island in Prince William Sound but it is very narrow. The area is far from communities and recreational boat use in the area is light. The distance from the edge to the core is between two and 20 miles. Off-site activities include marine based activities, such as commercial fishing and freighter traffic. These activities are easily screened by topography.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is high, with a high level of challenge for the recreation user and few or no developments in most of the area once away from the coast. There are nine miles of low development level trails and six recreation cabins in the area. Cabins are most popular in the late fall during fishing and hunting seasons.

Recreation opportunity spectrum class:

- Primitive – 2,500 acres
- Semi-primitive non-motorized – 202,000 acres

Motor Vehicle Recreation

Extensive motor vehicle use in the form of powerboats and aircraft occurs adjacent to the uplands. From May 1 to November 30, the area is closed to motor vehicle use except for subsistence, and open from December 1 to April 30, snow conditions permitting. There is essentially no historic motor vehicle use of the uplands within this area, and access is limited to boat.

Other Values

Ecological, Geological, or Scenic Features

The geologic uplift along the southern portion of the island, caused by the 1964 earthquake, presents a unique area to study geologic progression and succession. The Sitka Spruce Floodplain Old-Growth Plant Association is considered of conservation concern by the Alaska Natural Heritage Program and occurs in this area (Boggs et al. 2014).

As described previously, there are two species of mammals that may be endemic to the Island: Montague Island marmots and Montague Island voles. The last Montague Island marmot was found in1978, but may have been extirpated, since none have been seen since.

Cultural and Historic Features of Value

There are 43 known cultural sites within the area.

Features of Scientific or Educational Value

This inventoried area is the heart of the area impacted by the *Exxon Valdez* oil spill. Habitat restoration is being evaluated to benefit marbled murrelets and harlequin ducks, two species that have not yet recovered following the oil spill.

The area contains the Green Island Research Natural Area which includes old-growth forests, beaches uplifted by the 1964 earthquake, important haulout sites for harbor seals and Steller sea lions, marine bird colonies, and close linkages between terrestrial and highly productive marine environments (USDA 1997).

Manageability

Shape and Configuration of the Area

The NFS lands within the area are surrounded by Prince William Sound. The State and private land boundaries within the area are not well defined. State land below the mean high tide line is also poorly defined. The special-use road along the southern edge of Montague Island separates two small sections of the island from the rest of the inventoried area.

Management of Adjacent Lands

Private lands in the area have been logged in the past, but not in the past 20 or more years. The Village of Chenega Bay is within the external boundaries of the area. The Prince William Sound Inventoried Area is to the west and the Hinchinbrook-Hawkins Islands Inventoried Area is to the northeast.

Non-Federal Lands

There are 49,810 acres of private and State lands within the inventoried area. All private and State lands would require access from Prince William Sound. Wilderness designation could affect access to these lands.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for boat based hiking, kayak supported camping, freshwater fishing, and big game hunting. There is a small lodge under special-use permit at Macleod Harbor. There are also small telemetry and seismic sites on the island.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization.

Federal or State Laws Affecting Availability as Wilderness

None.

Rationale for Exclusion from Further Analysis

There are 49,810 acres of private and state lands within the inventoried area. All private and state lands would require access from Prince William Sound. Wilderness designation could affect access to these lands. In addition, special use authorizations in the area include outfitter/guide permits for boat based hiking, kayak supported camping, freshwater fishing, and big game hunting. There is a small lodge under special-use permit at Macleod Harbor. There are also small telemetry and seismic sites on the island. Desired objective for recreation management for the inventoried area is semi-primitive non-motorized (except Green Island which is partially primitive recreation opportunity spectrum class on the RNA).

Hinchinbrook-Hawkins Islands Area

Gross acres: 156,980
NFS acres: 145,260

Apparent Naturalness

Appearance and Developments

The majority of the area is natural appearing, where only ecological change has occurred. This area has a very high degree of natural integrity. Most long-term ecological processes are intact and operating. Little evidence of human activity exists (e.g., old mining operations and cabins), and these activities have had little or no effect on the natural appearance of the area. In very small portions of the area, there is evidence of summer motor vehicle use for subsistence access.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area. About 495 acres of logging has occurred on NFS lands meeting wilderness inventory criteria on Hinchenbrook Island.

Fish Resource

Pink and chum salmon are the most abundant salmon species in this area; however, several sockeye and coho populations occur as well. In total, 97 salmon populations were identified for this area, many occurring in relatively short and small stream systems. Dolly Varden char and cutthroat trout also occur in this area. With the exception of past logging that has occurred on Hinchinbrook Island, the majority of the aquatic habitat is in a natural condition.

Commercial fisheries catch a substantial portion of the wild pink and chum salmon each year with 1990 to 2011 average interception rates of 40 percent and 27 percent, respectively. It should be noted these impact estimates are for the entire Prince William Sound region and probably overestimate the impact of these fisheries on populations from these outside locations. Regardless, as a result of this fishing impact, the number of fish reaching the spawning grounds has likely been reduced from the natural historical condition as has been the rate of infusion of marine derived nutrients to the watershed ecosystems from decomposing salmon carcasses.

Although four large fish hatcheries are located in Prince William Sound, they are located at some distance from this inventoried area, and, as reported by Brenner et al. (2012), the incidence of stray hatchery fish mixing with wild fish on the spawning grounds is low. For streams on Hinchinbrook and Hawkins Islands, hatchery fish likely comprise no more than two percent of the natural spawning population. At such levels there is probably little risk to the genetic character and production of wild fish. Overall, the human influence on the fish resources within the borders of this study area has probably had a “slight impact” on its natural character.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators and resident and migratory shore and seabirds common in Prince William Sound (AKNHP 2013). Black bears are thought to be intermittent visitors to Hinchenbrook Island, and both black and brown bears occur on Hawkins Island. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference. None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. Hinchenbrook and Hawkins islands are in the ecological area affected by the *Exxon Valdez* oil spill but were not directly oiled. Most affected wildlife have been classified as “recovered” or “very likely recovered” by the EVOS Trustee Council, although some fish and marbled murrelets and pigeon guillemots are not recovering (EVOS TC 2014). Federally listed Steller sea lions haul out in several off-shore rocks in this roadless area. Two haul outs are buffered from disturbance as federally designated critical habitat.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is generally high. Off-site activities potentially affecting solitude include marine based activities, such as commercial fishing, freighter traffic, and recreational boating. The distance from the edge to the core is between two and four miles.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is high, with few developments in the area and a moderate to high level of challenge for the recreation user. There are three recreation cabins in the unit. There are no developed trails in the area, though five to 10 miles of user-created trails are used for subsistence purposes.

Recreation opportunity spectrum class:

- Primitive – 91,100 acres
- Semi-primitive non-motorized – 29,000 acres
- Semi-primitive motorized – 16,900 acres

Motor Vehicle Recreation

Motor vehicle use is not allowed except for subsistence use from May 1 to November 30, with the exception of two small sections of Hinchinbrook Island. Off-highway vehicle use by local residents for subsistence has been documented in the southeast portion of Hinchinbrook and in a small area on Hawkins Island near Canoe Passage. From December 1 to April 30, the area is closed to motor vehicle use except for subsistence use and the same to areas on Hinchinbrook Island that are open to motor vehicle use in the summer.

Other Values

Ecological, Geological, or Scenic Features

Populations of the Alaska Region sensitive plants Unalaska mist-maid (*Romanzoffia unalaschcensis*) and sessileleaf scurvygrass (*Cochlearia sessilifolia*) occur in the area. The *Cochelaria sessilifolia* Plant Association and Sitka Spruce Floodplain Old-Growth Plant Association are of conservation concern by the Alaska Natural Heritage Program and occur in this area (Boggs et al. 2014).

Cultural and Historic Features of Value

There are 72 known cultural sites within the area. The area's history includes early settlement by Alaska Natives and Russian fur traders.

Features of Scientific or Educational Value

A research natural area was proposed at Cutoff Creek in the 2002 forest plan but was not designated. The area contains old-growth Sitka spruce (*Picea sitchensis*) forests on alluvial soils. The cultural sites and locations of early settlement are of scientific and educational value.

Manageability

Shape and Configuration of the Area

The exterior boundaries are easily defined as the unit is made up of two islands. State and Native land boundaries within the unit are less clearly defined. State land below the mean high tide line is poorly defined on the ground. Native corporation selections, when conveyed, would create several small isolated parcels within the unit.

Management of Adjacent Lands

The closest inventoried area is Sheridan Glacier to the east. Orca Inlet and private land separate these two inventoried areas. Montague inventoried area is to the south across Hinchinbrook Entrance and the Fidalgo-Gravina Inventoried Area is to the north across Orca Bay.

Non-Federal Lands

There are 20,940 acres of State and private lands within the inventoried area. Several sections of NFS land are completely surrounded by private land. Access to State and private lands is by Prince William Sound. Wilderness designation could affect access to these lands.

The surface estate of 8,310 acres was purchased using the EVOS restitution funds. The result is a split estate: the Federal Government owns and manages the surface estate of these lands, while the subsurface estate is retained by the CAC and may be developed.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for boat based hiking, fishing, and big game hunting. There is a communication site on Johnstone Point on Hinchinbrook Island, and a communication site, also on Hinchinbrook Island, to support Alyeska Pipeline.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require an authorization.

Federal or State Laws Affecting Availability as Wilderness

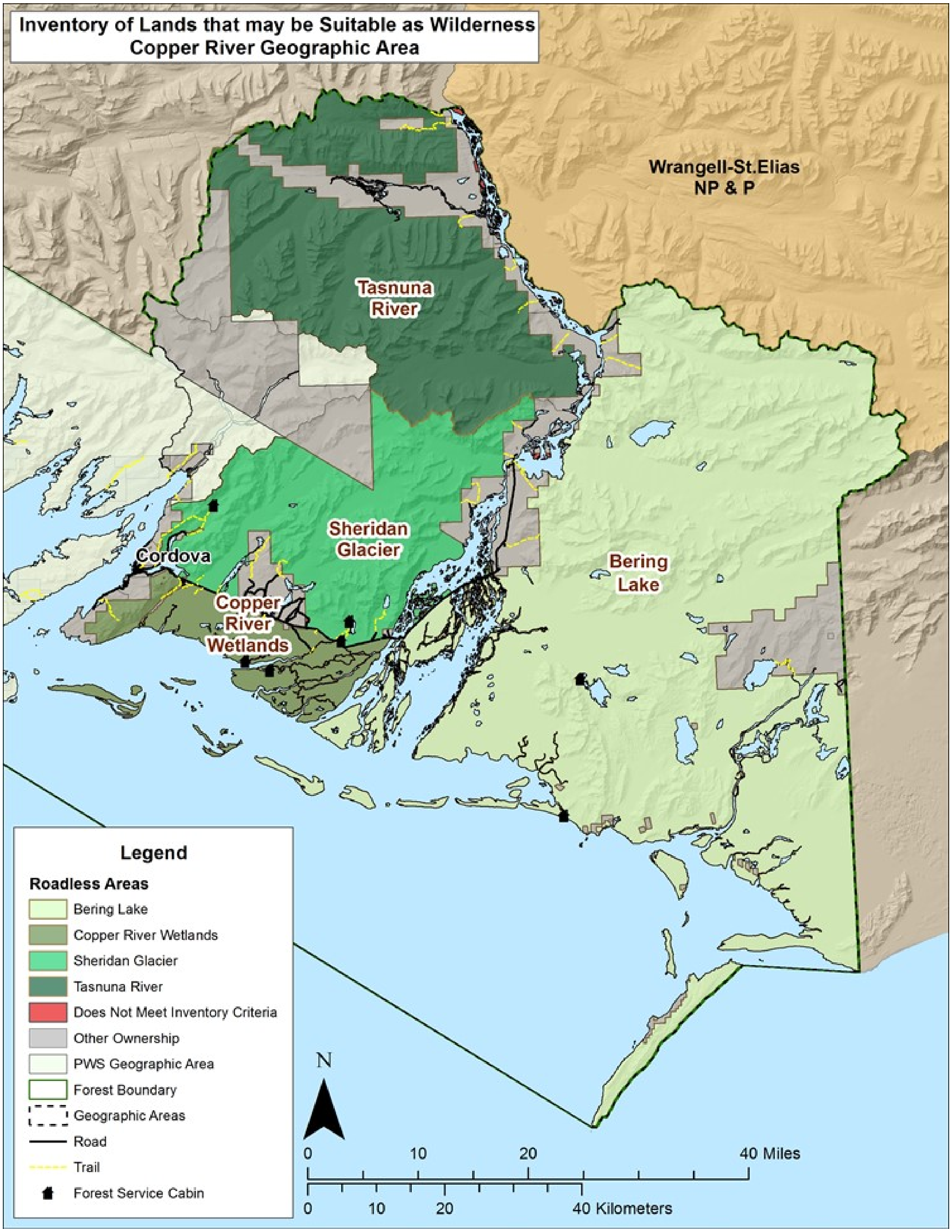
None.

Rationale for Exclusion from Further Analysis

There are 20,940 acres of state and private lands within the inventoried area. Several sections of National Forest System land are completely surrounded by private land. Access to state and private lands is by Prince William Sound. Wilderness designation could affect access to these lands.

The surface estate of 8,310 acres was purchased using the EVOS restitution funds. The result is a split estate: the Federal government owns and manages the surface estate of these lands, while the subsurface estate is retained by the Chugach Alaska Corporation and may be developed.

In addition, off highway motor vehicle use is allowed on two small sections of Hinchinbrook Island during summer months and by local residents for subsistence in the southeast portion of Hinchinbrook and in a small area on Hawkins Island near Canoe Passage.



Map 39. Inventory of lands that may be suitable as wilderness in the Copper River Delta Geographic Area

Copper River Geographic Area

Copper River Wetlands Area

Gross acres: 97,180
NFS acres: 87,540

Apparent Naturalness

Appearance and Developments

The area has a very high degree of natural integrity. While some evidence of human activity exists, these activities have had little or no effect on the natural integrity of the area. The apparent naturalness has been only slightly affected by human activity. The majority of the area is natural appearing where only ecological change has occurred.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are common in areas of human disturbance, especially near roads and along trails. The highly invasive aquatic plant *Elodea* spp. has been found in a number of locations in the area, including Eyak River and adjacent sloughs and ponds, and in lower Alaganik Slough and side sloughs.

