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Pacific Islands Aquaculture Management Program

Final Programmatic Environmental Impact Statement

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Abstract:

In accordance with the National Environmental Policy Act (NEPA) and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) prepared a draft Programmatic Environmental Impact Statement (DPEIS) for a 90-day public review and comment period from May 7 through August 5, 2021. NMFS considered the comments received and prepared this final PEIS. This document analyzes the potential direct, indirect, and cumulative effects of several management alternatives on the human, physical, and biological environment. PIRO and the Western Pacific Fishery Management Council (WPFMC) may use this PEIS to support a future management program for offshore aquaculture in the Pacific Islands Region (PIR).

Executive Summary:

The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) plans to work with the Western Pacific Fishery Management Council (Council) to establish an aquaculture management program in the Pacific Islands Region (PIR). Aquaculture is the propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose. Aquaculture in Federal waters in the PIR is not currently subject to extensive management oversight, with limited exceptions related to gear types used for culture and harvest of coral reef ecosystem component species (CRECS). This situation increases the potential for unplanned development and proliferation of unmanaged aquaculture operations in waters of the U.S. Exclusive Economic Zone (EEZ or Federal waters) in the PIR. NMFS national and regional priorities seek to increase opportunities for sustainable aquaculture to promote safe, sustainable, seafood production. Aquaculture operations could supplement wild-caught fish, increase food security, reduce reliance on seafood imports, and provide economic opportunity and job creation.

Any future management program would be designed to regulate, manage, and promote the development of an environmentally sound and economically sustainable aquaculture industry in Federal waters of the PIR. The program would enable NMFS and the Council to provide enhanced planning, coordination, and oversight of aquaculture in Federal waters, and is intended to help provide operational stability and maintain the Council's and NMFS commitments to sustainable and environmentally sound fisheries management.

NMFS published a Notice of Intent to Prepare a Programmatic Environmental Impact Statement (PEIS) on August 23, 2016 (81 FR 57567). NMFS and the Council conducted six scoping meetings in four island areas: American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI), Guam, and Hawaii. Scoping comments received during the process helped shape the alternatives and aquaculture management issues addressed in this PEIS.

NMFS published the draft PEIS (DPEIS) on May 7, 2021, in the *Federal Register* with a 90-day public comment period that closed on August 5, 2021 (86 FR 24616). NMFS also held four virtual public meetings[1] between June 15 and June 24, 2021 (noticed at 86 FR 27836, May 24, 2021), to record oral comments on the DPEIS. NMFS has considered oral and written comments received in response to the DPEIS in a comment analysis report attached to the final PEIS that categorizes and summarizes substantive comments received throughout the comment period, the demographics of commenters, the key themes of their statements, and includes responses to the comments. The public can view all comments at https://www.regulations.gov/document/NOAA-NMFS-2021-0044-0003/comment.

NMFS prepared this PEIS to support early planning for a future management program and evaluate the potential effects of alternatives currently under consideration. Although the management program is currently conceptual, aquaculture in Federal waters would be managed

[1] From March 2020 through June 2022 NMFS was operating under an emergency evacuation order due to the COVID-19 pandemic. This order prevented NMFS from holding any public meetings in person.

under amended Fishery Ecosystem Plans (FEPs) and their implementing regulations. The PEIS and comments received will inform early program planning and coordination with the WPFMC and interested and affected members of the public, completion of a programmatic review of potential management considerations, and an early analysis of potential environmental impacts. The final PEIS supports tiered environmental effects analyses in the future.

Management Alternatives

This PEIS proposes three possible management alternatives: one status quo and two management programs that are more comprehensive:

Alternative 1: No Action. NMFS would not develop a specific management program, and NMFS would continue to require special use permits for certain aquaculture activities.

Alternative 2: Limited Aquaculture Management Program. This alternative would be based on current aquaculture activities in the PIR, but would include aquaculture-specific permitting processes and allow culture of current FEP Management Unit Species (MUS), although this alternative would limit aquaculture gear to the types previously approved under other NMFS permits.

Preferred Alternative 3: Expanded Aquaculture Management Program. This alternative would provide the same management program outlined for Alternative 2, but with longer permit durations, and a broader scope of allowable species and gear types.

Under both Alternatives 2 and 3, the FEPs and regulations would be amended to establish a limited entry aquaculture management program including permits, monitoring, and operational requirements for commercial and research/innovation activities. These alternatives would also provide a streamlined avenue for navigating permitting processes with other relevant Federal and state agencies.

Environmental Consequences of the Alternatives: Direct, Indirect and Cumulative Impacts

We evaluated each alternative according to five impact criteria to assess the context of a potential effect and compare the alternatives based on the conclusions drawn from the analysis. These criteria, potential effects, and mitigation measures for each alternative are outlined in Table 1 below, with a more detailed assessment provided in Chapter 4. The body of research supporting the environmental effects of offshore aquaculture is sparse. Thus, we based the effects considered in the PEIS on current knowledge of offshore aquaculture, and similar types of aquaculture with much more established bodies of research (e.g., cage and net pen culture in nearshore waters). There may be impacts that vary between individual aquaculture facilities depending on siting parameters and the nature of the operations themselves. Future activity-specific environmental evaluations would be undertaken, if necessary, to address any unique impacts. Overall, the risk of negative effects could be mitigated with comprehensive siting and management programs outlined in Alternatives 2 and 3.

The PEIS assesses the cumulative impacts from past, present and reasonably foreseeable future actions according to the same criteria described in Chapter 4. Such actions include alternative energy production, commercial and non-commercial fishing, installation of undersea cables, military testing and training activities, tourism and recreation, marine managed areas, natural events, shipping, scientific research, exploitation of resources, predation, marine debris accumulation, and sedimentation.

Table 1. Comparison of Alternatives

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Aquaculture is managed through a comprehensive, coordinated program	No	Yes	Yes
Permit Eligibility and Transferability			
U.S. citizen, U.S. national, resident alien, or U.S. corporation/entity	Yes	Yes	Yes
Transferrable to qualified applicant.	Yes	Yes	Yes
Commercial Permit Duration and Renewal			
Up to 2 years with opportunities for renewal	Yes	No	No
Up to 10 years. Unlimited renewal if in good standing	No	Yes	No
Up to 20 years. Unlimited renewal if in good standing	No	No	Yes
Research Permit Duration and Renewal			
Up to 3 years with option for one renewal of 3 years	No	Yes	No
Up to 10 years with option for one renewal of 10 years	No	No	Yes
Dealer Permit	No	Yes	Yes
Program Capacity			
Unlimited	Yes	No	No
Limited	No	Yes	Yes
General Application Requirements			
Applicant and vessel information	Yes	Yes	Yes
Intended species	Yes	Yes	Yes
Objectives of the operation	Yes	Yes	Yes
Estimated ecosystem, habitat and protected species impacts	Yes	Yes	Yes
Detailed descriptions of site, systems, feeding	No	Yes	Yes
Risk mitigation and prevention plans	No	Yes	Yes
Emergency action plans (e.g., escapes, catastrophic failure, etc.)	No	Yes	Yes

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Veterinarian identification and commitment	No	Yes	Yes
Aquatic animal health plan	No	Yes	Yes
Assurance bond, decommissioning plan	No	Yes	Yes
Permit Application and Review Process			
Pre-Application Screening	No	Yes	Yes
Application Submission and Review	Yes	Yes	Yes
WPFMC Consultation	Yes	Yes	Yes
Siting Restrictions			
Specified in permit on a case-by-case basis	Yes	No	No
Comprehensive planning process for siting analysis	No	Yes	Yes
Prohibited where all commercial fishing is prohibited	No	Yes	Yes
Restrictions or prohibition near or within critical habitat, artificial reefs, special management areas, military training/transit areas, tidal buoys, legal fish aggregating devices (FAD), or commercial shipping lanes[2]	Yes	Yes	Yes
Restrictions based on depth, current, bottom type, wildlife attraction, potential algal blooms or hypoxia, or migratory pathways	No	Yes	Yes
Allowable Marine Aquaculture Systems and Technologies			
Specified in permit on a case-by-case basis	Yes	No	No
Limited to technologies previously used in the PIR, such as cages and net pens	No	Yes	No

[2] Review and permitting by other agencies requires NMFS coordination for protected species, essential fish habitat and other relevant laws.

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Any system allowed, provided it meets environmental requirements[3]	No	No	Yes
Allowable Species			
CRECS	Yes	Yes[4]	Yes
MUS and ECS	Yes	Yes[8]	Yes
Other Native Species	Yes	No	Yes
Non-Native Species	Yes	No	No
Recordkeeping and Reporting Requirements			
Specified in permit on a case-by-case basis	Yes	No	No
Production, harvest	Yes	Yes	Yes
Wild capture for broodstock	Yes	Yes	Yes
Transport	Yes	Yes	Yes
Interactions with protected resources	Yes	Yes	Yes
Escapes	Yes	Yes	Yes
Recapture of escapes	No	Yes	Yes
Mass mortality	Yes	Yes	Yes
Disease outbreaks	No	Yes	Yes
Water quality monitoring	Yes	Yes	Yes
Safety issues	No	Yes	Yes
Gear conflict issues	No	Yes	Yes
Gear failure	Yes	Yes	Yes

[3] Applicants must submit detailed information to evaluate functionality, safety, risks to habitat, protected species, wild stocks, public health or safety, or other considerations.

[4] May be limited to only species that have been previously cultured or likely to be successfully, sustainably cultured.

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Feeding records	No	Yes	Yes
Other records as consistent with the operation plan	No	Yes	Yes

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ACRONYMS AND ABBREVIATIONS

%	percent
ACL	Annual Catch Limit
ALOHA	A Long-term Oligotrophic Habitat Assessment
AOA	Aquaculture Opportunity Area
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulation
CNMI	Commonwealth of the Northern Mariana Islands
CPUE	Catch per unit effort
CRECS	Coral reef ecosystem component species
DLNR	State of Hawaii Department of Land and Natural Resources
DO	Dissolved oxygen
DOD	United States Department of Defense
DPEIS	Draft Programmatic Environmental Impact Statement
DPS	Distinct Population Segment
EA	Environmental Assessment
ECS	Ecosystem Component Species
EEZ	U.S. Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
FDA	U.S. Food and Drug Administration
FEP	Fishery Ecosystem Plan
FR	*Federal Register*
GDP	Gross domestic product
GHG	Greenhouse gas emissions
HAPC	Habitat Areas of Particular Concern
IRFA	Initial regulatory flexibility analysis
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
MNM	Marine National Monument
MPA	Marine protected area
MT	Million U.S. tons
t	metric tons
MUS	Management unit species
NAA	National Aquaculture Act
NADP	National Aquaculture Development Plan
NDSA	Naval Defense Seas Area
NEPA	National Environmental Policy Act
nm	nautical mile
NMFS	National Marine Fisheries Service

NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPTZ	North Pacific Transition Zone
NTU	Nephelometric Turbidity Units
NWHI	Northwestern Hawaiian Islands
NWR	National Wildlife Refuge
OIE	World Organization of Animal Health
ONMS	Office of National Marine Sanctuaries
PCBs	Polychlorinated biphenyls
PEIS	Programmatic Environmental Impact Statement
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PPGFA	Pago Pago Sport Fishing Association
PRA	Paperwork Reduction Act
PRIA	Pacific Remote Island Areas
PSZ	Protected Species Zone
RFFA	Reasonably Foreseeable Future Action
ROD	Record of Decision
SAFE	Stock Assessment and Fishery Evaluation
SCREFP	Special Coral Reef Ecosystem Fishing Permit
tons	U.S. tons
U.S.	United States of America
U.S.C.	U.S. Code
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WPFMC	Western Pacific Fishery Management Council

1 INTRODUCTION

The National Marine Fisheries Service (NMFS) Pacific Islands Regional Office (PIRO) is working to ensure sustainable growth and development of an offshore aquaculture industry. NMFS PIRO, in conjunction with the Western Pacific Fishery Management Council (WPFMC), plans to establish a Federal aquaculture management program for the U.S. Exclusive Economic Zone (EEZ or Federal waters) in the Pacific Islands Region (PIR). Aquaculture in Federal waters in the PIR is not currently subject to extensive management oversight, with limited exceptions related to certain gear types used for culturing and harvesting coral reef ecosystem component species (CRECS).