Fish Resource

Although populations of Chinook salmon do not occur within this area, the remaining four species of Pacific salmon are present as is Dolly Varden char and cutthroat trout. In addition, this area is one of two locations within the Chugach National Forest where eulachon can be found (the other being Twentymile River). The wetland habitat that is characteristic of this area is a significant nursery area for juvenile salmon that originate here as well as the Sheridan and Bering inventoried areas. The character of this area was substantially changed as the result of the land uplift associated with the 1964 earthquake; however, natural processes dominate the existing aquatic habitat. Fishery impacts on these populations are thought to be at moderate levels. There are no hatchery salmon in this area other than sockeye salmon in transit to and from a large sockeye hatchery located 260 miles north in the upper Copper River watershed. Overall, the fish resources in this area, although in transition as a result of the 1964 earthquake, have had little impact from humans and probably are in a “nearly natural” state.

Wildlife Resource

All native wildlife associated with habitats in this inventoried area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference. None of the native terrestrial wildlife in this inventoried area are proposed or listed in compliance with the ESA. Moose were introduced to the Copper River Delta in 1958 and 1959 with the translocation of 23 calves. Moose in this area are separated from other moose populations by topography. The European black slug (*Arion* spp.) is established in Cordova and may have expanded into this area. Off-highway vehicle use on the small barrier islands adjacent to the mainland likely has an impact on migratory birds, primarily during April and May.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in the area is low to moderate as a result of the area's small size, lack of topographic features, vegetation screening, and many permanent off-site intrusions. There are also several privately owned isolated cabins along the rivers and sloughs. The distance from the perimeter to the core is between six and 12 miles.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is low to moderate as a result of little diversity of opportunities and few challenges to the recreational user, who most often use motor vehicles. The area provides settings for semi-primitive opportunities.

Recreation opportunity spectrum class:

- Primitive – 1,500 acres
- Semi-primitive non-motorized – 10 acres
- Semi-primitive non-motorized (winter motorized allowed) – 65,900 acres
- Semi-primitive motorized – 15,900 acres
- Roaded natural – 300 acres

There are two recreation cabins in the area. Hunting and fishing are the most popular recreational activities, accessible primarily by motor boats.

Motor Vehicle Recreation

From May 1 to November 30, motor vehicle use on the mainland is prohibited except for subsistence use. On the small islands adjacent to the mainland, motor vehicle access is generally allowed in non-vegetated areas except on the Copper Sands. Most of the area is open to snowmachines from December 1 to April 30, snow conditions permitting, except for the Alaganik Slough area and Copper Sands. Powerboats are common on the waterways in this area during the summer.

Other Values

Ecological, Geological, or Scenic Features

The Copper River Delta is a unit of the western shorebird reserve network and is one of the world's most significant wetlands. The geologic uplift along the coast caused by isostatic forces is a geologic phenomenon to study active geological progression and succession. The Barrier Islands, Uplifted Tidal Marsh, and Tidal Marshes and Mudflats biophysical settings occur in this area and are considered of conservation concern by the Alaska Natural Heritage Program (Boggs et al. 2014).

Cultural and Historic Features of Value

There are three known cultural sites within the area.

Features of Scientific or Educational Value

The area contains the Copper Sands Research Natural Area, which includes barrier islands and breakwater sandbars, and is a site of active vegetation succession on sand dunes (USDA 2007a). In the 1984 forest plan, a research natural area was proposed at Pete Dahl Slough to represent the extensive wetland ecosystems of the Copper River Delta, but it was not designated.

The Copper River Delta provides essential feeding habitat for millions of migratory shorebirds in the spring, including most of the world’s dunlins and western sandpipers, essential fall migratory habitat for tule white-fronted geese, and nesting habitat for nearly all dusky Canada geese, a species recommended for species of conservation concern in the forest plan assessment (USDA 2014a).

This area has exceptional scientific value as a laboratory to learn about the transition response of a very large, productive wetland to a large natural disturbance (i.e., uplift from the 1964 earthquake). In addition, there are unique opportunities to study the impact of climate change on aquatic ecosystems.

Manageability

Shape and Configuration of the Area

The boundaries of the management area are poorly defined where Forest Service land abuts State or private land. The buffer between the Copper River Highway and the inventoried unit is not well defined on the ground. The mean high tide line defining State land is very difficult to locate.

Management of Adjacent Lands

The Sheridan Glacier inventoried area is separated from this unit by the Copper River Highway. To the east and across the Copper River is the Bering Lake inventoried area. Hinchinbrook-Hawkins inventoried area is separated from this unit by Orca Inlet. The Wrangell-Saint Elias National Park and Preserve Wilderness is about 50 miles to the northeast. The city of Cordova is just to the north of the area.

Non-Federal Lands

There are 13,490 acres of State and private lands within the inventoried area. About 70 percent of these lands are adjacent to major road access. The other 30 percent can only be reached by water. Wilderness designation could affect access to these lands.

The surface estate of 3,850 acres was purchased using the EVOS restitution funds. The result is a split estate: the Federal Government owns the surface estate on these lands, while the subsurface estate is retained by the CAC and may be developed.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for rafting, camping, boat-based hiking, and big game hunting. There is a communication site on Heney Ridge, accessible by helicopter only. Mile 22 Communication Site, near the Copper River Highway, is accessible by a short hike. There are approximately 23 privately owned isolated cabins that are used for recreational and subsistence purposes.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization.

Federal or State Laws Affecting Availability as Wilderness

The primary purpose of management in this area is for conservation of fish and wildlife and their habitat according to ANILCA 501(b).

Rationale for Exclusion from Further Analysis

ANILCA 501(b) states that multiple use activities shall be permitted in a manner consistent with the conservation of fish and wildlife and their habitat. Some of these activities may be in conflict with managing the area as designated wilderness.

In addition, the opportunity for solitude in the area is low to moderate as a result of the area's small size, lack of topographic, vegetative screening, and many permanent off-site intrusions. There are also several privately owned isolated cabins along the rivers and sloughs. The distance from the perimeter to the core is between 6 and 12 miles. There are two recreation cabins in the area. Hunting and fishing are the most popular recreational activities, accessible primarily by motor boats. From May 1 to November 30, motor vehicle use on the mainland is prohibited except for subsistence use. On the small islands adjacent to the mainland, motor vehicle access is generally allowed in non-vegetated areas except on the Copper Sands. Most of the area is open to snowmachines from December 1 to April 30, snow conditions permitting, except for the Alaganik Slough area and Copper Sands. Powerboats are common on the waterways in this area during the summer.

There are 13,490 acres of state and private lands within the inventoried area. About 70 percent of these lands are adjacent to major road access. The other 30 percent can only be reached by water. Wilderness designation could affect access to these lands.

The surface estate of 3,850 acres was purchased using the EVOS restitution funds. The result is a split estate: the Federal government owns the surface estate on these lands, while the subsurface estate is retained by the Chugach Alaska Corporation, and may be developed.

Sheridan Glacier Inventoried Area

Gross acres: 316,210
NFS acres: 232,320

Apparent Naturalness

Appearance and Developments

The unit has a high level of natural integrity. Long-term ecological processes are intact and operating. Most of the area appears unmodified. Minor inclusions, such as recreation cabins and trails, are evident when one is close to them.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are common in areas of human disturbance, especially near roads and along trails. The highly invasive aquatic plant *Elodea* spp. has been found in a number of locations in the area, including McKinley Lake, Wrong Way Pond, and Wooded Pond.

Fish Resource

Four of the five species of Pacific salmon (Chinook are absent) as well as Dolly Varden and cutthroat trout are represented in this area of diverse habitats. Although glaciers dominate the watersheds, there are several unique systems that are substantial producers of coho salmon, which are in part ground water fed by glacier meltwater that percolates through the gravels that have been deposited in wide valley floors. The habitat is in a relatively natural state, although the character of this area was altered as the result of the land uplift associated with the 1964 earthquake. There have been impacts to riparian areas alongside Ibeck Creek as a result of off-highway vehicles traffic; however, efforts are underway to repair this damage. *Elodea* spp., an invasive aquatic plant is present and there is a high potential for its spread to other areas. Fishery impacts on these populations are thought to be at moderate levels. There are no hatchery salmon in this area other than sockeye salmon in transit to and from a large sockeye hatchery located 260 miles north in the upper Copper River watershed near Paxton. Overall, the natural character of the fish resources in this area have been "slightly impacted" by human influences.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. Boreal toads have been observed historically along the southwestern portion of this area.

Moose were introduced to the Copper River area. The European black slug (*Arion* spp.) is established in Cordova and may have moved into this inventoried area. Other than these potentially unnatural conditions on the edge of the area, wildlife are expected to retain natural interactions with each other and their environment with minimal human interference.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude is high. There is a high level of topographic screening. The distance from the perimeter to the core is seven to 14 miles.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is moderate, with a low level of development away from the boundaries and moderate challenge and diversity of recreation opportunities. Much of the area, however, is regularly accessed by motor vehicles.

Recreation opportunity spectrum class:

- Primitive – 72,500 acres
- Semi-primitive non-motorized – 2,100 acres
- Semi-primitive non-motorized (winter motorized allowed) – 100 acres
- Semi-primitive motorized – 148,100 acres
- Roaded natural – 10 acres

There are three recreation cabins within the unit and four moderately developed trails totaling approximately 10 miles.

Motor Vehicle Recreation

All of the area is open to motor vehicle access from December 1 to April 30, depending on snow conditions, except for the Power Creek drainage which is closed year-round to all motor vehicle use. Helicopter-assisted skiing takes place in the northeast part of the area. The Sheridan Glacier area also includes the largest segment the national forest open to all motor vehicle uses from May 1 to November 30. Off-highway vehicle use in this area is relatively common for subsistence and recreational purposes.

Other Values

Ecological, Geological, or Scenic Features

There are four significant glaciers within the area: Scott, Sheridan, Sherman, and Childs glaciers. The Copper River Delta is the largest contiguous coastal wetland system along the West Coast of North America (Powers et al. 2002).

Cultural and Historic Features of Value

There are two known sites within the area. The McKinley Trail Cabin is the oldest cabin within the national forest available for public use, and mine ruins with interpretation can be found near the McKinley Lake Cabin.

Features of Scientific or Educational Value

The vast Copper River Delta has provided the setting for a variety of scientific studies and serves as a destination each year when hundreds of thousands of migratory birds pass through the area in late April and early May.

Manageability

Shape and Configuration of the Area

The exterior boundaries are fairly distinct where they follow topographic divides along the western and northern edge. The southern and eastern boundary is established by the Copper River Highway. Where the area abuts private or State land the boundaries are not distinct.

Management of Adjacent Lands

This unit is adjacent to the Tasnuna River inventoried area. It is separated from the Copper River Wetlands inventoried area to the south by the Copper River Highway. The Bering Lake inventoried area is across the Copper River Highway to the east. The Fidalgo-Gravina inventoried area is west of the area. The Wrangell-St. Elias National Park and Preserve Wilderness is about 10 miles to the northeast. The community of Cordova is in the western edge of the area.

Non-Federal Lands

There are 93,360 acres of State and private lands within the inventoried area. About 60 percent of these lands are adjacent to major roads. The other 40 percent has only water access.

The surface estate of 9,400 acres near Eyak Lake was purchased using the EVOS restitution funds. The result is a split estate: the Federal Government owns the surface estate on these lands, while the subsurface estate is retained by the CAC and may be developed.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for rafting, camping, and hiking. The area is also being analyzed for winter recreation activities. There are also seismic and telemetry stations within the area.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization. In the portion of the area added by ANILCA, minerals are managed under ANILCA requirements (hardrock leasable), not under the 1872 Mining Law (locatable).

Federal or State Laws Affecting Availability as Wilderness

The Alaska National Interest Lands Conservation Act (ANILCA) 501(b) added the eastern portion of this area to the Chugach National Forest in 1980 and directs that conservation of fish and wildlife and their habitat be the primary purpose of management.

Rationale for Exclusion from Further Analysis

ANILCA 501(b) states that multiple use activities shall be permitted in a manner consistent with the conservation of fish and wildlife and their habitat. Some of these activities may be in conflict with managing the area as designated wilderness.

In addition, motor vehicle use consists of watercraft, such as jet boats and airboats and motorboats, as well as float planes, which provide access into this area along waterways and lakes. Snow machine use is allowed in most of the area from December 1 to April 30, snow permitting. About half of the area is also open to helicopter landings in the winter. From May 1 to November 30, almost all of the area is closed to motor vehicle use except for subsistence. This area has a recreation objective of primitive. A future analysis is needed which would examine winter travel management and allowance of motorized vehicles in this inventoried area. Exceptions to this are on the small islands where motor vehicle use is allowed in non-vegetated areas only, and on Long Island in the center of the delta, where motor vehicle use is allowed. Mile 27 sand dunes are a popular destination for OHV riders. Access to most of this area is by boat or floatplane. Smaller portions of this inventoried area were not considered for wilderness recommendation due to the potential conflicts in activities allowed under ANILCA 501(b).

Bering Lake Inventoried Area

Gross acres: 1,032,730
NFS acres: 957,460

Apparent Naturalness

Appearance and Developments

This area has a very high degree of natural integrity. Most long-term ecological processes are intact and operating. While some evidence of human activity exists (e.g., mining operations, old railroad bed, and cabins), these activities have had little or no effect on the natural appearance of the area. There was an oil-drilling rig that was transported across an existing road near Katalla in the late 1980s. Drilling for oil and gas has been taking place since the turn of the century. Most of the area appears unmodified.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. The highly invasive aquatic plant *Elodea* spp. has been found in a number of locations in the area including Martin and Bering lakes. Other than *Elodea* spp., non-native plants are rare in the area.

Fish Resource

All five species of Pacific salmon as well as Dolly Varden and cutthroat trout are present in this area of diverse habitats. In addition, anadromous runs of rainbow trout (steelhead) are present; perhaps the only substantial occurrence of the anadromous form of this species within the Chugach National Forest. Although glaciers dominate the watersheds, there are several unique systems that are substantial producers of coho and sockeye salmon, which are in part groundwater fed by glacier meltwater that percolates through the gravels of wide valley floors. The character of this area was substantially changed as a result of the land uplift associated with the 1964 earthquake; however, natural processes dominate the existing aquatic habitat. *Elodea* spp., an invasive aquatic plant, has recently been confirmed in this area and there is potential for its spread. Fishery impacts on these populations are thought to be at moderate levels. There are no hatchery salmon in this area other than sockeye salmon in transit to and from a large sockeye hatchery located 260 miles north in the upper Copper River watershed near Paxton. The fish resources in this area, although in transition as a result of the 1964 earthquake, have had little impact from humans and probably are in a “nearly natural” state.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference.