Aquaculture is the propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose (NOAA 2011), and is used, for example, to produce food fish, edible algae, sport fish, bait fish, ornamental fish, and to support restoration activities. For hundreds of years, people throughout the Pacific Islands have practiced and continue to practice aquaculture in the form of fishponds and weirs. Today, aquaculture activities in the Pacific islands encompass a variety of species and systems. Offshore aquaculture is relatively new globally, and some Pacific island areas have been at the forefront of research and development for this industry.

For the United States, the PIR consists of American Samoa, Guam, Hawaii, the Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Pacific Remote Island Areas (PRIA).[5] The NMFS PIRO and the WPFMC manage fisheries in the EEZ for the PIR through four archipelagic Fishery Ecosystem Plans (FEPs) and one pelagic FEP. The WPFMC developed, and NMFS implements, these FEPs pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) requirements and processes for managing Federal fisheries.

There is a growing interest in offshore aquaculture in the PIR. However, aquaculture development in the EEZ for the PIR is hindered because there is no Federal permitting and management mechanism that can be applied to aquaculture activities other than for CRECS (50 CFR 665.121, 665.221, 665.421, 665.621), which is limited in scope and duration. In recognition of the growing need and desire to develop aquaculture, and the possibility of user conflicts and effects to the marine environment, the WPFMC recommended amending the five FEPs to establish a Federal management program for aquaculture fisheries in the EEZ for the PIR. If approved, the proposed action would establish such a program.

The proposed aquaculture management program would contain features that ensure consistency with the NMFS strategic goal to amplify the economic value of commercial and recreational fisheries while ensuring their sustainability, which includes a strategy of increased U.S. marine aquaculture production.

[5] The PRIA consists of the following island areas: Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Palmyra Atoll, and Wake Island.

1.1 Scope of this Programmatic Environmental Impact Statement

At present, NMFS does not have a WPFMC recommendation on a specific structure or scope for the aquaculture management program, nor does it have pending aquaculture proposals before the agency. “Programmatic” reviews under the National Environmental Policy Act (NEPA) are broad or high-level reviews that assess the environmental impacts of proposed policies, plans or programs under which subsequent actions may be implemented either based on the programmatic review itself, or based on subsequent NEPA reviews tiered to the programmatic review (e.g., a site- or project-specific review). Programmatic reviews often are undertaken when initiating a regional rulemaking, policy, plan, or program and/or assessing common elements or aspects of a series or suite of similar projects.

This programmatic environmental impact statement (PEIS) describes early plans to develop an aquaculture management program in the PIR. It describes early consideration of potential species for culture in offshore aquaculture facilities, potential locations, potential gear, permit application and review procedures, possible future conditions, and discusses potential mitigation measures for future aquaculture operations. It identifies programmatic alternatives and the range of potential environmental impacts expected for activities related to aquaculture operations. The PEIS is also based on currently available scientific information, as well as practical experience with existing projects. This PEIS will support tiered NEPA reviews for individual project proposals that fall within the program, but it does not supplant those reviews.

Programmatic alternatives in this PEIS do not evaluate site-specific issues associated with individual aquaculture projects. A variety of location-specific factors (e.g., oceanographic conditions, public use, threatened and endangered species, and cultural resources) may vary considerably from site to site, especially over the entirety of the PIR. In addition, project size and design would greatly influence the magnitude of the environmental impacts from given projects. A programmatic analysis cannot fully anticipate or address the combined effects of location-specific and project-specific factors. Such effects are analyzed at the project level after they have been proposed.

This PEIS is prepared using the 1978 Council on Environmental Quality (CEQ) NEPA Regulations (40 CFR Parts 1500-1508). The CEQ NEPA regulations were updated effective September 14, 2020 (85 FR 44304; July 16, 2020). According to the updated regulations, NEPA reviews initiated prior to the effective date of the revised CEQ regulations may be conducted using the 1978 version of the regulations. This review began on August 23, 2016 and NMFS has decided to proceed under the 1978 regulations.

1.2 Action area

The action area (or program area) for this PEIS encompasses the EEZ surrounding American Samoa, the Marianas Archipelago, the Hawaii Archipelago, and the PRIA (Figure 1). This includes a surface area of nearly 1.5 million mi^2 (3.9 km^2), constituting about half of the entire U.S. EEZ. This area hosts a wide variety of ocean users and activities, including, but not limited to, subsistence fishing commercial fishing, ecological and cultural conservation areas, historical sites, and military training areas. See Chapter 3 for further details on the affected environment within the action area.

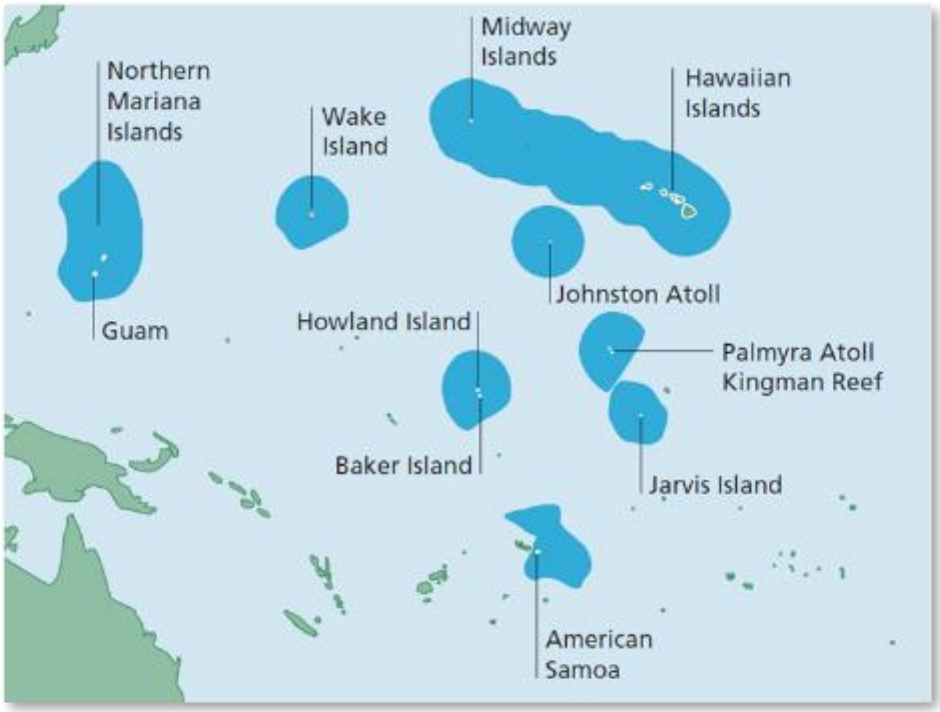

Figure 1. EEZ in the Pacific Islands Region

1.3 Proposed Action

The proposed Federal action is to identify desired elements of a comprehensive marine aquaculture management program in Federal waters of the PIR. The aquaculture management program would streamline the regulatory process for reviewing, authorizing and monitoring current and future offshore aquaculture proposals and operations in Federal waters. This PEIS outlines a status quo and two additional management alternatives for a Federal aquaculture program, should the WPFMC choose to proceed.

1.4 Purpose and Need for the Proposed Action

The purpose of this action is to identify elements of a management program so that any offshore aquaculture develops responsibly in the PIR. While the PIR has historically hosted, and continues to host, aquaculture research and development facilities, there is no comprehensive and coordinated regime for managing the growing interest in offshore aquaculture development in the region. Further, the current NMFS permitting mechanism available to aquaculture operations is too limited to accommodate the interest level and the industry's desired scope and duration of aquaculture operations. Developing an aquaculture management program would allow sustainable development of offshore aquaculture while ensuring avenues for reasonable, coordinated processes for future permit applicants. Further, a management program would ensure that aquaculture contributes responsibly to the food and economic security of the Nation.

Any future management program would be necessary to prevent future aquaculture operations for most federally managed species from developing in an ad hoc manner, inhibiting sound planning, coordination, oversight, safety, and environmental protection in the PIR. Supplementing the harvest of domestic fisheries with well-managed and safe cultured product would help the U.S. meet consumer demand for seafood and may reduce the dependence on seafood imports.

1.5 Background

1.5.1 State of Aquaculture in the U.S.

In the U.S., domestic aquaculture comprises about 7% of the total seafood production by volume and 21% by value (FUS 2018). Oyster production is the highest value and volume for domestic aquaculture, followed closely by clams by value and salmon by volume (Figure 2). Open ocean aquaculture is a nascent industry; for a full description of U.S. offshore aquaculture, please see Chapter 3.

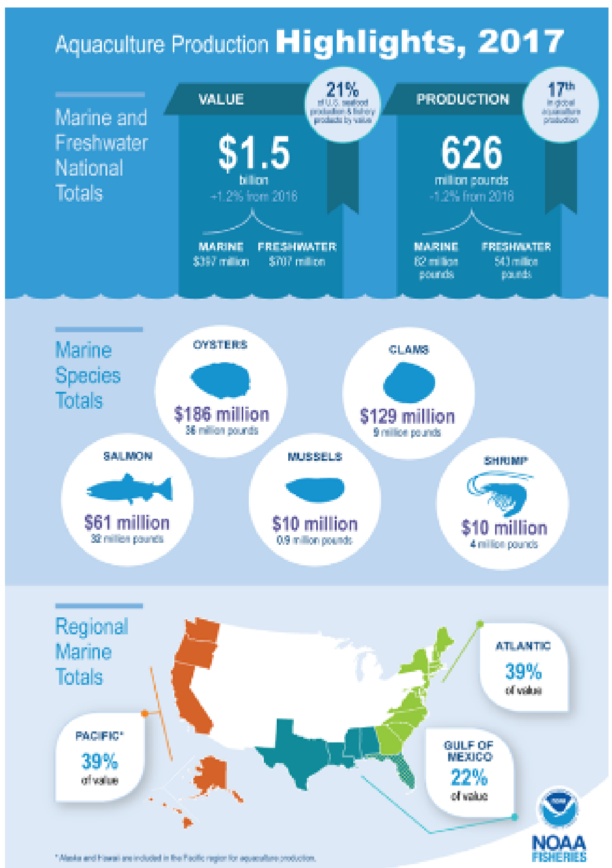

Figure 2. United States Aquaculture Production in 2017 (NOAA 2018).

1.5.2 State of Aquaculture in the Pacific Islands

There are currently two offshore aquaculture facilities operating in the PIR: one commercial facility in Hawaii state waters, and one research facility in Federal waters off the coast of Hawaii Island. Chapter 3 contains further information about the history and status of aquaculture practiced in the PIR in the respective archipelagic sections.

1.5.3 Federal Aquaculture Management Authority

The PIR Regional Administrator represents NMFS on the WPFMC and brings policy and technical advisement to WPFMC proceedings. The NMFS role in formally developing an Aquaculture Management Program would be to work as a member of the WPFMC and other stakeholder groups to develop a recommendation and, once the WPFMC makes a recommendation, NMFS is responsible for finalizing the environmental analyses and other compliance processes needed to approve FEP amendments and implement regulations. Thereafter, NMFS would administer the aquaculture management program, and would produce compliance guides. NMFS and the WPFMC would work together on outreach and education.

1.5.4 U.S. Legislative Background and Applicable Federal Laws

Many Federal statutes and Presidential Executive Orders (EOs) form the legal foundation for aquaculture and fishery management actions in the EEZ. The following includes a summary of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), The National Aquaculture Act (NAA) of 1980, and several other Federal actions relevant to aquaculture governance. Chapter 6 contains additional statutes and orders not specific to aquaculture.

Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)

The NMFS proposal to regulate marine aquaculture production and harvest in the EEZ for the PIR is authorized under the Magnuson-Stevens Act (16 U.S.C. 1801, et seq.) and associated regulations (50 CFR 600.745, 50 CFR 665). NOAA’s Aquaculture Policy defines marine aquaculture as the propagation and rearing of aquatic animals for any commercial, recreational, or public purpose (NOAA 2011). Establishing an aquaculture program for reviewing and permitting aquaculture projects is consistent with NOAA’s aquaculture policy to encourage environmentally responsible marine fisheries without threatening the long-term sustainability and viability of wild fisheries and their contributions to the local, regional, and national economies.

The primary goal of Federal fishery management, as described in National Standard 1 of the Magnuson-Stevens Act, is to conserve and manage U.S. fisheries to “...prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry” (Magnuson-Stevens Act Sec. 301(a)(1)). This Act also requires fishery management plans to describe and identify Essential Fish Habitat (EFH) for any fishery within its jurisdiction (Magnuson-Stevens Act Sec. 305(b)(1)(A)). The Magnuson-Stevens Act directs NOAA to conserve and manage all fish within the EEZ for the PIR, as well as provides for the development of fisheries. Thus, landings or possession of fish in the EEZ for the PIR from the commercial marine aquaculture production of any species managed under an FEP constitutes "fishing" as defined in the Magnuson-Stevens Act (Magnuson-Stevens Act Sec. 3(16)). Fishing includes all activities and operations related to the taking, catching, or harvesting of fish. As a result, NMFS may require permits and establish other regulatory requirements to conduct aquaculture in the EEZ.

National Aquaculture Act of 1980 (NAA)

The NAA established a national aquaculture policy declaring:

> Aquaculture has the potential for augmenting existing commercial and recreational fisheries and for producing other renewable resources, thereby assisting the U.S. in meeting its future food needs and contributing to the solution of world resource problems. It is, therefore, in the national interest, and it is the national policy, to encourage the development of aquaculture in the United States.

The NAA required the Secretaries of Commerce, Interior, and Agriculture to prepare a National Aquaculture Development Plan (NADP) that identifies potential species for commercial aquaculture development, and to discuss public and private actions and research necessary to carry out the objectives of the Act. Additionally, the NAA formally established the Joint Subcommittee on Aquaculture (JSA) to serve as a Federal government-wide coordinating group to increase the effectiveness of Federal aquaculture research and funding, as well as to provide recommendations for Federal aquaculture policy. Released in 1983, the NADP identified obstacles to the expansion of U.S. aquaculture that included:

- Poor understanding of nutrition and diets of cultured species.
- Problems in preventing and controlling disease.
- A need for education, information, and technology assistance efforts.
- A need to understand markets and marketing barriers.
- Multiple use conflicts.
- Legal constraints.
- Difficulty in locating capital for entrepreneurial exploration.
- Jurisdictional overlap and inadequate coordination at the Federal level.

The 1985 NAA reauthorization designated the U.S. Department of Agriculture (USDA) as the lead Federal agency with respect to the coordination and dissemination of national aquaculture information, including designation as the permanent chair of the JSA.

Other Federal actions related to aquaculture

In 2004, the U.S. Commission on Ocean Policy made recommendations for the advancement of marine aquaculture as part of its comprehensive review of national ocean policy. In response, U.S. Senate Commerce Committee Chairman Senators Ted Stevens and Ranking Member Daniel Inouye introduced the National Offshore Aquaculture Act of 2005 (S. 1195) to establish a permitting process for offshore aquaculture development within the EEZ and encourage private investment in aquaculture operations, demonstrations, and research. The Senate Commerce

Committee, Subcommittee on National Ocean Policy held two hearings in 2006, but the Congressional session ended before Congress acted on the bill. In 2007, the bill was revised and reintroduced in both the House and the Senate as the National Offshore Aquaculture Act of 2007, but again the Congressional session ended before Congress acted on the bill.

In 2007, NOAA completed and adopted a 10-Year Plan for Marine Aquaculture as an agency-wide policy document (NOAA 2007). The plan was prepared at the request of the agency's Marine Fisheries Advisory Committee, which advises the Secretary of Commerce on all living marine resource matters that are the responsibility of the U.S. Department of Commerce (DOC). The Secretary of Commerce also hosted a National Marine Aquaculture Summit in 2007. At the summit, national seafood and aquaculture business leaders, policy experts, government officials, non-governmental organizations, and researchers discussed the opportunities and challenges for marine aquaculture in the U.S. Summit participants also made recommendations as to how the U.S. could accelerate the integration of environmentally, economically, and socially responsible domestic aquaculture into domestic seafood production. Summit participants agreed on the need for national offshore legislation to provide regulatory certainty for those considering investing in Federal waters.

In 2011, NOAA published the Aquaculture Policy,[6] which further highlighted several national and regional goals related to offshore aquaculture, including the following:

1. Encourage and foster sustainable aquaculture development that provides domestic jobs, products, and services and that is in harmony with healthy, productive, and resilient marine ecosystems, compatible with other uses of the marine environment, and consistent with the National Policy for the Stewardship of the Ocean, our Coasts, and the Great Lakes (National Ocean Policy[7]).
2. Ensure agency aquaculture decisions protect wild species and healthy, productive, and resilient coastal and ocean ecosystems, including the protecting of sensitive marine areas.
3. Advance scientific knowledge concerning sustainable aquaculture in cooperation with academic and Federal partners.
4. Make timely and unbiased aquaculture management decisions based upon the best scientific information available.
5. Support aquaculture innovation and investments that benefit the Nation’s coastal ecosystems, communities, seafood consumers, industry, and economy.
6. Advance public understanding of sustainable aquaculture practices; the associated environmental, social, and economic challenges and benefits; and the services NOAA has to offer in support of sustainable aquaculture.

[6] The full NOAA Aquaculture Policy Statement may be viewed at: https://www.fisheries.noaa.gov/noaa-aquaculture-policies

[7] The National Ocean Policy articulates former President Barack Obama’s overarching goals, objectives, and priorities that provide a broader ocean policy context for NOAA’s aquaculture activities. Other Administration policies - such as those in support of job creation, economic development, innovation, food security, etc. - provide additional context for NOAA’s aquaculture activities.

7. Work with our Federal partners, through the JSA and other avenues, to provide the depth of resources and expertise needed to address the challenges facing expansion of aquaculture in the U.S.
8. Work internationally to learn from aquaculture best practices around the world and encourage the adoption of science-based sustainable practices and systems.
9. Integrate Federal, regional, state, local, and tribal priorities along with commercial priorities into marine aquaculture siting and management and ensure inclusion of aquaculture development within other existing and potential marine uses to reduce potential conflicts.

In 2016, NMFS published a Marine Aquaculture Strategic Plan.[8] The plan provides guidance on efforts within NMFS to support development of sustainable marine aquaculture from 2016-2020. The plan features four main goals: regulatory efficiency; science tools for sustainable management; technology development and transfer; and an informed public. Crosscutting strategies of the plan include strengthening partnerships, improving external communications, building infrastructure to support marine aquaculture, and sound program management. It also establishes a target of expanding sustainable U.S. marine aquaculture production by at least 50% by the year 2020. The alternatives presented in this PEIS align with this new Marine Aquaculture Strategic Plan.

In 2020, during the 116th Congress (2019-2020), the Advancing the Quality and Understanding of American Aquaculture (AQUAA) Act was introduced in both the U.S. House of Representatives and the U.S. Senate. The bill would direct the Department of Commerce to create an Office of Offshore Aquaculture within NOAA to coordinate regulatory, scientific, outreach, and international issues related to aquaculture, and would establish a unified permitting and review process for aquaculture operations. In the 117th Congress (2021-2022), the AQUAA Act was reintroduced in the Senate on October 28, 2021 (S. 3100) and in the House on December 14, 2021 (H.R. 6258). As of April 2022, no further action has been taken on the bills.

On May 7, 2020, Executive Order 13921 on Promoting American Seafood Competitiveness and Economic Growth was issued instructing agencies to seek streamlined solutions to aquaculture permitting and designates NOAA as the lead agency for aquaculture projects that meet all three of the following criteria:

1. Are located within the EEZ and outside of the waters of any State or Territory;
2. Require environmental review or authorization by two or more (Federal) agencies; and
3. The agency that would otherwise be lead agency has determined that it will prepare an environmental impact statement (EIS).

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[8] The NMFS Marine Aquaculture Strategic Plan can be found at: https://media.fisheries.noaa.gov/dam-migration/noaa_fisheries_marine_aquaculture_strategic_plan_fy2016-2020.pdf

The EO addresses several other aquaculture-relevant topics, including:

- Establishing Aquaculture Opportunity Areas (AOA)[9].
- Increasing interagency coordination for aquaculture permitting.
- Updating the National Aquaculture Development Plan.
- Updating the National Aquatic Animal Health Plan.

Other Relevant Statutes

Other statutes relevant to permitting aquaculture in the EEZ may include, but are not limited to, the Animal Health Act, the Clean Water Act, the Endangered Species Act, the Marine Mammal Protection Act, the Outer Continental Shelf Lands Act, and the National Marine Sanctuaries Act. These statutes authorize Federal agencies to permit certain aspects of an aquaculture operation, such as moorings and bottom leases (U.S. Army Corps of Engineers) or water quality requirements (Environmental Protection Agency). A full listing and brief overview of key statutes and EOs is located in Chapter 6.

1.5.5 Western Pacific Fishery Management Council Actions Related to Aquaculture Management

In 2009, the WPFMC started the process to formalize Federal aquaculture management. Between 2009 and 2011, the WPFMC held public meetings across the region and recommended the development of an aquaculture permitting program that incorporates environmental monitoring and remains consistent with State of Hawaii monitoring requirements. Table 2 provides an overview and chronology of WPFMC outreach and recommendations for aquaculture management in the PIR.

Table 2. Chronology of Western Pacific Fishery Management Council Actions Related to Aquaculture Management in the Pacific Islands Region

Council Meeting Number	Date	Summary of WPFMC Actions
146th	2009	WPFMC recommended developing omnibus FEP amendment to address aquaculture management and revised its Aquaculture Policy to encourage potential aquaculture operations that adhere to WPFMC guidelines
147th	2010	WPFMC staff hosted outreach meetings: • Six public meetings across Hawaii, Guam, American Samoa, and CNMI. • Ten meetings with State and Territory Advisory Panels, Plan Teams, and Regional Ecosystem Advisory Committees.

[9] An AOA is a small, defined geographic area that NOAA has evaluated through both spatial analysis and the NEPA process and determined to be environmentally, socially, and economically appropriate to support multiple commercial aquaculture operations. Identification of AOAs are not related to the proposed action and, if NOAA considers identifying AOAs in the PIR in the future, there would be a separate public comment and NEPA process.

Council Meeting Number	Date	Summary of WPFMC Actions
		WPFMC reviewed draft FEP amendment containing the following alternatives: • Permitting and reporting for aquaculture activities in Federal waters. • Prohibited areas. • Limiting the number of aquaculture operations. • Prohibiting aquaculture operations in Federal waters.
148th	2010	WPFMC recommended developing permitting and reporting requirements for aquaculture, with further direction to develop a limited entry and environmental monitoring program
151st	2011	WPFMC reviewed management options to: • Establish a control date. • Establish a limited entry program. • Recommend an environmental monitoring program. WPFMC recommended: • Conducting research to determine user capacity and conflicts, feed analysis, institutional capacity, etc. before considering a limited entry program. • Limiting participation as a future precaution and evaluated through the permitting process. • Incorporating environmental monitoring, inspection, and reporting requirements into the permitting amendment consistent with requirements already in place by the State of Hawaii or proposed through other regional/national organizations.
172nd	2018	WPFMC reviewed proposed alternatives for an early draft of this PEIS and recommended Alternative 2 as a preliminarily preferred alternative. WPFMC directed staff to prepare an amendment for final action
190th	2022	WPFMC reviewed Draft Aquaculture Management Framework PElS alternatives and: • Supported NMFS publishing the Final PElS • Supported PElS alternative 3 as its preliminarily preferred alternative • Rescinded its previously supported preliminarily preferred alternative identified at the 172nd Meeting WPFMC directed its staff to incorporate the PElS into an omnibus aquaculture FEP amendment that includes management measures and procedures

1.5.6 Cooperating Agencies

The U.S. Environmental Protection Agency is a cooperating agency for the purposes of this PEIS based on their expertise regarding National Pollution and Discharge Elimination System (NPDES) and water quality issues related to aquaculture. The U.S. Department of the Navy is a cooperating agency based on their expertise regarding military restricted zones. The following agencies have provided comments and information during its preparation: U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), U.S. Coast Guard (USGS).