Wolverine, brown bear, moose, mountain goats, trumpeter swans, dusky Canada geese, and bald eagles make this a popular area for national forest visitors. Although these species are not “unusual” for this region, wildlife is abundant in this area. The barrier islands provide some unique habitats for wildlife not found in many other places. Off-highway vehicle use on the small barrier islands adjacent to the mainland likely has an impact on migratory birds, primarily during April and May. Bering Lake is a shallow and sheltered lake that supports habitat for hundreds of swans, geese, and ducks and provides sheltered areas for summer molting.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in this area is outstanding. The area is very large, has a high level of topographic screening and few permanent off-site intrusions. The distance from the perimeter to the core is about 15 miles. Exceptions to this are found in areas popular with summer motor vehicle use, mostly on the small barrier islands and a few areas near the Copper River Highway.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is high, with a high level of challenge for the recreation user, a diversity of recreation opportunities, and few or no developments in most of the area. Because of the remote nature of this area, however, access is primarily through power boats and airplanes instead of human-powered means. There are two public use cabins within the area. Although the Copper River Highway abuts a part of the western boundary, there are only a few primitive trails serving as access points from the road. With the Copper River Highway closed at mile 36, access is even more limited.

Recreation opportunity spectrum class:

- Primitive – 900,800 acres
- Semi-primitive non-motorized (winter motorized allowed) – 21,400 acres
- Semi-primitive motorized – 25,400 acres
- Roaded natural – 9,900 acres

Motor Vehicle Recreation

Motor vehicle use consists of watercraft, such as jet boats and airboats and motorboats, as well as float planes, which provide access into this area along waterways and lakes. Snowmachine use is allowed in most of the area from December 1 to April 30, snow permitting. About half of the area is also open to helicopter landings in the winter. From May 1 to November 30, almost all of the area is closed to motor vehicle use except for subsistence. Exceptions to this are on the small islands where motor vehicle use is allowed in non-vegetated areas only, and on Long Island in the center of the delta, where motor vehicle use is allowed. Mile 27 sand dunes are a popular destination for off-highway vehicle riders. Access to most of this area is by boat or floatplane.

Other Values

Ecological, Geological, or Scenic Features

The Copper River Delta is the largest contiguous coastal wetland system along the West Coast of North America (Powers et al. 2002). The Copper River Delta, including the barrier islands, provides an essential spring stopover area for millions of migrating shorebirds, including most of the world’s population of dunlins and western sandpipers (Bishop et al. 2000). It also provides essential fall migratory habitat for tule white-fronted geese and nesting habitat for nearly all dusky Canada geese, a species recommended for species of conservation concern in the Assessment (USDA 2014).

The Sitka Spruce Floodplain Old-Growth Plant Association, Barrier Islands, Uplifted Tidal Marsh, and Tidal Marshes and Mudflats biophysical settings are considered of conservation concern by the Alaska Natural Heritage Program and occur in the area (Boggs et al. 2014). The area features high ecological diversity including three provinces, three sections, and four subsections. Populations of the Alaska Region sensitive plant Unalaska mist-maid (*Romanzoffia unalaschcensis*) occur in the area.

Cultural and Historic Features of Value

There are 45 known cultural sites within the area. Vitus Bering made first landfall in Alaska at Kayak Island in 1741. In the early 1900s, prospects for oil development and a railroad from Katalla to the Kennicott Mine brought over 2,000 people to Katalla. Evidence of the old railroad, log cabins, oil wells, and the refinery are still abundant. Controversy over development in this area led to the dismissal of the first Chief of the Forest Service in 1916. Oil was produced from a small field until the late 1930s.

Features of Scientific or Educational Value

This area has exceptional scientific value as a laboratory to learn the transition response of a very large, productive wetland to a very large natural disturbance, the uplift from the 1964 earthquake. In addition, there are unique opportunities to study the impact of climate change on aquatic and riparian ecosystems.

Dusky Canada geese have been studied on the Copper River Delta for decades, and the research provides a history of a species that has endured despite massive habitat changes related to earthquakes and historic overhunting in the lower 48 states.

Manageability

Shape and Configuration of the Area

The national forest boundary forms the northern and eastern edge of the area. This boundary is not clearly delineated on the ground. The western edge is the buffer along the Copper River Highway and the eastern bank of the Copper River. The southern edge is the Gulf of Alaska. State land below mean high tide is not clearly defined on the ground. Native corporation selections along the western edge may make the western boundary difficult to locate on the ground. Native corporation land in the Carbon Mountains area on the eastern side of the unit is not clearly delineated on the ground. An easement was issued to CAC for access to their private lands.

Management of Adjacent Lands

The Wrangell-St. Elias National Park to the north is a wilderness area. East of the unit are the Sheridan Glacier, Copper River Wetlands, and Tasnuna River inventoried areas. The Copper River Highway separates the Bering Lake inventoried area from the Sheridan Glacier inventoried area.

Non-Federal Lands

There are 66,500 acres of private and State land in the area. Wilderness designation could affect access to these lands. In 1982, the Chugach Natives, Inc., an Alaska Native corporation that is now known as CAC, entered into a settlement agreement (the CNI Agreement) with the United States and the State of Alaska regarding its selection rights under the ANCSA. Under the CNI Agreement, CAC obtained certain limited rights to explore, develop and produce oil and gas in the Katalla area and a right of access across NFS lands to the Bering River coal field located on the Carbon Mountain tract of CAC lands. An easement was issued to CAC on March 9, 2000 for the route depicted as running generally from the Copper River Highway (Alaska Route 10) to the coal fields. This road is known as the Carbon Mountain Road. The acres encumbered by the access rights are not included in the inventoried area.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for rafting, camping, freshwater fishing, and big game hunting. There are also seismic and telemetry stations within the area.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization. In the portion of the area added by ANILCA, minerals are managed under ANILCA requirements (hardrock leasable), not under the 1872 Mining Law (locatable).

Federal or State Laws Affecting Availability as Wilderness

The Alaska National Interest Lands Conservation Act (ANILCA) 501(b) added a portion of this area to the Chugach National Forest in 1980 and directs that conservation of fish and wildlife and their habitat be the primary purpose of management in this entire inventoried area.

Rationale for Exclusion from Further Analysis

ANILCA 501(b) states that multiple use activities shall be permitted in a manner consistent with the conservation of fish and wildlife and their habitat. Some of these activities may be in conflict with managing the area as designated wilderness.

In addition, motor vehicle use consists of watercraft, such as jet boats and airboats and motorboats, as well as float planes, which provide access into this area along waterways and lakes. Snow machine use is allowed in most of the area from December 1 to April 30, snow permitting. About half of the area is also open to helicopters in the winter. From May 1 to November 30, almost all of the area is closed to motor vehicle use except for subsistence. This area has a recreation objective of primitive. A future analysis is needed which would examine winter travel management and allowance of motorized vehicles in this inventoried area including helicopter landings in winter months. Exceptions to this are on the small islands where motor vehicle use is allowed in non-vegetated areas only, and on Long Island in the center of the delta, where motor vehicle use is allowed. Mile 27 sand dunes are a popular destination for OHV riders. Access to most of this area is by boat or floatplane. Smaller portions of this inventoried area were not considered for wilderness recommendation due to the potential conflicts in activities allowed under ANILCA 501(b).

Tasnuna River Inventoried Area

Gross acres: 438,890
NFS acres: 342,920

Apparent Naturalness

Appearance and Developments

This area has a very high degree of natural integrity. Most long-term ecological processes are intact and operating. Most of the area appears unmodified.

Ecological Conditions and Composition of Plant and Animal Communities

Vegetation

The vegetation composition and structure of this area is primarily the result of natural processes. Non-native plants are rare in the area.

Fish Resource

Three Pacific Salmon species are found within the fish production waters that are within this area (Chinook, coho, and sockeye salmon). Dolly Varden char are also present. Glaciers dominate the watersheds in this area. The habitat is in a relatively natural state. Fishery impacts on these populations are thought to be at moderate levels. There are no hatchery salmon in this area other than perhaps sockeye salmon in transit to and from a large sockeye hatchery located 260 miles north in the upper Copper River watershed. Overall, the fish resources in this area have had little impact from humans and probably are in a “nearly natural” state.

Wildlife Resource

All native wildlife associated with the habitats in this roadless area are expected to be present in sustainable numbers, including the dominant predators (AKNHP 2013). None of the native terrestrial wildlife in this roadless area are proposed or listed in compliance with the ESA. Wildlife are expected to retain natural interactions with each other and their environment with minimal human interference.

Opportunities for Solitude or Primitive and Unconfined Recreation

Opportunity for Solitude

The opportunity for solitude in this area is outstanding. The area is very large and has a high level of topographic screening and no permanent off-site intrusions. The distance from the perimeter to the core is 12 to 14 miles. Access is extremely difficult. The only points of access, except by air, are along the rivers by watercraft, where easement sites and trails provide access to NFS lands.

Opportunity for Primitive Recreation

The opportunity for primitive recreation is moderate to high, with a high level of challenge for the recreation user and virtually no developments in the area. The entire area is inventoried in the primitive recreation class. Access, however, is often by motor vehicles. There are no recreation cabins or established trails within the unit.

Motor Vehicle Recreation

The area is open to motor vehicle access from December 1 to April 30, depending on snow conditions. Helicopter-assisted skiing is permitted in a portion of the area. From May 1 to November 30, helicopter landings are allowed but not off-highway vehicles. Aerial observations and discussions with residents of Valdez suggest that snowmachine use is common in this area.

Other Values

Ecological, Geological, or Scenic Features

Outstanding icefields, glaciers, and rugged peaks cover much of this area. Mountain goats, a species of high public interest, can be observed in this inventoried area.

Cultural and Historic Features of Value

There are five known cultural sites within the area.

Features of Scientific or Educational Value

A research natural area was proposed in the 1984 forest plan at the Schwan Glacier terminus to represent a thinning and retreating alpine glacier but was not designated.

Manageability

Shape and Configuration of the Area

The national forest boundary forms three sides of the area. The watershed divide to the Sheridan Glacier forms the southern edge. Private land along the Copper and Tasnuna rivers are not well delineated and are difficult to identify on the ground. The northern most portion of the unit is separated from the southern part by private land along the Wernicke River.

Management of Adjacent Lands

The unit is surrounded by undeveloped Federal and private lands. A wilderness area within Wrangell-St. Elias National Park is to the northeast of the unit. The Bering Lake inventoried area is to the east and the Sheridan Glacier inventoried area is to the south.

Non-Federal Lands

There are 96,320 acres of private and State land in the area. Most of the State and Alaska Native Corporation selections occur along the major river drainages, where access is predominantly by boat.

Legally Established Rights or Uses

Land Use Authorizations

Special use authorizations in the area include outfitter and guide permits for big game hunting, tour skiing, heli-skiing, and camping. The area is being analyzed for additional winter recreation activities.

Minerals

There is low or no mineral activity in this area and no mining claims. The Forest Service currently has no plans of operations for mining activities, but mining activities may be occurring that do not require authorization. In the portion of the area added to the Chugach National Forest by ANILCA, minerals are managed under ANILCA requirements (hardrock leasable), not under the 1872 Mining Law (locatable).

Federal or State Laws Affecting Availability as Wilderness

The Alaska National Interest Lands Conservation Act (ANILCA) 501(b) added this area to the Chugach National Forest in 1980 and directs that conservation of fish and wildlife and their habitat be the primary purpose of management.

Rationale for Exclusion from Further Analysis

ANILCA 501(b) states that multiple use activities shall be permitted in a manner consistent with the conservation of fish and wildlife and their habitat. Some of these activities may be in conflict with managing the area as designated wilderness.

In addition, the area is open to motor vehicle access from December 1 to April 30, depending on snow conditions. Helicopter-assisted skiing is permitted in a portion of the area. From May 1 to November 30, helicopter landings are allowed but not off-highway vehicles. Aerial observations and discussions with residents of Valdez suggest that snow machine use is common in this area.

Appendix B. Relevant Agreements and Memoranda of Understanding

This appendix contains a list of relevant agreements and memoranda of understanding applicable to the USDA Forest Service.

Title	Effective Date	Expiration	Agency/Organization	Purpose
Chickaloon Flats Management Agreement	4/26/1972	Terminates only after one year written notice	USDA Forest Service, USDI Bureau of Sport Fisheries, Alaska Department of Fish and Game, Alaska Department of Natural Resources	The Chickaloon Flats are recognized by the agreement participants as valuable waterfowl habitat and a prime recreational hunting area.
Bering River – Controller Bay Trumpeter Swan Management Area Cooperative Agreement	10/19/1976	Continue in force until terminated in writing	USDA Forest Service Region 10, USDI Fish and Wildlife Service Alaska Region, Alaska Department of Fish and Game, Alaska Department of Natural Resources	Describes the responsibilities of each agency in their cooperative program to protect and manage bald eagles and their habitat on NFS lands in Alaska.
Programmatic Agreement Regarding Heritage Program Management on National Forests in the State of Alaska	7/10/2017	Remains in effect for a period five years, unless amended	USDA Forest Service Alaska Region, The Advisory Council on Historic Preservation, The Alaska State Historic Preservation Officer	Undertakings by the Forest Service Alaska Region shall be implemented in accordance with the following stipulations in order to take into account their effects on historic properties.
Memorandum of understanding with the U.S. Federal Aviation Administration	3/26/1964	Upon receipt of written notice from the Federal Aviation Administration stating lands are no longer needed.	USDA Forest Service, Federal Aviation Administration	Grant permission to the Federal Aviation Administration to construct and maintain facilities and related structures on a tract of land containing 466 acres, more or less, located near U.S. Coast and Geodetic Survey Station Pt. Johnstone situated on the northwest part of Hinchinbrook Island on the Chugach National Forest.
Memorandum of understanding: Cooperation with Fish and Wildlife Service	1/23/1983	Continue in force until terminated	USDA Forest Service Region 10, USDI Fish and Wildlife Service Alaska Region	Describes the responsibilities of each agency in their cooperative program to protect and manage bald eagles and their habitat on National Forest lands in Alaska.