1.6 Process

The PEIS would support future work by the WPFMC and NMFS to develop an aquaculture management program. The following describes the process for development and finalization of the PEIS. Updates on the PEIS schedule and anticipated publication dates are available on the program website.[10]

1.6.1 Scoping

On August 23, 2016, NMFS published a notice of intent to prepare a PEIS for aquaculture in the region. In September and October 2016, NMFS held six public scoping meetings throughout the Region as shown in Table 3.

Table 3. Dates and Locations of Public Scoping Meetings

Location	Date
NOAA Fisheries Conference Room Pago Pago, American Samoa 96799	Thursday September 8, 2016
University of Hawaii at Hilo Hilo, Hawaii 96720	Tuesday September 13, 2016
West Hawaii Civic Center Kailua-Kona, Hawaii 96740	Wednesday September 14, 2016
NOAA Fisheries Honolulu Service Center Pier 38, Honolulu, Oahu 96817	Thursday October 13, 2016
Northern Marianas College Saipan, Commonwealth of the Northern Mariana Islands 96950	Tuesday October 18, 2016
Hilton Guam Resort and Spa Tumon Bay, Guam 96913	Thursday October 20, 2016

NMFS received 38 distinct comment letters through the public scoping process. NMFS also received 28,209 copies of a form letter submitted by a non-governmental organization. Comments were both supportive and opposing an aquaculture management program.

NMFS considered the substantive comments received during the scoping process and prepared the draft PEIS (Table 4). The complete Scoping Summary Report, including additional

[10] https://www.fisheries.noaa.gov/pacific-islands/aquaculture/aquaculture-pacific-islands

information about the scoping comments received is available on the aquaculture program website.[11]

Table 4. Comments received during Scoping for the PEIS and where they are Addressed.

Comments received during scoping*	How and where comments are addressed in the PEIS
Cultural Topics	Considerations for socioeconomic impacts, including ensuring that aquaculture facilities and activities do not negatively affect cultural resources and uses or environmental justice, are in sections 4.3.5 and 5.7.
Management Plan Guidelines	Guidelines and details of each management plan alternative, permitting processes, siting considerations and restrictions, allowable aquaculture systems and species, and recordkeeping, monitoring and reporting requirements are in Chapter 2 and, particularly, section 2.2.
PEIS Analysis, Scoping Processes	The process for scoping, developing and finalizing the PEIS is in section 1.6. Details on NEPA and impact analyses are in sections 2.1.5, 2.1.6, 4.1, and 5.2.
Magnuson-Stevens Act Authority	NMFS authority to manage marine aquaculture is discussed in sections 1.5.3 and 1.5.4.
Diseases	Considerations and requirements related to diseases, other pathogens, genetics, and feeds are in sections 2.2.6 and 4.3.3.
Ecosystem Effects	Considerations for ecosystem effects including, amongst others, ecosystem health, function, and effects on wild species, are in sections 2.2.3, 4.3.1 through 4.3.4, and 5.3 through 5.6.
Pollution, Chemicals, Debris	Considerations and requirements related to pollution, chemicals, water quality, fish waste, marine debris, genetics, and feeds are in sections 2.2.1, 2.2.6, 4.3.1, 4.3.3, and 5.3.
Protected Species	Considerations, requirements and analysis related to protected species interactions, including potential for behavior change, collision, entanglement, injury or mortality, and prevention and mitigation measures, are in sections 2.2.2, 2.2.6, 4.3.4, and 5.6.
Cultured Species	Considerations and requirements for cultured species, including allowed and prohibited species, native and non-native species, and genetics are in sections 2.1.4, 2.2.5, 2.2.6, and 4.3.3.
Wild Stocks	Considerations and impacts related to wild stocks including, amongst others, broodstock, feed components, escapes, and genetics are in sections 2.2.5, 2.2.6, 4.3.3, and 5.5.

[11] https://www.fisheries.noaa.gov/action/proposed-aquaculture-management-program-Federal-waters-pacific-islands-region

Comments received during scoping*	How and where comments are addressed in the PEIS
Fishing, Economics	Considerations and analysis relating to socioeconomic impacts, including fishing, other ocean uses and users, job creation, and income are in sections 4.3.5 and 5.7.
Research	Considerations for research activities that support aquaculture development and understanding potential impacts are in sections 2.2.1, 2.2.2, and 2.2.3 and throughout Chapter 5.

* Note: the order of the topics generally aligns with the order presented in the Scoping Summary Report

1.6.2 Draft PEIS (DPEIS)

NMFS developed the DPEIS in collaboration with the WPFMC and in consideration of public comments received during scoping. The DPEIS conforms to agency policy and procedures for complying with NEPA (NOAA Administrative Order 216-6A) and guidance documents.

1.6.3 Public Review and Comment

NMFS published the DPEIS on May 7, 2021, in the *Federal Register* with a 90-day public comment period that closed on August 5, 2021 (86 FR 24616).[12] NMFS also held four virtual public meetings between June 15 and June 24, 2021 (86 FR 27836), to record oral comments on the DPEIS. NMFS reviewed and responded to substantive comments received in response to the DPEIS in a comment analysis report (see Appendix A). This report summarizes written and oral comments received throughout the comment period, the demographics of commenters, the key themes of their statements, and includes responses to the comments. This includes the written comments and summaries of the public meetings that contain close (but not exact) transcriptions of the oral comments. This report serves as a guide for reviewing the comments and should not substitute for reading the comments directly at: https://www.regulations.gov/document/NOAA-NMFS-2021-0044-0003/comment.

Table 5. Comments received during the DPEIS public comment phase and where they are incorporated. Please see Appendix A for further details and NMFS response.

Comment raised during DPEIS public comment phase	How and where comments are addressed in the PEIS
General supportive comments	
Investing in alternative aquaculture methods, rather than offshore aquaculture	No changes made to the PEIS.
Support for Alternative 1	No changes made to the PEIS.

[12] https://www.regulations.gov/docket/NOAA-NMFS-2021-0044

Comment raised during DPEIS public comment phase	How and where comments are addressed in the PEIS
Support for Alternative 2	No changes made to the PEIS.
Support for Alternative 3	No changes made to the PEIS.
Suggestions for future management program details	No changes made to the PEIS.
Legal authorities	
Legal status of offshore aquaculture in Federal waters	No changes made to the PEIS. Aquaculture, defined under the NOAA Marine Aquaculture Policy as the "propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose," may be conducted in the U.S. EEZ to the extent consistent with applicable federal laws and regulations.
Federal authority	No changes made to the PEIS. The PEIS discusses NMFS regulatory authority and relevant statutes in Sections 1.5.3 and 1.5.4. We will continue to work with stakeholders through existing policies to develop programs that continue to be and are consistent with applicable law.
Statutory requirements	• NMFS has made several changes to improve the PEIS clarity as it relates to NEPA requirements, including: • Adding a table summarizing key differences between the alternatives (Section 2.2). • Adding clarification regarding coordination of permit applications, reviews, and reporting requirements with other relevant agencies (Sections 2.2.2, 2.2.6). • Adding clarification to framework regulations and procedures that would follow a final PEIS and during program development and implementation (Section 2.3.1). • Adding clarification regarding the availability and analysis of research that is specifically for offshore aquaculture (Section 4.1.1). • Adding a summary table for environmental consequences of the alternatives (Section 4.2). • Adding information about potential greenhouse gas emissions associated with aquaculture (Section 4.3.1).

Comment raised during DPEIS public comment phase	**How and where comments are addressed in the PEIS**
	• Adding language to ensure potential for invasive species introductions are accurately outlined (Section 4.3.2). • Clarifying information around logistics and potential for recapturing escaped fish (Section 4.3.3). • Clarifying potential impacts related to cultural heritage and environmental justice (Section 4.3.5). We have added the Migratory Bird Treaty Act to Chapter 6 Applicable Laws. We have added clarifying information about the Marine Mamma Protection Act and List of Fisheries to PEIS Section 4.3.4. Though revoked, we have added the prior Executive Orders to Chapter 6 Applicable Laws for reference purposes only, not to suggest that they remain in effect.
Effluents	
Water quality impacts	We have added clarifying information to Sections 2.2.2 Applications and 2.2.6 Recordkeeping and Reporting Requirements regarding FDA requirements and engagement.
Habitat and Ecosystem Functioning	
Fish Aggregating Device (FAD) effect	We have clarified FAD effects in Section 4.3.2.
Habitat conservation	Table 7 in the PEIS identifies EFH and HAPC definitions for the Western Pacific region. We have updated this table to include a more comprehensive list. We have added clarifying information related to habitat to PEIS Sections 1.5.4, 2.2.3, 3.1.1, 3.1.2, and 4.3.2. For the two action alternatives, the siting analysis would consider all critical habitat, EFH, and HAPC.
Siting concerns	NMFS is working with the U.S. Department of the Navy, which is now a cooperating agency on this document, to ensure that any potential aquaculture siting excludes incompatible military areas. We have added more detailed information and maps to PEIS Sections 3.3.3 and 3.4.3 to

Comment raised during DPEIS public comment phase	How and where comments are addressed in the PEIS
	reflect such areas identified by the Navy in its comments on the draft PEIS. NMFS has added climate change forecasting to the potential siting restrictions listed in Section 2.2.3. We have added the Antiquities Act and the relevant Presidential Proclamations to Chapter 6 Applicable Laws.
Local Wild Fish Stocks	
Source of broodstock	No changes made to the PEIS. Under all alternatives, operations that collect broodstock from the wild will require a comprehensive plan and rigorous documentation (see PEIS Section 2.2.2). Action Alternatives 2 and 3 include a permit application process that would require stock status consideration for each proposed cultured species (see PEIS Section 2.2.5).
Potential for fish escapes	No changes made to the PEIS. The PEIS considers potential genetic and competition impacts of cultured fish escapes in Section 4.3.3. Potential impacts from, and additional prevention and mitigation measures for, fish escapes are being studied. Any future development and implementation of an aquaculture management program is a dynamic process and, as such, relevant results of such studies will be incorporated into the program as results become available.
Disease transfer	We have added potential epizootic transfer and updated several of the references in the socioeconomic impacts in PEIS Section 5.7.
Feed content	We have added clarification to the recordkeeping requirements in Section 2.2.6 to include source fisheries used in feeds.
Other Marine Wildlife and Protected Species	
Protected Species Concerns	No changes made to the PEIS. The PEIS considers entanglement, vessel strikes, and anthropogenic sound effects in Section 4.3.4. The PEIS covers FAD effects in Sections 4.3.2 and 4.3.4. This information will be incorporated into future consultations under ESA Section 7, and reporting and authorization requirements under the MMPA. As they become available, any relevant results from ongoing and possible future research and

Comment raised during DPEIS public comment phase	How and where comments are addressed in the PEIS
	development related to potential effects on marine species and mitigation measures will be incorporated into any future management program.
Wildlife behavior alteration	We have added information regarding documented cases of aquaculture interactions with protected species and the FAD effect in PEIS Section 4.3.4.
Socioeconomic Impacts	
Cultural resources and consultation	We have added information to Sections 2.2.2 Applications and 2.2.3 Siting Analysis to clarify responsibilities relevant to cultural consultation. Additional outreach and comment opportunities for public agencies, indigenous organizations, interest groups, and individuals will occur during any FEP amendment and rulemaking processes for a potential aquaculture management program.
Context with American Samoa Deeds of Cession	No changes made to the PEIS. The PEIS provides a framework for a potential future aquaculture management program and does not authorize aquaculture activities in any specific area. Any aquaculture projects proposed for American Samoa would be reviewed before approval to ensure compliance with all applicable federal laws. In addition, the MSA requires NMFS to consider, among other things, the impact of permitted activities on fishing and fishing communities, which would include the impact on cultural fishing in American Samoa.
Climate Change	We have added further information regarding potential climate change impacts throughout the cumulative effects analyzed in Chapter 5. NMFS and the Council regularly monitor the operations and require reporting for all federally managed fisheries within their jurisdiction. The same would be true under a Federal aquaculture program, as described in PEIS Chapter 2. This regular monitoring and reporting not only provides information on the effects of the fisheries' ongoing operations on a changing environment, but also the effects of changing environmental conditions on the fisheries. This information factors into ongoing NMFS and Council management decisions. Likewise, any relevant results from ongoing and possible future research related to potential effects of climate change and their relation to offshore aquaculture will be incorporated into any

Comment raised during DPEIS public comment phase	How and where comments are addressed in the PEIS
	aquaculture management program as they become available.

1.6.4 Final PEIS

This final PEIS, including the comments received on the DPEIS, will inform early program planning and coordination with the WPFMC and interested and affected members of the public, completion of a programmatic review of potential management considerations, and an analysis of potential environmental impacts. The PEIS will support tiered environmental effects analyses in the future, if necessary. NMFS is publishing this final PEIS, including a preferred action alternative, for public review, which NMFS will consider prior to publishing the Record of Decision (ROD).

2 MANAGEMENT ALTERNATIVES

2.1 Description of the Alternatives

In an environmental review document, NMFS must assess the environmental impacts of a proposal and reasonable alternatives to the proposal in comparative form. The purpose of this comparison of alternatives is to provide NMFS and the public with a clear basis for choosing among the alternatives. Alternative 1 is the No Action Alternative, as required under 40 CFR 1502.14. The No Action Alternative provides a benchmark to compare the magnitude of environmental effects of the action Alternatives 2 and 3.

NMFS developed the following alternatives, in part, based on the values and objectives expressed through public comments received during scoping meetings, as described in Section 1.6.1. The alternatives capture those values and objectives while remaining consistent with applicable Federal law (see Section 1.5). Chapter 4 contains an analysis of the effects for the proposed alternatives.

Any aquaculture program, if implemented, should provide sound conservation of the living marine resources, and socially and economically viable fisheries and fishing communities; minimize human-caused threats to protected species; and maintain healthy habitats for marine resources. The action Alternatives 2 and 3 should achieve the objectives stated in Section 1.4 without violating the Federal environmental statutes and regulations described in Section 1.5.4 and Chapter 6.

2.1.1 Alternative 1: No Action

Under the No Action Alternative, NMFS would not develop a specific aquaculture management program, nor would it create any new permits to regulate aquaculture activities, allowable species, allowable gear types, or allowable siting.

Current NMFS regulations for harvesting MUS in the PIR identify only those gear types that are prohibited (50 CFR 665.104, 665.206, 665.406, 665.810, and 600.725(v)). The regulations allow all other non-prohibited gear types, including aquaculture gear.

Unlike MUS regulations, CRECS harvest regulations in the PIR only identify allowable gear types, while prohibiting all other gear types (50 CFR 665.127, 665.227, 665.427, and 665.627). Allowable gear types for harvesting CRECS do not include aquaculture gear. The regulations, therefore, consider using aquaculture gear types for CRECS as experimental and require a special coral reef ecosystem fishing permit (SCREFP). A SCREFP may include conditions to control, monitor, and mitigate potential environmental effects. Section 2.2 below provides more information on SCREFPs.

There are no NMFS regulations applicable to aquaculture in the PIR for non-MUS and non-CRECS.

2.1.2 Alternative 2: Limited Aquaculture Management Program

Under Alternative 2, NMFS and the WPFMC would amend the FEPs and regulations to establish a new limited entry aquaculture management program. This program would include aquaculture-specific permit, application, and operational requirements for commercial and research/innovation activities. This alternative would also provide a streamlined avenue for navigating permitting processes with other relevant agencies. While this management program would be based on aquaculture activities and gear types currently or previously authorized in the PIR, it would also allow culture of current FEP MUS and ECS and provide for longer permit durations.

2.1.3 Preferred Alternative 3: Expanded Aquaculture Management Program

Preferred Alternative 3 would provide the same basic management program outlined for Alternative 2, but expanded with longer permit durations, and a broader scope of allowable species and gear types.

2.1.4 Alternatives Considered and Rejected from Further Analysis

NMFS considered and rejected the following potential alternatives for analysis. The reasoning for each rejection is below.

Aquaculture of Non-native or Genetically Engineered Species[13]

NMFS considered, but eliminated, an action alternative that would allow culture of species that are not native to the PIR or species that are genetically engineered . Evidence of the detrimental effects of non-native species on ecosystems indicates that this type of alternative could pose

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[13] Genetic engineering, as defined by the USDA: “Manipulation of an organism's genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant DNA techniques”

significant risk to the health of PIR ecosystems. Only allowing native, non-genetically engineered species for culture reduces and avoids these risks.

Prohibiting Aquaculture Operations in Federal Waters

Prohibiting aquaculture would not help the U.S. meet consumers' growing demand for seafood or reduce the Nation's dependence on seafood imports. This alternative would not meet the purpose and need of the action.

2.1.5 Environmentally Preferable Alternative

An environmentally preferable alternative is one that best meets the goals set forth in Section 101 of NEPA (42 U.S.C. 4331) because it causes the least damage to biological and physical environments and "best protects, preserves, and enhances historic, cultural, and natural resources." (43 CFR 46.30) In consideration of an agency's statutory mission, the environmentally preferable alternative may or may not be the agency-preferred alternative.

The No Action alternative (Alternative 1) provides minimal NMFS permitting for offshore aquaculture development in Federal waters under the Magnuson-Stevens Act. Under this alternative, if offshore aquaculture operations develop further, permitting would continue to be done on a case-by-case basis and in an ad hoc manner through many agencies. NMFS would have limited management over non-CRECS and would be involved through consultation (e.g.; Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA)). Without a comprehensive process for both oversight and public participation, environmental risk could increase. Therefore, while the current permitting scheme likely limits the siting and development of aquaculture facilities in the region and could lead to fewer facilities in the future, Alternative 1 is not considered the environmentally preferable alternative because facilities allowed under this alternative have the potential to cause greater adverse effects to biological and physical resources compared to Alternatives 2 and 3.

The two Action alternatives (Alternatives 2 and 3) are the environmentally preferable alternatives. Both Alternatives 2 and 3 would provide limitations on aquaculture infrastructure size in a given area and would require more comprehensive monitoring and reporting than the status quo. Alternatives 2 and 3 would also employ area-based management, which would require consideration of effects of multiple facilities in a particular location on water quality, wild species and stocks, habitats, and socioeconomics.

Both action alternatives require careful area-based management and consideration for a variety of factors in siting and operation. The environmental effects of Alternative 2 and Alternative 3 would be situational, dependent on the size and scale of individual operations that receive permits. While a shorter commercial permit duration in Alternative 2 might limit the size of an industry, a longer research permit duration under Alternative 3 could support innovation that leads to environmentally friendly answers to operational challenges.

Under any of the alternatives, NMFS would continue to follow its mandates to ensure any permitted activities would not pose unacceptable risk to the marine or human environment.

2.2 Comparison of Alternatives

Table 6 is a detailed side-by-side comparison of the three alternatives. Table 7 shows an overview of the key features for each alternative. Following that is a discussion of the details of Alternatives 2 and 3, with Alternative 1 included where relevant for comparison purposes.

Table 6. Comparison of Alternatives

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Aquaculture is managed through a comprehensive, coordinated program	No	Yes	Yes
Permit Eligibility and Transferability			
U.S. citizen, U.S. national, resident alien, or U.S. corporation/entity	Yes	Yes	Yes
Transferrable to qualified applicant.	Yes	Yes	Yes
Commercial Permit Duration and Renewal			
Up to 2 years with opportunities for renewal	Yes	No	No
Up to 10 years. Unlimited renewal if in good standing	No	Yes	No
Up to 20 years. Unlimited renewal if in good standing	No	No	Yes
Research Permit Duration and Renewal			
Up to 3 years with option for one renewal of 3 years	No	Yes	No
Up to 10 years with option for one renewal of 10 years	No	No	Yes
Dealer Permit	No	Yes	Yes
Program Capacity			
Unlimited	Yes	No	No
Limited	No	Yes	Yes
General Application Requirements			
Applicant and vessel information	Yes	Yes	Yes
Intended species	Yes	Yes	Yes
Objectives of the operation	Yes	Yes	Yes
Estimated ecosystem, habitat and protected species impacts	Yes	Yes	Yes
Detailed descriptions of site, systems, feeding	No	Yes	Yes
Risk mitigation and prevention plans	No	Yes	Yes
Emergency action plans (e.g., escapes, catastrophic failure, etc.)	Yes	Yes	Yes

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Veterinarian identification and commitment	No	Yes	Yes
Aquatic animal health plan	No	Yes	Yes
Assurance bond, decommissioning plan	No	Yes	Yes
Permit Application and Review Process			
Pre-Application Screening	No	Yes	Yes
Application Submission and Review	Yes	Yes	Yes
WPFMC Consultation	Yes	Yes	Yes
Siting Restrictions			
Specified in permit on a case-by-case basis	Yes	No	No
Comprehensive planning process for siting analysis	No	Yes	Yes
Prohibited where all commercial fishing is prohibited	No	Yes	Yes
Restrictions or prohibition near or within critical habitat, artificial reefs, special management areas, military training/transit areas, tidal buoys, legal fish aggregating devices (FAD), or commercial shipping lanes[14]	Yes	Yes	Yes
Restrictions based on depth, current, bottom type, wildlife attraction, potential algal blooms or hypoxia, or migratory pathways	No	Yes	Yes
Allowable Marine Aquaculture Systems and Technologies			
Specified in permit on a case-by-case basis	Yes	No	No
Limited to technologies previously used in the PIR, such as cages and net pens	No	Yes	No

[14] Review and permitting by other agencies requires NMFS coordination for protected species, essential fish habitat and other relevant laws.

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Any system allowed, provided it meets environmental requirements[15]	No	No	Yes
Allowable Species			
CRECS	Yes	Yes[16]	Yes
MUS and ECS	Yes	Yes[16]	Yes
Other Native Species	Yes	No	Yes
Non-Native Species	Yes	No	No
Recordkeeping and Reporting Requirements			
Specified in permit on a case-by-case basis	Yes	No	No
Production, harvest	Yes	Yes	Yes
Wild capture for broodstock	Yes	Yes	Yes
Transport	Yes	Yes	Yes
Interactions with protected resources	Yes	Yes	Yes
Escapes	Yes	Yes	Yes
Recapture of escapes	No	Yes	Yes
Mass mortality	Yes	Yes	Yes
Disease outbreaks	No	Yes	Yes
Water quality monitoring	Yes	Yes	Yes
Safety issues	No	Yes	Yes
Gear conflict issues	No	Yes	Yes
Gear failure	Yes	Yes	Yes

[15] Applicants must submit detailed information to evaluate functionality, safety, risks to habitat, protected species, wild stocks, public health or safety, or other considerations.
[16] May be limited to only species that have been previously cultured or likely to be successfully, sustainably cultured.

Management Features	Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
Feeding records	No	Yes	Yes
Other records as consistent with the operation plan	No	Yes	Yes

Table 7. Overview of key features for each alternative.

Alternative 1. No Action	Alternative 2. Limited Aquaculture Management Program	Alternative 3 (Preferred). Expanded Aquaculture Management Program
No aquaculture management program. NMFS permit not required for most species and gear types (with limited exceptions).	Comprehensive aquaculture management program that outlines requirements and processes for: • Limited entry permit. • Permit eligibility and transfer. • Application requirements, review and approval/disapproval. • Siting restrictions. • Recordkeeping and reporting. Allowable species limited to WPFMC-managed species: • Management Unit Species (MUS). • Ecosystem Component Species (ECS). • Coral Reef Ecosystem Component Species (CRECS). Permit types: • Commercial (up to 10 years). • Research (up to 3 years). • Dealer. Allowable systems (gear types): • Aquaculture systems and technologies previously approved for culture in the PIR.	Comprehensive aquaculture management program that outlines requirements and processes for: • Limited entry permit. • Permit eligibility and transfer. • Application requirements, review and approval/disapproval. • Siting restrictions. • Recordkeeping and reporting. Allowable species are limited to WPFMC - managed species: • Management Unit Species (MUS). • Ecosystem Component Species (ECS). • Coral Reef Ecosystem Component Species (CRECS). • Any native species. Permit types: • Commercial (up to 20 years). • Research (up to 6 years). • Dealer. Allowable systems (gear types): • Any aquaculture systems and technologies reviewed and approved during permit process.