Title	Effective Date	Expiration	Agency/Organization	Purpose
Memorandum of understanding: for Cooperative Management of the Copper River Delta Fish and Wildlife Management Area	10/23/1986	Continue in force until terminated in writing	USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, State of Alaska Department of Fish and Game, State of Alaska Department of Natural Resources	It is the mutual desire of the Forest Service, Fish and Wildlife Service, Bureau of Land Management, Alaska Department of Fish and Game, and Alaska Department of Natural Resources, to cooperate in protecting, developing, maintaining and managing the diverse fish and wildlife and their habitat in the Copper River Delta Fish and Wildlife Management Area for the best interest of the public of Alaska and the United States of America.
Memorandum of understanding: Cooperators in the conservation of species that are tending toward federal listing as threatened or endangered	1/25/1994	9/30/1999	USDA Forest Service, USDI Fish and Wildlife Service, USDI National Park Service, National Marine Fisheries Service, United States Department of Commerce	Cooperation and participation among the cooperators in the conservation of species that are tending toward federal listing.
Memorandum of understanding: Supplemental Memorandum of Understanding No. 1	3/16/1998	3/15/2004	USDA Forest Service Alaska Region, Alaska Department of Fish and Game	Supplement to the Master Memorandum no. 98RMU-10-010.
Memorandum of understanding: Regarding the Appropriation and Transfer of NFS Lands for Highway Purposes and Federal Land Transfers	8/20/1998, modification (5/12/2003)	Remains in effect unless terminated	USDA Forest Service, USDOT Federal Highway Administration	Provide procedures by which the Secretary of Transportation, acting through Federal Highway Administration may appropriate and transfer, to States, NFS lands for highway rights-of-way.
Memorandum of understanding: Coastal Zone Management Act/Alaska Coastal Management Program Consistency Reviews	3/2/2000	Not applicable	USDA Forest Service Alaska Region, State of Alaska	Improve cooperation, coordination, and communication between the Alaska Division of Governmental Coordination and the Alaska Region of the USDA Forest Service.

Title	Effective Date	Expiration	Agency/Organization	Purpose
Memorandum of understanding: The Nature Conservancy	11/16/2001	Termination requires 60 days written notice	USDA Forest Service, The Nature Conservancy	A framework for cooperation and coordination between The Nature Conservancy and Forest Service in achievement of mutual goals, especially needed in the area of threatened, endangered and imperiled plant and animal species, and threatened ecosystems.
Memorandum of understanding: Service-wide between USDA Forest Service and Mule Deer Foundation	3/12/2002	12/31/2007	USDA Forest Service, Mule Deer Foundation	Establish a framework for cooperation and coordination between Forest Service and Mule Deer Foundation.
Memorandum of understanding: Kenai Peninsula Interagency Brown Bear Study Team Support Agreement	4/25/2003	Five years unless renewed	USDA Forest Service, Chugach National Forest, USDI Fish and Wildlife Service Kenai National Wildlife Refuge, USDI National Park Service Kenai Fjords National Park, Alaska Department of Fish and Game	Provide necessary coordination required between the four agencies responsible for brown bear population and habitat management on the Kenai Peninsula. The four agencies involved have formed an interagency study team.
Memorandum of understanding: Sportsmen's Access to Federal Public Lands	9/24/2003	Five years from date of execution	USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, and 17 private organizations	Establish a framework for cooperation between the agencies, private organizations, their local offices, chapters, and affiliated organizations to cooperatively work towards achieving improved access to federally managed public land units for hunters and anglers.
Master memorandum of understanding with Bat Conservation International Inc.	4/27/2004	9/30/2007	USDA Forest Service, Bat Conservation International Inc.	Provide a framework for cooperation and coordination between Bat Conservation International and Forest Service in achievement of the mutual goals. The framework is especially needed for restoration and conservation of threatened, endangered and sensitive bat species.

Title	Effective Date	Expiration	Agency/Organization	Purpose
Memorandum of understanding for wildlife damage management activities on NFS lands	6/4/2004	Review for renewal 1 June 2014	USDA Forest Service Alaska Region, State of Alaska Department of Fish and Game	Identify responsibilities of the Parties and foster a partnership in discharging the Federal obligation under the Animal Damage Control Act of March 2, 1931.
Master memorandum of understanding with State of Alaska Department of Fish and Game	6/9/2004	Review for renewal 1 June 2014	USDA Forest Service Alaska Region, State of Alaska Department of Fish and Game	Replaces the expired master memorandum of understanding (98RMU-1-010) signed March 16, 1998. Establishes a framework that recognizes the responsibilities for both agencies to cooperate in the common stewardship of fish, wildlife and their habitats on NFS lands.
Memorandum of understanding related to Alaska Natural Gas Transportation Projects	5/9/2006	Remains in effect until one year after construction of an Alaska Natural Gas Transportation Project is completed	Departments of: Agriculture, Commerce, Defense, Energy, Homeland Security, Interior, Labor, State, Transportation, and Treasury; Advisory Council on Historic Preservation; Council on Environmental Equality; Environmental Protection Agency; Federal Energy Regulatory Commission; Office of the Federal Coordinator for Alaska Natural Gas Transportation Projects	Executive Order 13212 directs Federal agencies to expedite their review of permits for energy-related projects and to take other action necessary to accelerate the completion of such projects, while protecting public health, safety, and the environment.
Service-wide Memorandum of understanding with the Association of American State Geologists	8/28/2006	Remains in effect for five years, unless amended	USDA Forest Service, Association of American State Geologists	Provide a framework for cooperation to foster communication, cooperation, and coordination between the Association of American State Geologists and the Forest Service; to share geologic information; and to promote and share geologic research and development of geologic maps and databases.
Memorandum of understanding: Snow Survey and Water Supply Forecasting Program Activities	11/20/2007	Remains in effect for five years, unless amended	USDA Forest Service, Natural Resources Conservation Service	Promote effective coordination and cooperation in the measurement and monitoring of snowpack and climate conditions in mountain watersheds.

Title	Effective Date	Expiration	Agency/Organization	Purpose
Memorandum of understanding to Promote the Conservation of Migratory Birds	12/8/2008	Remains in effect for five years, unless amended	USDA Forest Service, USDI Fish and Wildlife Service	Pursuant to Executive Order 13186, 66Fed. Reg. 3853 (2001), the purpose of this memorandum of understanding is to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds.
Master Memorandum of Understanding and joint meeting notes	12/8/2009	6/1/2014	USDA Forest Service, State of Alaska Department of Fish and Game	Includes a copy of meeting notes and the master memorandum of understanding, which establishes a framework for both agencies to work in harmony for the common purpose of maintaining, developing and managing the fish and wildlife populations and their habitats on NFS lands.
Memorandum of understanding: Addendum to Promote the Conservation of Migratory Birds	6/20/2014	12/8/2015	USDA Forest Service, USDI Fish and Wildlife Service	Extends the memorandum of understanding between the Forest Service and Fish and Wildlife Service to promote the conservation of migratory birds through 8 December 2015. States: Upon signature of a revised memorandum of understanding, the current memorandum will no longer be valid.
Memorandum of understanding: Sqilantnu Archeological District	12/22/2015	No expiration. Modifications made in writing 30 days prior to implementation	USDA Forest Service Chugach National Forest, USDI Fish and Wildlife Service, Cook Inlet Region, Inc. (CIRI), The Kenaitze Indian Tribe	Ensure cooperation and consultation among the Parties on all significant activities related to the Sqilantnu Archeological District.

Title	Effective Date	Expiration	Agency/Organization	Purpose
Memorandum of understanding: Waiver of fees	12/13/2016	6/30/2026 unless extended	USDA Forest Service Alaska Region; State of Alaska Departments of: Administration, Fish and Game, Natural Resources, and Transportation and Public Facilities	Document the cooperation between the parties to further their missions by establishing a reciprocal relationship to waive collection of fees that the Forest Service could charge the State Agencies, and which the State Agencies could charge the Forest Service, for land use occupancy leases and associated rental fees. Where feasible co-locate electronic communication equipment between the Forest Service and the Department of Administration.
How to interpret the Alaska Coastal Management Program/Coastal Zone Management Act Memorandum of Understanding	2/1/2009	Not applicable	USDA Forest Service employees	Guidance for Forest Service personnel who work on NEPA and Coastal Zone Management Act reviews and need to know which parts of the memorandum of understanding still apply as written.
Expectations Regarding State of Alaska Administrative Activities in National Forest Wilderness	12/3/2009	Not applicable	USDA Forest Service Alaska Region, State of Alaska	Defines the process for considering State of Alaska administrative activities in wilderness activities areas.

Glossary

A

active management: Planned, intentional actions in an area that are specifically designed to obtain a desired objective or result.

activity: A measure, course of action, or treatment that is undertaken to directly or indirectly produce, enhance, or maintain a desired resource management condition or objective.

adaptive management: Adaptive management is the general framework encompassing the three phases of planning: assessment, plan development, and monitoring (36 CFR 219.5). This framework supports decision-making that meets management objectives while simultaneously accruing information to improve future management by adjusting the plan or plan implementation. Adaptive management is a structured, cyclical process for planning and decision-making in the face of uncertainty and changing conditions with feedback from monitoring, which includes using the planning process to actively test assumptions, track relevant conditions over time, and measure management effectiveness.

administrative site: Areas such as work centers, fire lookouts, permitted ranch headquarters, seed orchards, communication sites, utility corridors, developed campgrounds, and other areas that are occupied or used by the Forest Service during the administration of work associated with national forest lands.

administrative unit: All the Chugach NFS lands where one forest supervisor has responsibility. The basic geographic management area within a Forest Service Region, station, or area.

adverse effect: An action that has an apparent direct or indirect adverse effect on the conservation and recovery of a species listed as threatened or endangered. Such actions include, but are not limited to:

- Any action that directly alters, modifies, or destroys critical or essential habitats or renders occupied habitat unsuitable for use by a listed species, or that otherwise affects its productivity, survival, or mortality.
- Any action that directly results in the taking of a listed species. See Title 50 Code of Federal Regulations, Section 17.3 for an explanation of what constitutes a taking.
- Any action involving the disposal of land that is essential to achieving recovery objectives.

air quality: The composition of air with respect to quantities of pollution therein, used most frequently in connection with standards of maximum acceptable pollutant concentrations.

Alaska Native Corporation: One of the regional, urban, and village native corporations formed under the Alaska Native Claims Settlement Act of 1971 (36 CFR 219.19).

alternative: In forest planning, a mix of resource outputs designed to achieve a desired management emphasis as expressed in goals and objectives, and in response to public issues or management concerns.

amendment: A formal alteration of the Forest Plan by modification, addition, or deletion. Forest Plan amendment requires an environmental analysis. Significant findings require an environmental impact statement and the amendment will follow the same procedure used for plan preparation. Insignificant findings allow the changes to be implemented following public notification. Amendments can take place at any time following plan approval.

anadromous fish: Fish that hatch in fresh water, migrate to the ocean, mature there, and return to fresh water to reproduce; for example, salmon and steelhead.

aquatic: Pertaining to water.

aquatic ecosystem: Waters that serve as habitat for interrelated and interacting communities and populations of plants and animals. The stream channel, lake or estuary bed, water, biotic communities and the habitat features that occur therein.

aquatic habitat types: The classification of instream habitat based on location within channel, patterns of water flow, and nature of flow controlling structures. Habitat is classified into a number of types according to location within the channel, patterns of water flow, and nature of flow controlling structure. Riffles are divided into three habitat types: low gradient riffles, rapids, and cascades. Pools are divided into seven types: secondary channel pools, backward pools, trench pools, plunge pools, lateral scour pools, dammed pools, and beaver ponds. Glides, the third habitat type, are intermediate in many characteristics between riffles and pools. It is recognized that as aquatic habitat types occur in various parts of the country, additional habitat types may have to be described. If necessary, the regional fishery biologist will describe and define the additional habitat types.

assessment: For the purposes of the land management planning regulation at 36 CFR part 219, an assessment is the identification and evaluation of existing information to support land management planning. Assessments are not decision-making documents, but provide current information on select topics relevant to the plan area, in the context of the broader landscape (36 CFR 219.19).

at-risk species: A term used in land management planning to refer to, collectively, the federally recognized threatened, endangered, proposed, and candidate species and species of conservation concern within a plan area.

authorized activity: Any activity specifically authorized by the forest service under a permit, contract, or agreement which is conducted by federal or state agencies, organizations or individuals other than the Chugach National Forest.

authorized use: Specific activity or occupancy, including a ski area, historical marker, or oil and gas lease, for which a special authorization is issued.

B

background: The area after the middleground in a picture or landscape; generally over 4 miles distance from the viewer.

basin (river): In general, the area of land that drains water, sediment, and dissolved materials to a common point along a stream channel. River basins are composed of large river systems.

beneficial uses: Any of the various uses which may be made of the water, including, but not limited to, domestic water supplies, fisheries and other aquatic life, industrial water supplies, agricultural water supplies, navigation, recreation in and on the water, wildlife habitat, and aesthetics.

best management practices (BMPs): Practice or set of practices that enable a planned activity to occur while still protecting the resource managed, normally implemented, and applied during the activity rather than after the activity.

best management practices for water quality (BMPs): Methods, measures, or practices selected by an agency to meet its nonpoint source control needs. BMPs include but are not limited to structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters (36 CFR 219.19).

biophysical: The combination or grouping of biological and physical components in an ecosystem.

boreal: Pertaining to cool or cold temperature regions of the northern hemisphere; the northern coniferous zone.

browse: That part of leaf and twig growth of shrubs, woody vines, and trees available for animal consumption.

Bureau of Land Management (BLM): An agency within the U.S. Department of the Interior with land management responsibility for public domain lands.

C

capability: The potential of an area of land to produce resources, supply goods and services, and allow resource uses under an assumed set of management practices and at a given level of management intensity. Capability depends upon current conditions and site conditions such as climate, slope, landform, soils, and geology, as well as the application of management practices, such as silviculture or protection from fire, insects, and disease.

channel (stream): The deepest part of a stream or riverbed through which the main current of water flows.

channel morphology: The dimension (width, depth), shape and pattern (sinuous, meandering, straight) of a stream channel.

Classification: Identification of the class (wild, scenic, or recreational) that appropriately describes an eligible river or river segment, based on the criteria established in section 2(b) of the Wild and Scenic Rivers Act.

Clean Air Act of 1970: A congressional act, along with the amendments passed in 1977 and 1990 that provides authority for the Environmental Protection Agency to develop specific regulations controlling air pollution.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the Federal Register (FR) by the executive departments and agencies of the federal government.

collaboration or collaborative process: A structured manner in which a collection of people, with diverse interests share knowledge, ideas, and resources, while working together in an inclusive and cooperative manner toward a common purpose. Collaboration, in the context of land management planning, falls within the full spectrum of public engagement described in the Council on Environmental Quality's publication of October, 2007: Collaboration in NEPA—A Handbook for NEPA Practitioners (36 CFR 219.19).

compaction: Making soil hard and dense and decreasing its ability to support vegetation because the soil can hold less water and air and because roots have trouble penetrating the soil.

compatible: Capable of existing together in harmony.

connectivity: Ecological conditions that exist at several spatial and temporal scales that provide landscape linkages that permit the exchange of flow, sediments, and nutrients; the daily and seasonal movements of animals within home ranges; the dispersal and genetic interchange between populations; and the long distance range shifts of species, such as in response to climate change (36 CFR 219.19).

conservation: The protection, preservation, management, or restoration of natural environments, ecological communities, and species (36 CFR 219.19).

conserve: For the purpose of meeting the requirements of 36 CFR 219.9, to protect, preserve, manage, or restore natural environments and ecological communities to potentially avoid federally listing of proposed and candidate species (36 CFR 219.19).

constraint: A restriction or limit that must be met.

corridor: A tract of land forming a passageway. Can refer to areas of wildlife movement, boundaries along rivers, or the present or future location of transportation or utility rights-of-way within its boundaries.

cover: (1) Trees, shrubs, rocks, or other landscape features that allow an animal to conceal itself partly or fully for protection from predators, or to ameliorate conditions of weather, or in which to reproduce; (2) the area of ground covered by plants of one or more species.

cover type: A vegetation classification depicting a genus, species, group of species, or life form of tree, shrub, grass, or sedge of an area.

culture: The ideals, values, and beliefs that members of a society share to interpret experience and generate behavior that is reflected by their work and thought (Haviland 1999).

cultural resources: An object or definite location of human activity, occupation, or use identifiable through field survey, historical documentation, or oral evidence. Cultural resources are prehistoric, historic, archaeological, or architectural sites, structures, places, or objects and traditional cultural properties. Cultural resources include the entire spectrum of resources for which the Heritage Program is responsible, from artifacts to cultural landscapes, without regard to eligibility for listing on the National Register of Historic Places.

cumulative impacts: Cumulative impacts or effects are the impacts on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. Effects and impact are synonymous (40 CFR 1508.7).

D

decommission (building): Demolition, dismantling, removal, obliteration and/or disposal of a deteriorated or otherwise unneeded asset or component, including necessary cleanup work. This action eliminates the deferred maintenance needs for the fixed asset. Portions of an asset or component may remain if they do not cause problems nor require maintenance.

decommission (road): Permanently closing a road to vehicular use and left in a hydrological maintenance free condition. Decommissioning will include activities, such as water barring, out sloping, recontouring, decompaction of road surface, removal of drainage structures, and road barricades, as needed.

deferred maintenance: Maintenance that was not performed when it should have been or when it was scheduled and that, therefore, was put off or delayed for a future period. When allowed to accumulate without limits or consideration of useful life, deferred maintenance leads to deterioration of performance, increased costs to repair, and decreased asset value. Deferred maintenance needs may be categorized as critical or noncritical at any point in time. Continued deferral of noncritical maintenance will normally result in an increase in critical deferred maintenance. Code compliance (such as safety, ADA, OSHA, or environmental), plan direction, best management practices, biological evaluations, other regulatory or executive order compliance requirements, or applicable standards not met on schedule are considered deferred maintenance.

departure: The difference between an existing condition and the desired condition.

designated area: An area or feature identified and managed to maintain its unique special character or purpose. Some categories of designated areas may be designated only by statute and some categories may be established administratively in the land management planning process or by other administrative processes of the Federal executive branch. Examples of statutorily designated areas are national heritage areas, national recreational areas, national scenic trails, wild and scenic rivers, wilderness areas, and wilderness study areas. Examples of administratively designated areas are experimental forests, research natural areas, scenic byways, botanical areas, and significant caves (36 CFR 219.19).

designated right-of-way (ROW) corridor: A parcel of land with specific boundaries identified by law, Secretarial order, the land use planning process, or by some other management decision as being a preferred location for existing and future ROW facilities. The corridor may be suitable to accommodate more than one type of ROW use or facility or one or more ROW uses or facilities that are similar, identical, or compatible. A designated corridor may already be occupied by existing utility facilities. It has been adequately analyzed to provide for a high degree of assurance that in being identified as a “designated corridor,” it can accommodate at least one new additional utility facility.

designed use: The managed use of a trail that requires the most demanding design, construction, and maintenance parameters and that determines which design, construction, and maintenance parameters will apply to a trail.

desirable non-native species: A non-native species that the Chugach National Forest considers beneficial for meeting specific resource management goals or objectives.

desired conditions: For the purposes of the land management planning regulation at 36 CFR part 219, a description of specific social, economic, and/or ecological characteristics of the plan area, or a portion of the plan area, toward which management of the land and resources should be directed. Desired conditions must be described in terms that are specific enough to allow progress toward their achievement to be determined, but do not include completion dates (36 CFR 219.7(e)(1)(i)). Desired conditions are achievable, and may reflect social, economic, or ecological attributes, including ecosystem processes and functions.

developed recreation: Recreation that requires facilities that in turn result in concentrated use of an area; for example, a campground. Examples of developed recreation areas are campgrounds and ski areas; facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, ski lifts, and buildings.

developed site: Facility provided for developed recreation use. See facilities.

development level: An indication of site modification based on classes in the Recreation Opportunity Spectrum. Development Level 1 equates to Primitive, with minimum site modification; 2 equates to Semi-Primitive Motorized/Nonmotorized, with little site modification; 3 equates to Roaded, with moderate modification; 4 equates to Rural, with heavy site modification; and 5 relates to Urban, with a high degree of site modification.

diameter at breast height (DBH): A tree's diameter measured at about 4.5 feet (1.37m) above the forest floor on the uphill side of the tree. For the purposes of determining breast height, the forest floor includes the duff layer that may be present, but does not include unincorporated woody debris that may rise above the ground line.

disease: A harmful deviation from normal functioning of physiological processes, usually pathogenic or abiotic in origin.

dispersed (recreation): Recreation that does not occur in a developed recreation site; for example, hunting or backpacking.

dispersed campsites: Primitive sites typically used for overnight, dispersed recreation. Usually includes a hardened area around a fire pit, a barren area, and/or user-constructed facility.

displacement: Recreation visits are considered "displaced" or no longer consumed at a site or area when practical maximum capacity thresholds of the site or area are exceeded. Visitors are assumed to completely leave the national forest rather than seek an alternative location for their activity.

disturbance: Any relatively discrete event in time that disrupts ecosystem, watershed, community, or species population structure and/or function and changes resources, substrate availability, or the physical environment (36 CFR 219.19).

disturbance regime: A description of the characteristic types of disturbance on a given landscape; the frequency, severity, and size distribution of these characteristic disturbance types; and their interactions (36 CFR 219.19).

diversity: The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan (36 CFR 219.16).

drainage: The natural or artificial removal of surface and sub-surface water from an area.

E

ecological conditions: The biological and physical environment that can affect the diversity of plant and animal communities, the persistence of native species, and the productive capacity of ecological systems. Ecological conditions include habitat and other influences on species and the environment. Examples of ecological conditions include the abundance and distribution of aquatic and terrestrial habitats, connectivity, roads and other structural developments, human uses, and invasive species (36 CFR 219.19).

ecological function: Refer to ecological processes.

ecological integrity: The quality or condition of an ecosystem when its dominant ecological characteristics (for example, composition, structure, function, connectivity, and species composition and diversity) occur within the natural range of variation and can withstand and recover from most perturbations imposed by natural environmental dynamics or human influence (36 CFR 219.19).

ecological processes: The flow and cycling of energy, materials, and organisms in an ecosystem. Examples of ecosystem processes include the carbon and hydrologic cycles, terrestrial and aquatic food webs, and plant succession, among others.

ecological status: The degree of departure of current vegetation from the potential natural vegetation, or potential natural community. Often synonymous with seral stage.

economics: A social science concerned primarily with description, distribution, and consumption of goods and services.

economic well-being: A condition that enables people to work, provide income for their families, and generate economic wealth to local communities, the region, and the nation.

economy: System of production, distribution, and consumption of economic goods.

ecosystem: A spatially explicit, relatively homogeneous unit of the Earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its:

- **composition:** The biological elements within the different levels of biological organization, from genes and species to communities and ecosystems

- **structure:** The organization and physical arrangement of biological elements such as, snags and down woody debris, vertical and horizontal distribution of vegetation, stream habitat complexity, landscape pattern, and connectivity
- **function:** Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire, and floods
- **connectivity:** (see connectivity) (36 CFR 219.19)

ecosystem diversity: The variety and relative extent of ecosystems (36 CFR 219.19).

ecosystem function (processes): Ecological processes that sustain composition and structure, such as energy flow, nutrient cycling and retention, soil development and retention, predation and herbivory, and natural disturbances such as wind, fire, and floods.

ecosystem management: The use of an ecological approach to achieve multiple-use management of public lands by blending the needs of people and environmental values in such a way that lands represent diverse, healthy, productive, and sustainable ecosystems.

ecosystem services: Benefits people obtain from ecosystems, including:

- Provisioning services, such as clean air and fresh water, energy, food, fuel, forage, wood products or fiber, and minerals;
- Regulating services, such as long term storage of carbon; climate regulation; water filtration, purification, and storage; soil stabilization; flood and drought control; and disease regulation;
- Supporting services, such as pollination, seed dispersal, soil formation, and nutrient cycling; and
- Cultural services, such as educational, aesthetic, spiritual, and cultural heritage values, recreational experiences, and tourism opportunities.

ecosystem sustainability: The ability to sustain diversity, productivity, resilience to stress, health, renewability and/or yield of desired values, resource uses, products, or services from an ecosystem, while maintaining the integrity of the ecosystem over time.

edge: An area where plant communities meet or where successional stages or vegetation conditions within the plant communities come together.

effects: Environmental changes resulting from an action. Included are direct effects, which are caused by the action and occur at the same time and place, and indirect effects, which are caused by the action and are later in time or further removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic quality, historic, cultural, economic, social, or healthy effects, whether direct, indirect, or cumulative. Effects may also include those resulting from actions that may have both beneficial and detrimental effects even if on balance the agency believes that the effects will be beneficial (40 CFR 1508.8, 2).

electronic communication sites: Areas designated for the operation of equipment which transmits and receives radio signals.

endangered species: Any species that the Secretary of the Interior or the Secretary of Commerce has determined is in danger of extinction throughout all or a significant portion of its range. Endangered species are listed at 50 CFR sections 17.11, 17.12, and 224.101.

Endangered Species Act of 1973: An act that enables endangered and threatened species to be conserved. It provides a program for the conservation of such species, and takes appropriate steps to achieve the purposes of the (relevant) treaties and conventions.

Environment: All the conditions, circumstances, and influences surrounding and affecting the development of an organism, or group of organisms.

environmental impact: Used interchangeably with environmental consequence or effect.

environmental impact statement (EIS): Adetailed written statement as required by section 102(2)(C) of the National Environmental Policy Act (NEPA) of 1969 (40 CFR 1508.11; 36 CFR 220). (36 CFR 219.62)

erosion: The wearing away of the land surface by the action of wind, water, or gravity.

evaluation: An essential companion activity to monitoring; the tool for translating data gathered by monitoring into useful information that could result in change or adaptive management.

F

facility: A single or contiguous group of improvements that exists to shelter or to support Forest Service programs. The term may be used in either a broad or narrow context; for example, a facility may be a ranger station compound, lookout tower, leased office, work center, separate housing area, visitor center, research laboratory, recreation complex, utility system, or telecommunications site.

facilities maintenance: Work performed to maintain serviceability or repair failures.

facilities maintenance (deferred): Work that was not performed when it should have been or when it was scheduled and has been delayed to a future period. Deferred maintenance includes actions not taken to comply with codes for health and safety, accessibility, environmental factors and other compliance requirements or applicable standards. To reduce or eliminate deferred maintenance, rehabilitation or replacement may be necessary.

- **rehabilitation:** Renovation or restoration of an existing fixed asset or any of its components in order to restore the functionality or life of the asset. Because there is no significant expansion or change of purpose for the fixed asset, the work primarily addresses deferred maintenance.
- **replacement:** Substitution or exchange of an existing fixed asset or component with one having essentially the same capacity and purpose.
- **custodial:** Replacement of nonfunctional site elements or facilities with in–kind materials or structures. Location, design, and configuration remain constant. Accessibility standards, where possible, are compatible with designated ROS settings.
- **decommission:** Demolition, dismantling, removal, obliteration, and/or disposal of a deteriorated or otherwise unneeded asset or component, including necessary cleanup work. This action eliminates the deferred maintenance needs for the fixed asset. Portions of an asset or component may remain if they do not cause problems nor require maintenance.

federally listed species: Species that are listed in compliance with the Endangered Species Act.

fire management plan: A plan that identifies and integrates all wildland fire management and related activities within the context of approved land/resource management plans. It defines a program to manage wildland fires (wildfire, prescribed fire, and wildland fire use). The plan is supplemented by operational plans, including but limited to preparedness plans, preplanned dispatch plans, and prevention plans. Fire management plans assure that wildland fire management goals and components are coordinated.

fire suppression: All work and activities connected with fire-extinguishing operation, beginning with discovery and continuing until the fire is completely extinguished.

focal species: A small subset of species whose status permits inference to the integrity of the larger ecological system to which it belongs and provides meaningful information regarding the effectiveness of the plan in maintaining or restoring the ecological conditions to maintain the diversity of plant and animal communities in the plan area. Focal species would be commonly selected on the basis of their functional role in ecosystems (36 CFR 219.19).

forage: All browse and herbaceous foods that are available to grazing animals. It may be grazed or harvested for feeding.

forb: Broad-leafed, herbaceous, nongrass-like plant species other than true grasses, sedges, and non–woody plants; fleshy leafed plants; having little or no woody material.

forest: An area managed for the production of timber and other forest products, or maintained under woody vegetation for indirect benefits as protection of a watershed, recreation, or wildlife habitat.

Forest and Rangeland Renewable Resources Planning Act of 1974: An act of Congress requiring the preparation of a program for the management of the national forests' renewable resources, and of land and resource management plans for units of the NFS. It also requires a continuing inventory of all NFS lands and renewable resources.

forest health: The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects and disease and resilience to disturbance.

forest land: Land at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest uses. Lands developed for non-forest use include areas for crops, improved pasture, residential or administrative areas, improved roads of any width and adjoining road clearing, and power line clearings of any width (36 CFR 219.19).

forest products: Special forest products include, but are not limited to, mushrooms, boughs, Christmas trees, bark, ferns (also known as fiddleheads), moss, burls, berries, cones, conks, herbs, roots, and wildflower. More traditional woody materials, such as shrub cuttings, fire wood, seedlings, transplants, and rooted saplings, are also considered special forest products. Forest botanicals products, a subset of forest products, include a wide variety of herbaceous plants and plant parts (36 CFR 223.216; 36 CFR 223.277).