2.2.1 Permits

Permit Requirements

Fishing permits are frequently required to identify participants, facilitate data gathering and scientific analysis, manage fishing activities and effort, and aid law enforcement. As described in Chapter 1, NMFS, Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (USACE) all have permitting responsibilities for offshore aquaculture operations.

Alternative 1 - Individual Special Use Fishing Permits:

NMFS would not require permits for operations raising any species, with limited exceptions for CRECS, which would require a SCREFP. Examples of potential species harvested under a SCREFP include, but are not limited to, jacks and snappers. Information regarding PIR species classified as CRECS is located at 50 CFR 665 et seq. and in the respective FEPs available on the WPFMC website.[17] Additional information about permit requirements is on the NOAA NMFS permit webpage.[18]

Alternatives 2 and 3 - Aquaculture Permitting System:

Under these alternatives, the implementation of an aquaculture-specific permit would place NMFS as the lead agency in the management of aquaculture in PIR Federal waters. Note that each Federal agency that issues a permit is required to consult with other regulatory agencies. NMFS would endeavor to coordinate these processes amongst permitting agencies. One NMFS aquaculture permit would be required for conducting offshore marine aquaculture in Federal waters. NMFS permits would authorize deployment of approved gear; operation of the approved facility at the approved site; harvest, possession, transport, landing, and sale of allowable aquaculture species. Any vessel, aircraft, or vehicle authorized for use in aquaculture operations would be required to have a copy of the permit on board to assist law enforcement in determining compliance with aquaculture regulations.

In addition to commercial permits, both Alternatives 2 and 3 would allow for a research and innovation permit option. This could act as a stepping-stone to a full commercial permit. The subsequent sections discuss the restrictions for this permit.

Eligibility and Transferability

Alternatives 1, 2, and 3: Any U.S. citizen or partnership of U.S. citizens, U.S. national, permanent resident, or U.S. corporation or other entity organized under U.S. law is eligible to apply for an aquaculture permit(s). The program may consider eligibility for other entities consistent with Federal law. All permits issued would be transferable to other eligible persons or entities upon written notice to NMFS.

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[17] www.wpcouncil.org/fishery-ecosystem-plans-amendments/

[18] https://www.fisheries.noaa.gov/pacific-islands/resources-fishing/pacific-islands-fishing-permits#coral-reef-fishing-and-precious-coral

Permit Duration and Renewal

Permit duration would depend on an applicant's request and nature of operation, species, previous experience, and potential environmental effects. NMFS could revoke permits at any time if the applicant or operation does not meet permit conditions. Duration and timing would be coordinated with other corresponding permit durations. Applicants in good standing may renew their permits. There is no limit to the number of times a permit may be renewed.

Alternative 1: No species other than CRECS require a permit. For CRECS requiring a SCRFP, there are no term limits specified in the regulations.

Alternative 2: NMFS would issue and renew commercial permits for terms of up to 10 years each. NMFS would issue and renew research permits for terms of up to 3 years each.

Preferred Alternative 3: NMFS would issue and renew commercial permits for terms of up to 20 years each. NMFS would issue and renew research permits for terms of up to 10 years each.

The extended terms for the action alternatives are intended to help reduce the financial burden of establishing an offshore aquaculture operation by allowing a permittee the time to secure investment support, develop a proof of concept, obtain any other necessary permits, and establish a stable, productive operation.

A permittee seeking renewal would be required to submit a completed renewal application form and all required supporting documents to NMFS within a specified time prior to expiration of an existing permit. If the permittee is in good standing, the information required for a renewed permit would be streamlined. Depending on scope, a permit modification may require information and review similar to the initial permit application as described below.

Dealer Permit

Alternative 1: Dealer permits are not required.

Alternatives 2 and 3: Non-transferable dealer permits and reporting would be required for anyone purchasing cultured organisms from a permitted facility for resale. Such requirements would be coordinated with any analogous regional and local (e.g., state and territorial) authorities to prevent duplication.

Program Capacity

Alternative 1 - Unrestricted Capacity:

For all species other than CRECS, no permit is required. For CRECS, there is no limited entry system for a SCREFP.

Alternatives 2 and 3 - Limited Entry Permitting Program:

Under Alternatives 2 and 3, NMFS and the WPFMC could restrict the number of commercial and research permits issued. This could be done on a region-wide basis or by sub-regions (e.g., for each island area). As with other fisheries, NMFS and the WPFMC may modify the number of permits based on new information developed as aquaculture proceeds. This could include establishing limits on participation, harvest timing, annual production capacity (e.g., production cap or catch share), cultured species, location, or activity density (i.e., the number and size of facilities within a given area).

2.2.2 Applications

General Application Requirements

Applications must include, but are not limited to, the following:

- Applicant contact information.
- Detailed description of the proposed aquaculture site.
- The objectives of the aquaculture activity, including:
    - Description of the species intended for culture, including anticipated annual production (e.g., number and weight).
    - Detailed description of the aquaculture systems and equipment employed, including support equipment.
    - Contact information and location of each feed supplier and hatchery that the applicant will use.
    - General description of the expected disposition of the resources harvested under the permit (e.g., stored live, fresh, frozen, preserved, sold for food, ornamental, research, or other use).
- For operations where broodstock will be collected from the wild:
    - A comprehensive description of the planned fishing operations, including duration, location of fishing, gear types and operations, species likely harvested, and anticipated total catch for the purposes of broodstock on an annual basis.
    - Certification that any broodstock collected for culture at the facility would be harvested from the same population or subpopulation (based on the best scientific information available) from Federal waters of the same region where the facility is located.
    - Documentation that broodstock would be marked or tagged at the hatchery.
    - For operations raising MUS: individuals captured for use as broodstock would count towards catch limits implemented by NMFS under the Magnuson-Stevens Act.
- Documentation of an assurance bond and decommissioning plan.
- Risk mitigation plans, including prevention and mitigation plans for disease transfer, escapes and protected species interactions.
- An emergency response plan, including a contingency plan for escaped cultured fish.
- An aquatic animal health plan with evidence of approval from an accredited veterinarian.

- Copy of a contractual arrangement with an accredited veterinarian, and a commitment that the following assurances will be made:
    - Certification that the applicant will not culture genetically engineered species.
    - Certification that juveniles are free from pathogens of concern (defined as any pathogens listed by the World Organisation for Animal Health (OIE) or in the National Aquatic Animal Health Plan) prior to stocking.
    - If therapeutants are used, the applicant will only administer thereapeutants approved by the Food and Drug Administration (FDA) for veterinary purposes.
- Any other information concerning the aquaculture facility or its operations or equipment, as specified on the application form.

Permit Application and Review Process

Alternative 1 - Permits follow existing procedures:

No permit would be necessary to conduct aquaculture of MUS in the EEZ. However, for aquaculture of coral reef ecosystem component species, applicants must follow the SCREP procedures codified at 50 CFR 665.124 for American Samoa, 50 CFR 665.424 for the CNMI and Guam, 50 CFR 665.224 for Hawaii, and 50 CFR 665.624 for the PRIA.

Alternatives 2 and 3 - Dedicated Permitting Process for Aquaculture:

The process for obtaining permits to establish an offshore aquaculture operation in Federal waters would have six basic steps. Subsequent guidance documentation may include a process for appealing permit decisions.

1. Pre-Application Screening. Prospective applicants would provide general project information in a pre-application checklist to NMFS PIRO. Based on the proposed activity, and vested interest in ocean uses in the specific proposed site, NMFS PIRO would forward this information to other relevant agencies for review and comment. These agencies can include, but are not limited to, Federal, state, territory and/or local agencies with responsibility (e.g., permitting, authorizing, and management) or other expertise in natural area and/or cultural uses in the proposed area. This review would help identify requirements for other agencies early in the process to ensure a streamlined, coordinated process for permitting. NMFS will collect all agency comments and return them to the applicant. The agencies will determine whether additional consultation under ESA, MMPA, or other relevant law (e.g., NEPA) is necessary for the proposed project. The applicant may also request to schedule a pre-application meeting with NMFS and other applicable Federal, state or territorial agencies, during which time agencies and the applicant discuss any questions or concerns about the proposed project and guidance regarding application process. Following the pre-application step, the applicant may prepare and submit a permit application in the form provided by NMFS.
2. Application Review. A completed aquaculture permit application and required supporting documents submitted to NMFS would be reviewed and a preliminary determination made whether the application contains all required information (i.e., is “complete”) and warrants further consideration. NMFS PIRO will notify an applicant of an incomplete

application within a specified time of application receipt, including a description of incomplete or additional information required. Based on permitting requirements of other Federal agencies, prospective applicants would submit other required information or agency-specific permit applications to those agencies in tandem (or sooner depending on other agency permit timelines) with the NMFS application process. Failure to submit required information to other agencies in a timely manner could result in a delay in NMFS's decision on the application and issuance of the NMFS permit.

3. WPFMC Consultation. NMFS would consult with the WPFMC concerning the application. NMFS would notify applicants in advance of any WPFMC meeting where the application may be considered and the applicant will have the opportunity to appear in support of the application through public testimony. The WPFMC may also seek guidance from its advisory bodies on the proposed project prior to providing its recommendations to NMFS.
4. Determination of Permit Issuance. As soon as is practicable after consultation with WPFMC, NMFS will make a decision whether or not to issue the aquaculture permit. NMFS may recommend that the applicant revise the application in response to comments from the WPFMC or its advisory bodies before making a final decision. Upon reaching a final decision, NMFS will notify the applicant in writing, including reasons for approval or denial. The decision would be eligible for an appeal process. The decision to approve or deny the application could be based on, amongst others:
    a. Information provided by the applicant.
    b. Current harvest and stock status of the cultured species.
    c. Estimated impacts of the proposed activity on ecosystems, habitats, and protected species.
    d. Other biological and ecological information relevant to the proposal.
5. Permit Issuance and Operational Phase. If approved, NMFS will issue the written permit simultaneously with its approval notice to the applicant. The permit will specify terms and conditions for incorporation into the construction, deployment, operation, and maintenance of the project. Some permit requirements would be common to all aquaculture operations, such as adherence to protected species laws, while others may be tailored to an individual operation. Note that each Federal agency that issues a permit is required to consult with other regulatory agencies and may solicit public input regarding the potential impacts of each proposed project. The permit terms and conditions may reflect these consultations. NMFS will endeavor to coordinate these processes amongst permitting agencies, including permit durations. All agencies must issue the required permits before operations may commence (i.e., before structures or animals may be placed in the water). The WPFMC will consider further details for the permit issuance and operational phase if it decides to develop a coordinated, comprehensive program.

2.2.3 Siting Restrictions

Proper siting of an aquaculture facility is critical to both an operation's success and the protection of the surrounding physical, biological, and ecological environments. In considering potential sites, a number of factors are particularly relevant, and the applicant should be aware that these would be material considerations when assessing permit applications.[19]

Alternative 1 - Existing Restrictions:

Siting restrictions are limited to those outlined by NMFS and other agencies requiring coordination for protected species, essential fish habitat and other relevant laws. Otherwise, there are no explicit siting restrictions within the Western Pacific Fishery regulations as outlined in 50 CFR part 665.

Alternatives 2 and 3 - Area-Based Management:

Placement and spacing between aquaculture facilities would be determined on a project-specific basis according to the facility details and best available science, and relative to other ocean users. Aquaculture facilities would be required to identify the boundaries of the facility.

Siting factors could include, but are not limited to:

- Environmental considerations such as:
    - Proximity to critical habitat, EFH, habitat areas of particular concern (HAPC)[20], artificial reefs, or special management areas.
    - Depth, current, bottom type.
    - Wildlife attraction or migratory pathways.
    - Potential algal blooms or hypoxia.
    - Climate change forecasting.
- Cumulative interactions with existing area activities:
    - Impact and proximity to navigation and fisheries (e.g., commercial shipping lanes or fishing grounds).
    - Impact and proximity to military activities or restricted areas (e.g., training ranges, defensive sea areas or transit areas).
    - Effects on recreation and tourism.
    - Scenarios regarding changes in boating, fishing or other constituent behavior.
    - Impact and proximity to other marine spatial planning frameworks.
- Impacts from methods of operation (e.g., lighting, noise, visual amenity, etc.).
- Proximity to markets and ports with particular demographic profiles.
- Implications for environmental justice (e.g., impacts on minority and low-income groups).