Forest Service Handbook (FSH): Directives that provide detailed instructions on how to proceed with a specialized phase of a program or activity.

Forest Service Manual (FSM): A system of manuals that provides direction for Forest Service activities.

forest trail: A trail wholly or partly within or adjacent to and serving the NFS that the Forest Service determines is necessary for the protection, administration, and utilization of the NFS and the use and development of its resources (36 CFR 212.1).

fragmentation (habitat): The break-up of a large continuous land area by reducing and dividing into smaller patches isolated by areas converted to a different land type. Habitat can be fragmented by natural events or development activities.

free-flowing: A river or stream that exists or flows in natural condition without impoundment, diversion, straightening, rip-rapping, or other modification of the waterway (16 U.S.C. §1286).

fuel: Plants, both living and dead, and woody vegetative materials capable of burning.

fuel break: Any natural or constructed barrier used to segregate, stop, and control the spread of fire, or to provide a control line from which to work.

G

game species: Any species of wildlife or fish for which seasons and bag limits have been prescribed, and which are normally harvested by hunters, trappers, and fishermen under state or federal laws, codes, and regulations.

geographic area: A spatially contiguous land area identified within the planning area. A geographic area may overlap with a management area (36 CFR 219.19).

geographic information system (GIS): An information processing technology to input, store, manipulate, analyze, and display data; a system of computer maps with corresponding site-specific information that can be combined electronically to provide reports and maps.

geologic: Based on geology, the study of the structure, processes, and chronology of the earth.

geologic features: Landforms or other features of significant geologic interest that may require special management to protect the special qualities, or provide interpretation to the public.

Goals: An optional plan component that are broad statements of intent, other than desired conditions, usually related to process or interaction with the public. Goals are expressed in broad, general terms, but do not include completion dates (36 CFR part 219.7(e)(2)).

goods and services: The various outputs, including on-site uses, produced from forest and rangeland resources.

groundwater: Water in a saturated zone in a geologic stratum. Water stored below the water table where the soil (or other geologic material) is saturated.

guideline: A guideline is a constraint on project and activity decision making that allows for departure from its terms, so long as the intent of the guideline is met (§ 219.15(d)(3)). Guidelines are established to help achieve a desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

H

habitat: A place that provides seasonal or year-round food, water, shelter, and other environmental conditions for an organism, community, or population of plants or animals.

habitat type: A land or aquatic unit, consisting of an aggregation of habitats having equivalent structure, function, and responses to disturbance.

harvest: (1) Felling and removal of trees from the forest; and (2) removal of game animals or fish from a population, typically by hunting or fishing.

historic properties: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.

hydroelectric: Of or relating to the production of electricity by waterpower.

hydrologic: Refers to the properties, distribution, and effects of water. Hydrology refers to the broad science of the waters of the earth, their occurrence, circulation, distribution, chemical and physical properties, and their reaction with the environment.

hydrologic function: The behavioral characteristics of a watershed described in terms of ability to sustain favorable conditions of water flow. Favorable conditions of water flow are defined in terms of water quality, quantity, and timing.

I

impacts: Refer to effects.

implement: To carry out.

indicator: A measure or measurement of an aspect of a sustainability criterion. A quantitative or qualitative variable that can be measured or described and, when observed periodically, shows trends. Indicators are quantifiable performance measures of outcomes or objectives for attaining criteria designed to assess progress toward desired conditions.

Infestation: The attack by macroscopic organisms in considerable concentration. Examples are infestations of tree crowns by budworm, timber by termites, soil or other substrates by nematodes or weeds.

infrastructure: The basic facilities, equipment, and installation needed for the functioning of a system; commonly refers to items such as roads, bridges, power facilities, and the like.

inherent capability of the plan area: The ecological capacity or ecological potential of an area characterized by the interrelationship of its physical elements, its climatic regime, and natural disturbances (36 CFR 219.19).

instream flow: Flow of water in its natural setting (as opposed to waters diverted for off-stream uses, such as industry or agriculture). Instream flow levels provided for environmental reasons enhance or maintain the habitat for riparian and aquatic life, with timing and quantities of flow characteristic of the natural setting.

interagency: Involving the Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Environmental Protection Agency, and/or other Federal agencies.

interdisciplinary team: A group of specialists assembled as a cohesive team with frequent interactions to solve a problem or perform a task.

intermittent streams: Streams that flow in response to a seasonally-fluctuating water table in a well-defined channel. The channel will exhibit signs of annual scour, sediment transport, and other stream channel characteristics, absent perennial flows. Intermittent streams typically flow during times of elevated water table levels, and may be dry during significant periods of the year, depending on precipitation cycles.

interpretive services: Visitor information services designed to present inspirational, educational, and recreational values to forest visitors in an effort to promote understanding, appreciation, and enjoyment of their forest experience.

invasive species: An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health. A species that causes, or is likely to cause, harm and that is exotic to the ecosystem it has infested. Invasive species infest both aquatic and terrestrial areas and can be identified within any of the following four taxonomic categories: plants, vertebrates, invertebrates, and pathogens (Executive Order 13112).

inventoried roadless areas (IRAs): Areas identified on a set of inventoried roadless area maps, contained in Forest Service Roadless Area Conservation, Final Environmental Impact Statement, Volume 2, (USDA Forest Service 2000), which are held at the Washington Office of the Forest Service, or any subsequent update or revision of those maps.

issue: A point, matter of controversy, dispute, question of public discussion, or general concern over resource management activities or land uses to be addressed or decided through the planning process. To be considered a significant environmental impact statement issue, it must be well defined, relevant to the proposed action, and within the ability of the agency to address through alternative management strategies.

K

key ecosystem characteristics:

- Are important specific elements of an ecosystem that sustain the long-term integrity of the ecosystems (FSH 1909, Chapter 10, Assessment sec. 12.14).
- Include dominant ecological characteristics of composition, structure, function, and connectivity of terrestrial, aquatic, and riparian ecosystems.
- May be stressors and possible effects of stressors.

L

land exchange: The conveyance of non-federal land or interests in the land in exchange for NFS land or interests in land.

land management plan: A document that provides broad strategic guidance and information for project and activity decision making in a national forest through plan components (desired conditions, suitable uses, standards, guidelines, and objectives), as required by the National Forest Management Act and the Planning Rule.

land management planning: A formal process of management planning involving four interactive steps: monitoring, assessment, decision making, and implementations as described in the Federal Code of Regulations.

landform: One of the attributes or features that make up the Earth's surface, such as a plain, mountain, or valley, as defined by its particular combination of bedrock and soils, erosion processes, and climatic influences.

landscape: A defined area irrespective of ownership or other artificial boundaries, such as a spatial mosaic of terrestrial and aquatic ecosystems, landforms, and plant communities, repeated in similar form throughout such a defined area (36 CFR 219.19).

landscape character: Identifiable image made by particular attributes, qualities, and traits of a landscape.

landtype: An intermediate level in the ecological classification system hierarchy that addresses land areas ranging in size from hundreds of acres up to ten thousands of acres. These units typically have similarities in landform, natural vegetative communities, and soils.

landtype association: A group of landtypes. The landtypes in the association are sufficiently homogeneous to be considered as a whole for modeling the future outputs and effects of planned management activities. Landtype associations may not follow watershed boundaries, and are defined on the basis of general similarities in climate, geology, landform, and vegetation.

large woody debris (LWD): Logs, sticks, branches, and other wood that falls into streams and rivers. This debris can influence the flow and the shape of the stream channel.

leave tree: A tree (marked to be) left standing for wildlife, seed production, etc, in an area where it might otherwise be felled.

lichens: Organisms made up of specific algae and fungi, forming identifiable crusts on soil, rocks, tree bark, and other surfaces. Lichens are primary producers in ecosystems; they contribute living material and nutrients, enrich the soil and increase soil moisture-holding capacity, and serve as food sources for certain animals. Lichens are slow growing and sensitive to chemical and physical disturbances.

litter: The uppermost layer of organic debris on the soil surface, which is essentially the freshly fallen or slightly decomposed vegetation material such as stems, leaves, twigs, and fruits.

line officer: A Forest Service official who serves in a direct line of command from the Chief (36 CFR 219.62).

listed species: Any species of fish, wildlife, or plant officially designated as endangered or threatened by the Secretary of the Interior or Commerce. Listed species are documented in 50 CFR 17.11 and 17.12.

local population: A group of individuals that spawn or breed in a particular area; the smallest group of individuals that is known to represent an interacting reproductive unit.

long term: Generally refers to a period longer than 10 years up to 100 years.

M

Maintain: In reference to an ecological condition: To keep in existence or continuance of the desired ecological condition in terms of its desired composition, structure, and processes. Depending upon the circumstance, ecological conditions may be maintained by active or passive management or both (36 CFR 219.19).

management action: Activities conducted by the Chugach National Forest to achieve specific resource management outcomes.

management area: A land area identified within the planning area that has the same set of applicable plan components. A management area does not have to be spatially contiguous (36 CFR 219.19).

management direction: A statement of multiple-use and other goals and objectives, the associated management prescriptions, and standards and guidelines for attaining them.

management practice: A specific activity, measure, course of action, or treatment.

mineral exploration: The search for valuable minerals on lands open to mineral entry.

mineral resource: A known or undiscovered concentration of naturally occurring solid, liquid, or gaseous material in or on the earth’s crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible.

minerals-locatable: Those hardrock minerals that are mined and processed for the recovery of metals. They also may include certain nonmetallic minerals and uncommon varieties of mineral materials, such as valuable and distinctive deposits of limestone or silica.

minerals-leasable: Coal, oil, gas, phosphate, sodium, potassium, oil shale, sulphur, and geothermal resources. All hard-rock minerals that occur on acquired lands, as opposed to public domain lands, are leasable.

minerals-materials (salable): A collective term to describe common varieties of sand, gravel, stone, pumice, pumicite, cinders, clay, and other similar materials. Common varieties do not include deposits of those materials that may be locatable.

minimum impact suppression tactics: A set of guidelines prescribing safety, fire line procedures, tools, and equipment that has the least impact on the environment during suppression and mop-up phases of fire (USDA and USDI 2003).

mining: Any activity related to the discovery, extraction, and exploration of minerals under the Mining Act of 1872 and the Mineral Leasing Act of 1920 through the use of, among other things, hydraulic equipment, pans, ground sluicing, sluice boxes, rockers, or suction dredges.

Mitigation: Actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.

Monitoring: A systematic process of collecting information to evaluate effects of actions or changes in conditions or relationships (36 CFR 219.19).

monitoring program: Prioritized criteria, indicators, and measures that are the means of measuring progress toward the desired conditions when conducting the annual and comprehensive evaluations.

mosaic: A pattern of vegetation in which two or more kinds of communities are interspersed in patches, such as clumps of shrubs with grassland between.

motorized equipment: Machines that use a motor, engine, or other non-living power source. This includes, but is not limited to such machines as chain saws, aircraft, snowmobiles, generators, motor boats, and motor vehicles. It does not include small battery or gas powered hand carried devices that include shavers, wristwatches, flashlights, cameras, stoves, or other similar small equipment.

multiple use: The management of all the various renewable surface resources of the NFS so that they are utilized in the combination that will best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output, consistent with the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528–531) (36 CFR 219.19).

municipal watersheds (public supply watersheds): A watershed that serves a public water system as defined in Public Law 93-523 (Safe Drinking Water Act) or as defined in state safe drinking water regulations. The definition does not include communities served by a well or confined groundwater unaffected by Forest Service activities.

N

National Ambient Air Quality Standards (NAAQSs): Standards set by the Federal Environmental Protection Agency for the maximum levels of air pollutants that can exist in the outdoor air without unacceptable effects on human health or the public welfare.

National Environmental Policy Act (NEPA) of 1969: An act to declare a national policy which will encourage productive and enjoyable harmony between humankind and the environment, to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, to enrich the understanding of the ecological systems and natural resources important to the nation, and to establish a Council on Environmental Quality.

National Forest Management Act (NFMA) of 1976: A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of forest plans and the preparation of regulations to guide that development.

NFS (NFS): All national forest lands reserved or withdrawn from the public domain of the United States; all national forest lands acquired through purchase, exchange, donation, or other means; the National Grasslands and land utilization projects administered under Title III of the Bankhead-Jones Farm Tenant Act (50 Stat. 525, 7 U.S.C. 1010-1012); and other lands, waters, or interests therein which are administered by the Forest Service or are designated for administration through the Forest Service as a part of the system.

NFS trail: A forest trail other than a trail which has been authorized by a legally documented right-of-way held by a state, county, or local public road authority (36 CFR 212.1).

National Recreation Trail: Trails designated by the Secretary of the Interior or the Secretary of Agriculture as part of the national system of trails authorized by the National Trails System Act. National recreation trails provide a variety of outdoor recreation uses.

National Register of Historic Places: The Nation's official list of cultural resources worthy of preservation. Authorized under the National Historic Preservation Act of 1966,the National Register is part of a national program to coordinate and support public and private efforts to identify, evaluate, and protect our historic and archeological resources. Properties listed in the Register include districts, sites, buildings, structures, and objects that are significant in American history, architecture, archeology, engineering, and culture. The National Register is administered by the National Park Service, which is part of the U.S. Department of the Interior.

National Wild and Scenic River System: Includes rivers with outstanding scenic, recreational, geological, fish and wildlife, historic, cultural or other similar values designated by Congress under the Wild and Scenic Rivers Act for preservation of their free-flowing condition. Refer to Wild and Scenic River.

National Wilderness Preservation System: All lands covered by the Wilderness Act and subsequent wilderness designations, irrespective of the department or agency having jurisdiction.

native species: An organism that was historically or is present in a particular ecosystem as a result of natural migratory or evolutionary processes; and not as a result of an accidental or deliberate introduction into that ecosystem. An organism's presence and evolution (adaptation) in an area are determined by climate, soil, and other biotic and abiotic factors (36 CFR 219.19).

natural disturbance: Periodic impact of natural events such as: fire, severe drought, insect or disease attack, or wind.

niche: A place or activity for which a an organisim is best fitted.

non-native species: An organism that was not historically present in a particular ecosystem as a result of natural migratory or evolutionary process, but is now present due to an accidental or deliberate introduction into that ecosystem.

O

objective: An objective is a concise, measurable, and time-specific statement of a desired rate of progress toward a desired condition or conditions. Objectives should be based on reasonably foreseeable budgets.

old growth forests: An ecosystem distinguished by old trees and related structural attributes. Old growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics including tree size, accumulation of large dead woody material, number of canopy layers, species composition, and ecosystem function. Old growth encompasses older forests dominated by early seral species, and forests in later successional stages dominated by shade tolerant species.

on-site: A term referring to species normally found on a site under natural conditions. The same or contiguous property that may be divided by a public or private right-of-way, provided that the entrance and exit between the properties is at a crossroads intersection, and that access is by crossing, as opposed to going along the right-of-way.

optional plan component: A plan may include goals as plan components. Goals are broad statements of intent, other than desired conditions, usually related to process or interaction with the public. Goals are expressed in broad, general terms, but do not include completion dates.

outcome: The long-term results of a program activity compared to its intended purpose (Government Performance and Results Act of 1993 (5 U.S.C. 306)). Outcome is a state of being similar to long-term ecological, social, or economic condition or goal (such as the maintenance of an ecosystem's biodiversity, jobs and income, or the quality of a regions' surface water as measured by indicators).

outdoor recreation activities: Activities such as camping, picnicking, rafting, boating, hiking, rock climbing, fishing, hunting, horseback riding, and the viewing of wildlife or scenery.

outfitting: Providing through rental or livery any saddle or pack animal, vehicle or boat, tents or camping gear, or similar supplies or equipment, for pecuniary remuneration or other gain. The term guide includes the holder's employees, agents, and instructors. Pecuniary remuneration means monetary reward (Washington Office Amendment 2709.11-95-11, 41-53C).

outstanding mineral rights: Instances in which the minerals in federally-owned lands were severed prior to the transaction in which government acquired the land. Removal or extraction of these minerals must be allowed in accordance with the instrument severing the minerals from the surface and under applicable state and local laws and regulations.

outstandingly remarkable values: Term used in the Wild and Scenic Rivers Act of 1968; to qualify as outstandingly remarkable, a resource value must be a unique, rare, or exemplary feature that is significant at a regional or national level.

overstory: Portion of the trees, in a forest or in a forested stand of more than one story, forming the upper or uppermost canopy.

P

paleontological sites: Areas that contain any remains, trace, or imprint of a plant or animal that has been preserved in the earth's crust before the Holocene epoch.

parcel: Contiguous tax lots under one ownership. For the purposes of the Private LURs, rights-of-way do not divide parcels into smaller units.

participation: Activities that include a wide range of public involvement tools and processes, such as collaboration, public meetings, open houses, workshops, and comment periods (36 CFR 219.19).

partnership: Voluntary, mutually beneficial and desired arrangement between the Forest Service and another or others to accomplish mutually agreed-on objectives consistent with the agency's mission and serving the public's interest.

patch: An area of vegetation that is relatively homogeneous internally and differs from surrounding elements.

pathogen: An agent such as a fungus, virus, or bacterium that causes disease.

pattern: The spatial arrangement of landscape elements (patches, corridors, matrix) that determines the function of a landscape as an ecological system.

plan or land management plan: A document or set of documents that provide management direction for an administrative unit of the NFS developed under the requirements of the land management planning regulation at 36 CFR part 219 or a prior planning rule (36 CFR 219.19).

plan (planning) area: The NFS lands covered by a plan (36 CFR 219.19).

plan components: The parts of a land management plan that guide future project and activity decision-making. Specific plan components may apply to the entire plan area, to specific management areas or geographic areas, or to other areas as identified in the plan. Every plan must include the following plan components: Desired conditions; Objectives; Standards; Guidelines; Suitability of Lands. A plan may also include Goals as an optional component.

plan monitoring program: An essential part of the land management plan that sets out the plan monitoring questions and associated indicators, based on plan components. The plan monitoring program informs management of resources on the plan area and enables the responsible official to determine if a change in plan components or other plan content that guide management of resources on the plan area may be needed.

plan (planning) record: The documents and materials considered in the making of a forest plan, plan revision, or plan amendment.

plant and animal community: A naturally occurring assemblage of plant and animal species living within a defined area or habitat (36 CFR 219.19).

plant communities: Any grouping of plants that have some structural similarity (Johnson and Simon 1987).

point source pollution: Pollution that comes from a single identifiable source such as a smokestack, a sewer, or a pipe.

prehistoric site: An area that contains important evidence and remains of the life and activities of early societies that did not record their history.

prescribed fire: Any fire ignited by management actions to meet specific objectives.

prescription: A management pathway to achieve a desired objective(s).

primitive recreation: Those types of recreation activities associated with unroaded land, for example: hiking, backpacking, and cross-country travel.

priority heritage assets: Heritage assets of distinct public value that are or should be actively maintained and meet one or more of the following criteria:

- The significance and management priority of the property is recognized through an official designation such as listing on the National Register of Historic Places or on a State register.
- The significance and management priority of the property is recognized through prior investment in preservation, interpretation, and use.
- The significance and management priority of the property is recognized in an agency–approved management plan.
- The property exhibits critical deferred maintenance needs and those needs have been documented. Critical deferred maintenance is defined as a potential health or safety risk or imminent threat of loss of significant resource values.

private land: Land not in federal, state, or local government ownership.

productivity: The capacity of NFS lands and their ecological systems to provide the various renewable resources in certain amounts in perpetuity. For the purposes of land management planning, productivity is an ecological term, not an economic term (36 CFR 219.19).

program: Sets of activities or projects with specific objectives, defined in terms of specific results and responsibilities for accomplishments.

project: An organized effort to achieve an objective identified by location, timing, activities, outputs, effects, and time period and responsibilities for executions (36 CFR 219.19).

public participation activities: Meetings, conferences, seminars, workshops, tours, written comments, survey questionnaires, and similar activities designed or held to obtain comments from the general public and specific publics.

public roads: Any road or street under the jurisdiction of and maintained by a public authority and open to public travel (23 U.S.C. §101(a)).

Q

quality of life: Refers to the satisfaction people feel for the places where they live (or may visit) and for the places they occupy as part of that experience.

R

ranger district: Administrative subdivisions of a national forest supervised by a district ranger who reports to the forest supervisor.

rare species: Any native or once-native species of wild animal which exists in small numbers.

reasonable assurance: A judgment made by the responsible official based on best available scientific information and local professional experience that practices based on existing technology and knowledge are likely to deliver the intended results. Reasonable assurance applies to average and foreseeable conditions for the area and does not constitute a guarantee to achieve the intended results.

reconstruction: Work that includes, but is not limited to, widening of roads, improving alignment, providing additional turnouts, and improving sight distance that improve the standard to which the road was originally constructed. Also undertaken to increase the capacity of the road or to provide greater traffic safety.

recovery: With respect to threatened or endangered species: The improvement in the status of a listed species to the point at which listing as federally endangered or threatened is no longer appropriate (36 CFR 219.19).

recreation: Leisure time activity, such as swimming, picnicking, boating, hunting, and fishing.

- **developed recreation:** Recreation that requires facilities that, in turn, result in concentrated use of an area. Examples of developed recreation areas are campgrounds and ski areas; facilities in these areas might include roads, parking lots, picnic tables, toilets, drinking water, ski lifts, and buildings.
- **dispersed recreation:** A general term referring to recreation use outside developed recreation sites; this includes activities in primitive environments, such as scenic driving, hiking, backpacking, hunting, fishing, snowmobiling, horseback riding, cross-country skiing, and recreation.

recreation opportunity: An opportunity to participate in a specific recreation activity in a particular recreation setting to enjoy desired recreation experiences and other benefits that accrue. Recreation opportunities include non-motorized, motorized, developed, and dispersed recreation on land, water, and in the air (36 CFR 219.19).

recreation opportunity spectrum: A recreation opportunity setting is the combination of physical, biological, social, and managerial conditions that give value to a place. Thus, an opportunity includes qualities provided by-nature (vegetation; landscape, topography, scenery), qualities associated with recreational use (levels and types of use), and conditions provided by management (developments, roads, regulations). By combining variations of these qualities and conditions, management can provide a variety of opportunities for recreationists. The settings, activities, and opportunities for obtaining experiences have been arranged along a continuum or spectrum divided into six classes: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban (40 CFR 1505.2).

- **Primitive:** Area is characterized by an essentially unmodified natural environment of fairly large size Interaction between users is very low and evidence of other users is minimal. The area is managed to be essentially free from evidence of human-induced restrictions and controls. Motorized use within the area is not permitted.
- **Semi-primitive Non-motorized:** Area is characterized by a predominantly natural or natural appearing environment of moderate to large size. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present, but would be subtle. Motorized recreation use is not permitted, but local roads used for other resource management activities may be present on a limited basis. Use of such roads is restricted to minimize impacts on recreational experience opportunities.
- **Semi-primitive Motorized:** Area is characterized by a predominantly natural or natural appearing environment of moderate to large size. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions use of local primitive or collector roads with predominantly natural surfaces and trails suitable for motor bikes is permitted.
- **Roaded Natural:** Area is characterized by predominantly natural-appearing environments with moderate evidence of the sights and sounds of man. Such evidence usually harmonizes with the natural environment. Interaction between users may be moderate to high, with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is allowed and incorporated into construction standards and design of facilities
- **Rural:** Area is characterized by substantially modified natural environment. Resource modification and utilization practices are to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of humans are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities is designed for use by a large number of people Facilities are often provided for special activities. Moderate densities are provided far away from developed sites Facilities for intensified motorized use and parking are available.
- **Urban:** Area is characterized by a substantially urbanized environment, although the background may have natural appearing elements. Renewable resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of humans, on-site, are predominant. Large numbers of users can be expected, both on site and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site.

recreation site: Specific places in the national forest other than roads and trails that are used for recreational activities. These sites include a wide range of recreational activities and associated development. These sites include highly developed facilities, such as ski areas, resorts, and campgrounds. It also includes dispersed recreation sites that have few or no improvements but show the effects of repeated recreation use.

recreational facilities: Refers to facilities associated with or required for outdoor recreational activities and includes, but is not limited to, parks, campgrounds, hunting and fishing lodges, and interpretive displays.

recreational river: Refer to wild and scenic river.

refugia: Areas that have not been exposed to great environmental changes and disturbances undergone by the region as a whole; refugia provide conditions suitable for survival of species that may be declining elsewhere.

regeneration: The process of establishing new plant seedlings, whether by natural means or artificial measures (planting).

regulations: Generally refers to CFR, Title 36, chapter II, which covers management of the Forest Service.

rehabilitate: To repair and protect certain aspects of a system so that essential structures and functions are recovered, even though the overall system may not be exactly as it was before.

renewable energy: Energy derived from natural sources, such as sunlight, wind, rain, tides, or geothermal resources, that does not consume the resource when used.

research natural area (RNA): An area set aside by a public or private agency specifically to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. In Forest Service usage, research natural areas are areas designated to ensure representative samples of as many of the major naturally occurring plant communities as possible.

resilience: The ability of an ecosystem and its component parts to absorb, or recover from the effects of disturbances through preservation, restoration, or improvement of its essential structures and functions and redundancy of ecological patterns across the landscape.

resource: Anything that is beneficial or useful, be it animal, vegetable, mineral, a location, a labor force, a view, an experience, etc. Resources, in the context of land use planning, thus vary from such commodities as timber and minerals to such amenities as scenery, scenic viewpoints, or recreation opportunities.

responsible official: The official with the authority and responsibility to oversee the planning process and to approve a plan, plan amendment, and plan revision (36 CFR 219.62).

restore: To renew by the process of restoration. See restoration (36 CFR 219.19).

resource allocation: The action of apportioning the supply of a resource to specific uses or to particular persons or organizations.

retention: A visual quality objective in which man's activities are not evident to the casual national forest visitor.

revegetation: The re-establishment and development of a plant cover. This may take place naturally through the reproductive processes of the existing flora or artificially through the direct action of humans (e.g.: afforestation and range reseeding).

revision: To make the plan new or up-to-date. Plan revision must be considered and approved in accordance with the requirements for the development and approval of a forest plan. Revisions take place every 10-15 years, but may occur more frequently if conditions or public demands change significantly.

right-of-way (ROW): Public or NFS lands authorized to be used or occupied pursuant to a ROW grant or special use authorization.

riparian areas: Three-dimensional ecotones [the transition zone between two adjoining communities] of interaction that include terrestrial and aquatic ecosystems that extend down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain to the water, laterally into the terrestrial ecosystem, and along the water course at variable widths (36 CFR 219.19).

risk: A combination of the likelihood that a negative outcome will occur and the severity of the subsequent negative consequences (36 CFR 219.19).

road: A motor vehicle route over 50 inches wide, unless designated and managed as a trail. A road may be classified, unclassified, or temporary (36 CFR 212.1).

- **classified roads:** Roads wholly or partially within or adjacent to national forest lands that are determined to be needed for long-term motor vehicle access, including state roads, county roads, privately owned roads, forest roads, and other roads authorized by the Forest Service (36 CFR 212.1).
- **closed road:** A road with all use suspended year-long by an active form of facility management utilizing regulations and appropriate enforcement to secure and ensure user compliance with closure.
- **open road:** A road that has no use restrictions or regulations imposed and is available for use by vehicles at any time during the year.
- **temporary roads:** Roads authorized by contract, permit, lease, other written authorization, or emergency operation not intended to be a part of the forest transportation system and not necessary for long-term resource management (36 CFR 212.1).
- **unclassified roads:** Roads on national forest lands that are not managed as part of the forest transportation system, such as unplanned roads, abandoned travelways, and off-road vehicle tracks that have not been designated and managed as a trail and those roads that were once under permit or other authorization and were not decommissioned upon the termination of the authorization (36 CFR 212.1).

road construction: Activity that results in the addition of forest classified or temporary road miles (36 CFR 212.1). New construction activities may include vegetation clearing and grubbing, earthwork, drainage installation, instream activities, pit development or expansion, surfacing (including paving), and aggregate placement.

road management objectives: Road management objectives define the level of service provided by a NFS road consistent with the surrounding recreation opportunity spectrum (ROS) class.

Semi-primitive Non-motorized (SPNM): Most semi-primitive nonmotorized areas do not have developed roads. All motorized traffic is prohibited. Semi-primitive nonmotorized roads provide hiking or equestrian trails on closed or decommissioned roads.