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[19] In an activity completely separate from this PEIS, NMFS may establish a limited number of marine aquaculture opportunity areas (AOAs) to provide a streamlined approach to permitting. AOAs would not be exclusive zones only for aquaculture, nor would an aquaculture facility be required to site within them. AOA establishment would follow a public process including environmental review. An AOA would provide a pre-assessment of these factors, which would assist advanced planning for operation density in a given area.

[20] Federal actions, in general, do not need to avoid HAPC but will receive greater scrutiny during the EFH consultation process when HAPC may be affected.

- Implications for cultural activities and culturally important areas.
- Availability of any access and necessary infrastructure.
- Proximity to marine protected areas.
- Proximity to DOD training, testing, or restricted zones.

To prevent impacts to the biological and physical environments, NMFS could consider other siting restriction criteria on an individual project basis. NMFS and partner agencies would establish siting guidance, requirements, and restrictions.

2.2.4 Allowable Marine Aquaculture Systems

Alternative 1 - No prohibitions on marine aquaculture systems:

Systems restrictions are limited to those outlined by NMFS and other agencies on an individual basis and requiring coordination for protected species, essential fish habitat and other relevant laws. Otherwise, there are no explicit prohibitions on aquaculture systems or gear types within the Western Pacific Fishery regulations as outlined in 50 CFR part 665.

Alternative 2 - Cages and net pens only:

Management under this alternative would only allow cages and net pens of specific construction and size ranges. Floating or submerged net-pens or cages are the most commonly used offshore finfish aquaculture systems and have been utilized in the PIR previously. This alternative limits the allowable aquaculture systems to minimize the uncertainty associated with the potential effects of new systems. Using known systems may also help to expedite application review. Management under this alternative would not allow aquaculture system designs that do not meet the definition of a cage or net pen.

Preferred Alternative 3 - No prohibitions on marine aquaculture systems

This alternative proposes no specific prohibitions for marine aquaculture systems, so systems other than traditional cages and net pens (e.g., longline culture for bivalves) could be permissible. Applicants would be required to submit detailed information on the proposed system in their application, which would allow NMFS to conduct project-specific reviews. In addition, applicants must submit documentation sufficient to evaluate the structural integrity of the system, especially its ability to withstand physical stresses associated with the open ocean and storm events. NMFS may deny use of a proposed system or specify conditions for its use if it poses significant risks to essential fish habitat, endangered or threatened species, marine mammals, wild fish and invertebrate stocks, public health, or safety.

2.2.5 Allowable Species

Alternative 1 - All species allowed:

With limited exceptions for CRECS, there is no restriction on any species for culture within the Western Pacific Fishery regulations as outlined in 50 CFR part 665. Culturing CRECS would require a SCREFP.

Alternative 2 - WPFMC-managed native species only:

This alternative would only permit native species managed by the WPFMC. The relevant Archipelagic or Pelagic FEP must list these species as an MUS or ECS for culture. The permit application process would consider the stock status for each proposed cultured species. Stock enhancement would be considered on a case-by-case basis. This alternative would prohibit genetically engineered[21] species.

Preferred Alternative 3 - All native species allowed:

This alternative would allow all species to be cultured provided they are native to the region of the proposed aquaculture facility, regardless of whether their management status under the WPFMC. The permit application process would consider the stock status for each proposed cultured species. Stock enhancement would be considered on a case-by-case basis. This alternative would prohibit genetically engineered[21] species.

2.2.6 Recordkeeping and Reporting Requirements

Alternative 1: For non-CRECS, there are no NMFS permits, so there are no NMFS recordkeeping and reporting requirements. There may be such requirements for permits from other agencies. Recordkeeping and reporting may be included in the conditions for maintaining a SCREFP (50 CFR 665.13).

Alternative 2 and 3: Recordkeeping and reporting requirements would be part of the conditions for maintaining an aquaculture permit and would allow NMFS to evaluate the impacts of a marine aquaculture operation. Requirements would be consistent among all permits issued and consultation requirements would be coordinated with other relevant permitting agencies. Permit validity and renewal would be contingent upon adherence to reporting requirements.

Recordkeeping

Under Alternatives 2 and 3, required records include:

- Valid paperwork for all required Federal, state and/or territorial permits or licenses.
- Number and pounds of harvested cultured species.
- Major escapes of the cultured species.
- Entanglements or other interactions with protected species.
- Detection or outbreak of reportable diseases or pathogens as required by OIE or in the National Aquatic Animal Health Plan.

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[21] Genetic engineering, as defined by the USDA: "Manipulation of an organism's genes by introducing, eliminating or rearranging specific genes using the methods of modern molecular biology, particularly those techniques referred to as recombinant DNA techniques"

- Dosage and frequency of any FDA-approved[22] antibiotics or other therapeutant[23] administration, if applicable.
- Human health and safety issues.
- Records relating to feed purchases, source fisheries used in feeds, juvenile and seed suppliers, sales records, transport records.
- Current documentation, registration and ownership information for project vessels and aircraft owned or contracted for the operation, along with names and contact information for employed or contracted captains and pilots.
- Any other appropriate recordkeeping and reporting requirements necessary for evaluating and assessing the environmental impacts of an aquaculture operation and compliance with permit terms and conditions.

Reporting

Permitees must notify NMFS in writing of the following:

- Escapes. For major escapes, which will be defined in greater detail if a management program is developed, the following information shall be provided to NMFS within 24 hours of discovery of the event:
    - Permit number, contact person name and phone number.
    - Specific location and cause of the escape(s).
    - Number, species, size and percent of cultured organism that escaped.
    - Response and actions taken, including any recaptures, system repairs and further prevention measures.

If no major escape occurs during a given year, then the permittee shall provide NMFS with an annual report on or before January 31 each year indicating this.

- Interactions with protected species (e.g., entanglement, entrapment, etc.). For any interactions with protected species (e.g., marine mammals, sea turtles, migratory birds) the following information shall be provided within 24 hours of discovery of the event:
    - Permit Number, contact person name and phone number.
    - Date and time of entanglement or interaction, if known.
    - Nature of entanglement or interaction, and species and numbers of individuals affected.
    - Number of mortalities and/or injuries observed.
    - Cause and resolution of the entanglement or interaction.
    - Actions to prevent future entanglements or interactions.

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[22] https://www.fda.gov/animal-veterinary/aquaculture/approved-aquaculture-drugs

[23] A therapeutant can be any substance used to maintain the health of a cultured organism.

If no entanglement or interaction occurs during a given year, then the permittee shall provide NMFS with an annual report on or before January 31 each year indicating this.

- Disease. Any findings or suspected findings of reportable diseases or pathogens as required by OIE or the National Aquatic Animal Health Plan shall be reported within 24 hours including the following information:
  - Permit number, contact person name and phone number.
  - Identification of the pathogen.
  - Percent of cultured species infected.
  - Findings of the aquatic animal health expert.
  - Plans for submission of specimens for confirmatory testing.
  - Testing results (where applicable).
  - Actions taken to address the episode, including administration of any FDA-approved antibiotics.

If there are no outbreaks during a given year, then the permittee shall provide NMFS with an annual report on or before January 31 each year indicating this.

- Capture of broodstock. At least 30 days prior to collection activities, a permittee shall provide the following information:
  - Number of animals, species, and size.
  - Methods, gears, and vessels (including U.S. Coast Guard (USCG) documentation or state or territory registration) used for capturing, holding, and transporting.
  - Date and specific location of intended harvest.
  - Location to which broodstock will be delivered.

2.3 Program Implementation

If the WPFMC amends the FEPs to include aquaculture activities, the aquaculture program would develop permitting and operational requirements, review and process applications, issue permits, monitor and evaluate permitted operations and facilities, and revise permitting or operating requirements, as needed. The FEP amendment process requires the opportunity for additional public input.

2.3.1 Framework Regulations and Procedures

Effectiveness of the program depends heavily on the foresight exercised in preparing the amendments to the FEPs to include aquaculture management, the scope of the PEIS and its impact analysis, and on identification of data needs to monitor the changing conditions in the aquaculture program. The WPFMC is considering amending each of its five FEPs to include the aquaculture program. To the extent possible, once FEPs are amended, future management actions taken within any aquaculture program may fall under a framework that allows for future adjustment to management measures provided the changes fall within the scope and criteria established by the FEP amendment and implementing regulations, as evaluated in the PEIS, or subsequent NEPA analysis supporting the aquaculture FEP amendment.

This is different from the process of revising a management program through yet another FEP amendment, where future adjustments and associated analyses are not generally considered. Therefore, the framework will describe future management actions, which would be implemented within a range as defined and analyzed in the aquaculture FEP amendment and associated analyses. The framework process would also require consultation pursuant to the ESA and Magnuson-Stevens Act (EFH, HAPC) among other relevant statutes.

This subsequent FEP process would establish framework regulations similar to those existing in 50 CFR 665.18, which includes considering periodic reports and input from WPFMC members and WPFMC advisory bodies, its Scientific and Statistical Committee, and periodic review of the management program by the WPFMC for recommending modifications to and new management measures for the program. Measures adjusted through framework procedures and subsequent NMFS regulations may include, but are not limited to:

- Adjustments to harvest limits and annual planned production levels.
- Permit application requirements.
- Aquaculture operational requirements and restrictions.
- Requirements for allowable aquaculture systems and gear.
- Siting requirements.
- Economic and social considerations.
- Recordkeeping and reporting requirements.
- Additional species not currently managed by the WPFMC.

The WPFMC would review any proposed recommendations and determine whether changes to the program are needed. Opportunities for public comment and input would be available before any proposed changes to regulatory measures are approved. After public input, the WPFMC would submit findings on the need for changes to aquaculture management measures, if any, and advise NMFS in writing of its recommendations. All relevant background material, analysis and public comments would accompany any WPFMC recommendations.

NMFS would review the WPFMC recommendations for consistency with the goals and objectives of the FEPs and all applicable laws. If NMFS concurs with the recommendations, NMFS will draft regulations and implement them through standard Federal rulemaking processes, notices and opportunity for public comment. If NMFS rejects the recommendations, NMFS will notify the WPFMC in writing of the reasons for rejection and existing regulations would remain in effect.

2.3.2 Best Management Practices (BMPs)

NMFS recognizes the importance of using BMPs during development and throughout implementation of the offshore aquaculture program. Chapter 4 discusses BMPs and mitigation measures necessary for implementing the preferred alternative, which would undergo further development in subsequent guidance documents. BMPs would help minimize potential impacts to wild fish stocks, marine mammals, protected resources, essential fish habitat (EFH), and other resources managed by NMFS and the WPFMC. Applicants would need to provide sufficient detail about their proposed aquaculture project to allow NMFS to determine whether the proposed project satisfies specific BMP criteria and would not pose unacceptable risk to the marine or human environment.

2.3.3 Mitigation Measures

Under all three alternatives, mitigation measures would be components of the permit approval and aquaculture operational processes. The following mitigation measures aim to avoid or minimize potential negative impacts of offshore marine aquaculture:

- Siting analysis, limitations and requirements.
- USACE and USCG review and permitting with respect to siting, anchoring, aids to navigation, and identification and marking to protect maritime navigation.
- Monitoring of the physical and biological environment, water quality, feed, and effluent, including required EPA discharge permitting and monitoring.
- Regular inspections by permittees of all equipment to ensure proper function, condition, maintenance, and repair.
- Required recordkeeping and regular reporting by permittees, and periodic onsite inspection by NMFS and other authorities to ensure compliance with permit terms and conditions and to inform adaptive management.
- Prohibitions on culturing non-native species under Alternatives 2 and 3.
- Compliance with requirements of the Food, Drug and Cosmetic Act, and the Clean Water Act, among others.

3 AFFECTED ENVIRONMENT

3.1 Pacific Islands Region

The resources in this region are governed by one of five Fishery Ecosystem Plans (FEPs) developed by the WPFMC and NMFS. The FEPs include the American Samoa Archipelago FEP, the Hawaii Archipelago FEP, the Mariana Archipelago FEP (which covers EEZ waters around Guam and the CNMI), and the PRIA FEP. Lastly, the Pacific Pelagic FEP covers management of highly migratory pelagic fishery resources such as tunas and billfish, which play an important role in the biological and socioeconomic environment of the western Pacific region.