Semi-primitive Motorized (SPM): Semi-primitive motorized roads are generally used for four-wheel drive, logging, or ranching activities. Passenger-car use is discouraged by entrance conditions or signage. Users can expect SPM roads where there are no attractions such as viewpoints or trailheads.

Roaded Natural (RN): Roaded natural roads provide safe access for passenger cars. Maintenance activities generally occur annually or every two years, depending on funding and need. Forest Service clears these roads of brush and logs. Surface maintenance increases at higher levels. Because of increased speeds, turnouts are needed more frequently. Open local roads and some collector roads within RN are managed for high-clearance vehicles. In such cases, road-maintenance standards defined for SPM would be used.

rural (R): Rural is generally the highest standard of road. These arterial roads provide the main access to the national forest lands but generally lack the speeds and alignment provided by state highways. Roads are double–lane with a road-surface treatment and generally 24-feet wide. The road has center striping and often stripes marking the shoulders. Corresponds to ML 5 and Traffic Service Level A (abbreviated: 5-A).

road reconstruction: Activity that results in improvement or realignment of an existing classified road as defined below. Reconstruction activities may include vegetation clearing and grubbing, earthwork, drainage installation, instream activities, surfacing (including paving), and aggregate placement.

roundwood: Timber and fuelwood prepared in the round state - from felled trees to material trimmed, barked, and crosscut (e.g.: logs and transmission poles).

runoff: The total stream discharge of water from a watershed including surface and subsurface flow, but not groundwater. Usually expressed in acre-feet.

runoff (surface): Fresh water from precipitation and melting ice that flows on the earth's surface into nearby streams, lakes, wetlands, or reservoirs.

S

sacred site: Executive Order 13007 defines an Indian sacred site as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the Indian tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site."

scale: (1) The level of resolution under consideration (for example, broad-scale or fine-scale); (2) the ratio of length on a map to true length.

scenic character: A combination of the physical, biological, and cultural images that gives an area its scenic identity and contributes to its sense of place. Scenic character provides a frame of reference from which to determine scenic attractiveness and to measure scenic integrity (36 CFR 219.19).

scenic integrity objectives (SIOs) and landscape character goals: These are developed for forest plan management areas. Scenic Integrity Objectives are Very High-unaltered, High-appears unaltered, Moderate-slightly altered, and Low-moderately altered. A desired level of excellence based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations of the characteristic landscape. Objectives include Very High, High, Moderate, and Low.

- **Very High (VH)** - Generally provides for only ecological changes in natural landscapes and complete intactness of landscape character in cultural landscapes.
- **High (H)** - Human activities are not visually evident to the casual observer. Activities may only repeat attributes of form, line, color, and texture found in the existing landscape character.
- **Moderate (M)** - Landscapes appear slightly altered. Noticeable human created deviations must remain visually subordinate to the landscape character being viewed.

- **Low (L)** - Landscapes appear moderately altered. Human created deviations begin to dominate the valued landscape character being viewed but borrow from valued attributes such as size, shape, edge effect, and pattern of natural openings, vegetative type changes, or architectural styles outside the landscape being viewed.

scenic river areas: Refer to Wild and Scenic River.

scenic river: Refer to Wild and Scenic River.

sediment: Solid materials, both mineral and organic, in suspension or transported by water, gravity, ice, or air; may be moved and deposited away from their original position and eventually will settle to the bottom.

seep: A wet area where a seasonal high water table intersects with the ground surface. Seeps that meet the definition of a wetland are included in the riparian corridor.

self-reliance: Reliance on one's own capabilities, judgment, or resources through application of outdoor skills in an environment that offers a high degree of risk and challenge.

self-sustaining populations: Populations that are sufficiently abundant, interacting, and well-distributed in the planning area, within the bounds of their life history and distribution of the species and the capability of the landscape, to provide for their long-term persistence, resilience, and adaptability over multiple generations.

sense of place: A reference for the physical, emotional, cultural, symbolic, and spiritual aspects of people's tangible and intangible relationships with the land and the meanings associated with them.

shelterwood: The cutting of most trees, leaving those needed to produce sufficient shade to produce a new age class in a moderated microenvironment.

short term: Generally refers to a period of 10 years or less.

silvicultural system: A management process whereby forests are tended, harvested, and replaced, resulting in a forest of distinctive form. Systems are classified according to the method of carrying out the fellings that remove the mature crop and provide for regeneration and according to the type of forest thereby produced.

silviculture: The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

site: (1) A specific location of an activity or project, such as a campground, a lake, or a stand of trees to be harvested; (2) The location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined or vanished, where the location itself maintains historical or archeological value regardless of the value of any existing structure [36CFR65] (historic or archaeological definition).

snag: A standing dead tree usually greater than five feet in height and six inches in diameter at breast height (DBH).

society: A group of people who have a common homeland, are interdependent, and share a common culture.

soil: The earth material that has been so modified and acted upon by physical, chemical, and biological agents that it will support rooted plants.

soil productivity: The inherent capacity of a soil to produce plant growth, due to the soil's chemical, physical, and biological properties (such as depth, temperature, water-holding capacity, and mineral, nutrient, and organic matter content). It is often expressed by some measure of biomass accumulation.

soil quality: The capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health.

soil stability: (1) Mass stability of the soil profile or resistance to mass failure; (2) stability of the soil surface with respect to accelerated sheet, rill, and gully erosion processes.

spatial: Related to or having the nature of space.

special habitat: A habitat that has a special function not provided by plant communities and successional stages. Includes riparian zones, snags, dead and downed wood, and edges.

special use authorization: A permit, term permit lease, or easement which allows occupancy, use, rights, or privileges of NFS lands (36 CFR 251.51).

special use permit: A permit issued under established laws and regulations to an individual, organization, or company for occupancy or use of NFS lands for some special purpose.

species: A population or series of populations of organisms that can interbreed freely with each other but not with members of other species.

species composition: The species that occur on a site or in a successional stage of a plant community.

species diversity: The number of species occurring in a given area.

species groups: A group of species that are associated with the same habitat conditions. Groupings are made based on the ecological conditions necessary to maintain or, in the case of federally listed threatened or endangered species, recover each group member.

species of conservation concern: A species of conservation concern is a species, other than federally recognized threatened, endangered, proposed, or candidate species, that is known to occur in the plan area and for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area (36 CFR 219.9(c)).

spring: A water source located where water begins to flow from the ground due to the intersection of the water table with the ground surface. Generally flows throughout the year. Springs that are the source of perennial or intermittent streams are included in the riparian corridor.

stand: A group of trees in a specific area that are sufficiently alike in composition, age, arrangement, and condition so as to be distinguishable from the forest in adjoining areas.

standard: A mandatory constraint on project and activity decision making, established to help achieve or maintain the desired condition or conditions, to avoid or mitigate undesirable effects, or to meet applicable legal requirements.

stream channel: Refer to channel.

stressors: Actors that may directly or indirectly degrade or impair ecosystem composition, structure, or ecological process in a manner that may impair its ecological integrity, such as an invasive species, loss of connectivity, or the disruption of a natural disturbance regime (36 CFR 219.19).

structure: (1) Any permanent building or facility, or part thereof, such as barns, outhouses, residences, and storage sheds, including transmission line systems, substations, commercial radio transmitters, relays or repeater stations, antennas, and other electronic sites and associated structures; or (2) the size and arrangement of vegetation, both vertically and horizontally.

subbasin: A drainage area of approximately 800,000 to 1,000,000 acres, equivalent to a 4th field HUC watershed.

subsistence: Customary and traditional uses of wild renewable resources (plants and animals) for food, shelter, fuel, clothing, tools, etc.

subsistence uses: The customary and traditional uses by rural Alaska residents of wild renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade (ANILCA Section 803).

subwatershed: A drainage area of approximately 20,000 acres, equivalent to a 6th-field HUC (12 digit). Hierarchically, subwatersheds (6th field HUC) are contained within watersheds (5th field HUC, which in turn are contained within a subbasin (4th field HUC).

succession: The sequential replacement over time of one plant community by another, in the absence of major disturbance. Conditions of the prior plant community or successional stage create conditions that are favorable for the establishment of the next stage. The different stages of succession are often referred to as seral stages. Developmental stages are as follows:

- **early seral:** Communities that occur early in the successional path and generally have less complex structural developmental than other successional communities. Seedling and sapling size classes are an example of early seral forests.
- **mid-seral:** Communities that occur in the middle of the successional path. For forests, this usually corresponds to the pole or medium sawtimber growth stages.
- **late-seral:** Communities that occur in the later stage of the successional path with mature, generally larger individuals, such as mature forests.

suitability of lands: A determination that specific lands within a plan area may be used, or not, for various multiple uses or activities, based on the desired conditions applicable to those lands. The suitability of lands determinations need not be made for every use or activity, but every plan must identify those lands that are not suitable for timber production.

suitable uses: Uses that are compatible with the desired conditions and objectives for a given area that are identified as guidance for project and activity decision making and do not represent a commitment or final decision approving projects or activities.

sustainability: The capability to meet the needs of the present generation without compromising the ability of future generations to meet their needs. For the purposes of this plan ''ecological sustainability'' refers to the capability of ecosystems to maintain ecological integrity; ''economic sustainability'' refers to the capability of society to produce and consume or otherwise benefit from goods and services including contributions to jobs and market and nonmarket benefits; and ''social sustainability'' refers to the capability of society to support the network of relationships, traditions, culture, and activities that connect people to the land and to one another, and support vibrant communities (36 CFR 219.19).

sustainable recreation: The set of recreation settings and opportunities on the NFS that is ecologically, economically, and socially sustainable for present and future generations (36 CFR 219.19).

T

terrestrial: Pertaining to the land.

threatened species: Any species that the Secretary of the Interior or the Secretary of Commerce has determined is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Threatened species are listed at 50 CFR sections 17.11, 17.12, and 223.102.

timber: Wood retaining many of the recognizable characteristics of a tree: round, bark covered, and tapering, but without the limbs and leaves. In wood-industry usage, it may be standing timber (that portion of living trees with characteristics of value to the wood-using industry), or cut trees not yet processed beyond removing limbs and tops.

timber harvest: The removal of trees for wood fiber utilization and other multiple-use purposes (36 CFR 219.19).

timber production: The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use (36 CFR 219.19).

tolerance: The ability of a tree to grow satisfactorily in the shade of, and in competition with, other trees.

topography: The configuration of a land surface including its relief, elevation, and the position of its natural and human-made features.

trailhead: The transfer point between a trail and a road, water body, or airfield, which may have developments that facilitate transfer from one mode of transportation to another. For purposes of the FSTAG (FSM 2353.27), a trailhead is a site designed and developed to provide staging for trail use and does not include:

- Junctions between trails where there is no other access.
- Intersections where a trail crosses a road or users have developed an access point, but no improvements have been provided beyond minimal signage for public safety.

travel route: A route, such as a county or national forest road or river or trail, that is open for use by members of the public.

trend: As used to define range conditions, the direction of change in range or forage condition or in ecological status.

U

upland: The portion of the landscape above the valley floor or stream.

utility corridor: A parcel of land, without fixed limits or boundaries, that is being used as the location for one or more transportation or utility rights-of-way.

urban: An area characterized by a substantially urbanized environment. The background may have natural-appearing elements.

V

vegetation management: Activities designed primarily to promote the health of forest vegetation in order to achieve desired results. Vegetation management is the practice of manipulating the species mix, age, fuel load, and /or distribution of wildland plant communities within a prescribed or designated area in order to achieve desired results. It includes prescribed burning, grazing, chemical applications, biomass harvesting, and any other economically feasible method of enhancing, retarding, modifying, transplanting, or removing the aboveground parts of plants.

viability: In general, viability means the ability of a population of a plant or animal species to persist for some specified time into the future.

viable population: A population of a species that continues to persist over the long term with sufficient distribution to be resilient and adaptable to stressors and likely future environments (36 CFR 219.19).

viewshed: The total landscape seen, or potentially seen from all or a logical part of a travel route, use area, or water body.

W

water right: A right to use surface water or ground water evidenced by a court decree or by a permit or certificate approved by the state water resources department. Statutory exempt uses of surface water and ground water are not water rights, nor are time-limited licenses. A perfected water right is defined by applicant name, source, purpose, amount (quantity, rate and duty), season of use, priority date, point of diversion, place of use, and certificate number.

water quality: A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

water yield: The measured output of the forest’s streams expressed in acre-feet. The amount or volume of water that flows in a given period of time from a watershed.

watershed: A region or land area drained by a single stream, river, or drainage network; a drainage basin (36 CFR 219.19).

watershed function: The processes acting on hillslopes and stream channel within a drainage basin that control the movement of water, wood, sediment, and nutrients.

water yield: The amount of water that flows from a watershed within a specific period of time.

weed: A plant considered undesirable, unattractive, or troublesome, usually introduced and growing without intentional cultivation.

wetlands: Those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal circumstances do or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds (Executive Order 11990, Section 7c).

wild and scenic river (WSR): Ariver designated by Congress as part of the National Wild and Scenic Rivers System that was established in theWild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 (note), 1271–1287). (36 CFR 219.19) for possessing outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural or other similar values.

Wilderness Act of 1964: Act which gave Congress authority to designate certain areas of public land as wilderness. It established the National Wilderness Preservation System to secure an enduring resource of wilderness.

wilderness: Any area of land designated by Congress as part of the National Wilderness Preservation System that was established in the Wilderness Act of 1964 (16 U.S.C. 1131–1136) (36 CFR 219.19).

wildfire: An unplanned, unwanted wildland fire, including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fire where the objective is to put the fire out.

wildland: A nonurban, natural area that contains uncultivated land, timber, range, watershed, brush or grassland.

wildland fire: Any non-structure fire that occurs in vegetation or natural fuels. Wildland fire includes prescribed fire and wildfire.

wildland urban interface (WUI): The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Describes an area within or adjacent to private and public property where mitigation actions can prevent damage or loss from wildfire.

wildlife: All non-domesticated mammals, birds, reptiles, and amphibians living in a natural environment, including game species and non-game species. Animals, or their progeny (i.e., feral animals, including horses, burros, and hogs), that once were domesticated, but escaped captivity, are not considered wildlife.

wildlife habitat improvement: The manipulation or maintenance of vegetation to yield desired results in terms of habitat suitable for designated wildlife species or groups of species.

withdrawal: Water removed from the ground or diverted from a surface water source for use.

Maps (see separate folder)

Management Area Maps by Alternative:

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