Because the action area is the EEZ, most of the natural resources and human activities align with pelagic habitat, as the ocean depths at 3 nm from nearly any shore in the PIR are considered the pelagic zone. As such, we present a full description of the pelagic resources common to all areas first. The following archipelagic sections outline characteristics unique to the specific respective FEP areas. Chapter 1 contains a map of the action area.

3.1.1 Physical Environment

The Pacific Pelagic FEP describes the physical environment of the greater Western Pacific Ocean in detail (WPFMC 2009d). In addition to the pelagic habitat, this document includes descriptions of deep reef slopes, banks and seamounts, and the deep ocean floor. Each of the corresponding FEPs contains additional archipelagic-specific information.

Temperatures

In the Western Pacific, the thermocline (transition layer between warmer mixed surface water and cooler deep water) is generally from 1,312 to 2,624 ft deep (400 to 800 m) and forms a temperature gradient that inhibits mixing with the surface layer. Surface temperatures range from 72°F to 77°F (22°C to 25°C) throughout the year (Hawaii Ocean Time-Series 2015). Below the thermocline, water temperature is constant, between 32°F and 39°F (0 and 4°C).

Light Penetration and Turbidity

Light penetration decreases with depth. The epipelagic zone extends from the surface to nearly 656 ft (200 m). This is where virtually all primary productivity occurs. Below 656 ft, sunlight is too faint to drive photosynthesis. When waters become turbid, signaling excessive undissolved organic material, light penetration reduces substantially. This is rare in open-ocean, oligotrophic waters and is generally a coastal phenomenon in the PIR.

Salinity, Dissolved Oxygen, Chlorophyll a, pH, Nitrogen

Over the last twenty years, salinity in the north Pacific ranged from 34.8 to 35.3 parts per thousand (ppt). In general, variation in salinity inversely relates to rainfall, with lower salinity near the equator where rainfall is more prevalent, and higher salinity in northern latitudes where rainfall is lower. In any given area, there are fluctuations throughout the year, caused by different weather patterns; however, the salinity remains relatively constant in wider Pacific Ocean (Hawaii Ocean Time-Series 2015).

Dissolved oxygen (DO) at the surface is at a constant around 200 μmol kg^{-1}. DO remains steady to 2 mi (3.2 km) deep, decreasing to 50 μmol kg^{-1} at 4 mi (6.4 km). Since this depth is outside the typical specification range for cages, the working range for aquaculture would be 200 μmol kg^{-1} (Hawaii Ocean Time-Series, 2015).

Chlorophyll concentration is a useful proxy for primary production. Average chlorophyll at Station ALOHA (A Long-term Oligotrophic Habitat Assessment, 22°45’N, 158°00’W, located approximately 62 mi (100 km) north of Oahu, Hawaii) is 27 mg/m^2, with large seasonal fluctuations (Hawaii Ocean Time-Series, 2015). Over the last 20 years, pH has been steadily declining from 8.12 to 8.04 (Hawaii Ocean Time-Series, 2015).

Nitrogen over the last twenty years has averaged 4.5 mg $m^{-2}d^{-1}$. Large seasonal fluctuations range from a high of 9 mg $m^{-2}d^{-1}$ to a low of 1.25 mg m-2d^{-1} (Hawaii Ocean Time-Series, 2015).

Hypoxic Waters

Hypoxic waters, where the concentration of DO in the water column decreases to a level that can no longer support living aquatic organisms, occur when DO levels drop below 2 mg/L. These areas, commonly called “dead zones,” generally occur near inhabited coastlines with significant run-off. There are no known hypoxic waters in the EEZ of the PIR, and only a few in very isolated marine waters adjacent to land (e.g., some harbors).

Geological Features

The majority of the benthic environment within the program area is deep ocean floor, with an average depth of 16,400 ft (5,000 m). The seafloor is categorized as either hard bottom (consolidated rock) or sediment. The type of sediment varies with depth and region and is either categorized as carbonates or terrigenous.

Banks and seamounts are common topographical features around active seafloor areas. Banks are generally volcanic structures of various sizes and occur both on the continental shelf and in oceanic waters. Coralline structures tend to be associated with shallower parts of the banks as reef-building corals are generally restricted to a maximum depth of 100 ft (30 m). Deeper parts of banks may be composed of rock, coral rubble, sand, or shell deposits. Banks thus support a variety of habitats that in turn support a variety of fish species (Levington 1995).

Seamounts are undersea mountains, mostly of volcanic origin, which rise steeply from the sea bottom and do not rise above sea level (Rogers 1994). Hawaii has 219 seamounts within its EEZ and American Samoa has 34, Guam has 45, and the CNMI has 147 (Allain et al. 2008). Seamounts have complex effects on ocean circulation including the Taylor column, when eddies trapped over seamounts form quasi-closed circulations. This likely helps retain pelagic larvae around seamounts and maintain the local fish population, thus contributing to the role of seamounts as stepping stones for transoceanic dispersal (Wilson and Kaufman 1987).

On banks and seamounts, species composition varies with depth, with a rapid decrease in species richness typically occurring between 650 and 1,300 ft (200 and 400 m) (Chave and Mundy 1994).

Oceanographic Features

While the pelagic environment is thought to be devoid of physical features, surface and deep-water currents, convergence zones and fronts (upwelling and downwelling of water), thermoclines and haloclines (where temperature and salinity change quickly with depth), do create structure in the open-ocean that influences biological production. In addition, the impact of the atmosphere, which creates wind waves and facilitates the mixing of the surface waters, penetrates to approximately 1,300 ft (400 m).

The Hawaii Ocean Time-Series (HOT) program has been conducting monthly cruises to the deep water (> 13,000 ft [4,000 m]) at station ALOHA since 1988. Scientists have been collecting data on the hydrography, chemistry, and biology of the water column to develop the most comprehensive representation of the North Pacific subtropical gyre, and subsequently the best proxy for ocean water quality in the action area.

Surface Currents and Eddies

Wind is the predominant driver for surface currents, but they are predictable enough to be mapped and named. These currents transport plankton, fish, heat, momentum, salts, oxygen, and carbon dioxide.

Eddies are short- to medium-lived circular currents that spin off surface currents. They play important roles in regional climate (e.g., heat exchange) as well as the distribution of marine organisms. Persistent eddies generated by the interaction of the North Equatorial Current with the island of Hawaii have been an area of interest for open-ocean aquaculture research (i.e., the Velella project). These eddies propel deep, nutrient-rich cold water to the surface which can create localized increases in primary production (Bigg 2003). The edges of eddies, where the mixing is greatest, are often targeted by fishermen as these are areas of high biological productivity.

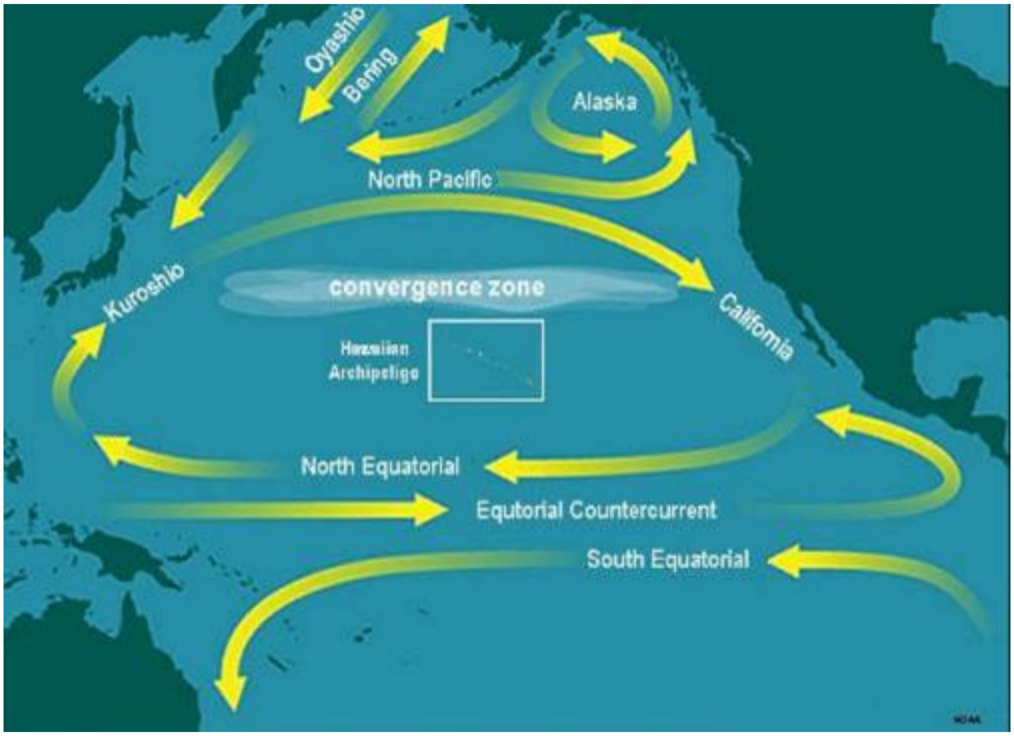

Figure 3. Surface Currents and Eddies in the Pacific Ocean

Transition Zones

Transition zones are areas of ocean water bounded to the north and south by large-scale surface currents originating from subarctic and subtropical locations (Polovina et al. 2001). The North Pacific Transition Zone (NPTZ) migrates 1,000 mi (1,609 m) between summer and winter. It supports a marine food chain that experiences variation in localized productivity due to changes in nutrient levels brought on, for example, by storms or eddies. Some of the most abundant animals found in the Transition Zone such as flying squid, blue sharks, Pacific pomfret, and Pacific saury undergo seasonal migrations from summer feeding grounds in subarctic waters to winter spawning grounds in the subtropical waters. Other animals found in the NPTZ include swordfish, tuna, albatross, whales, and sea turtles (Polovina et al. 2001). In the winter months, the NPTZ may occur within the northernmost portion of the EEZ around Hawaii, although it predominantly occurs in international waters.

Extreme Weather

On average, four to five tropical cyclones occur in the central Pacific Ocean basin (between 140-180º W) each year. The Northeast Pacific activity generally begins in late May/early June and goes until late October/early November with a peak in late August/early September (Neumann et al. 1993). The frequency and severity of extreme weather events are expected to shift as the region experiences the effects of climate change.

Designated Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC)

The Magnuson-Stevens Act defines EFH as those waters and substrate necessary for fish spawning, breeding, feeding, and growth to maturity. This includes the marine areas and their chemical and biological properties that the organism utilizes. Substrate includes sediment, hard bottom, and other structures (including artificial) underlying the water column along with their associated biological communities. HAPCs are subsets of EFH that exhibit one or more of the following traits: rarity, stressed by development, providing important ecological functions for federally managed species, or are especially vulnerable to anthropogenic (or human impact) degradation. They can cover a specific location (a bank or ledge, spawning location) or cover habitat that is found at many locations (e.g., coral, nearshore nursery areas, or pupping grounds) (Magnuson-Stevens Act Sec. 305(b)(1)(A)). Table 8 outlines the relevant EFH and HAPC within the PIR. The shoreline and the seaward boundary of the EEZ bound all areas, unless otherwise indicated. This PEIS covers EFH that exists within the action area defined in Section 1.2. For any future management program, effects to EFH would be considered for a specific site and would be evaluated on a site-specific and habitat-wide basis.

Table 8. Detailed EFH Designations for Managed Commercial Fisheries in the PIR (source: WPFMC 2009d, WPFMC 2009e, WPFMC and NMFS 2018).

FEP, Fishery, Stock or Stock Complex	Life Stage(s)	EFH Designation
American Samoa Archipelago FEP		
Bottomfish, Shallow-water and deep-water complexes	Egg/larval	The water column extending from the shoreline to the outer limit of the EEZ to a depth of 400 m.
	Juvenile/adult	The water column and all bottom habitat extending from the shoreline to a depth of 400 m.
Marianas FEP		
Bottomfish, Shallow-water and deep-water complexes	Egg/larval	The water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m.
	Juvenile/adult	The water column and all bottom habitat extending from the shoreline to a depth of 400 m.
Hawaii Archipelago FEP		
Crustaceans, Kona Crab	Egg/larval	The water column from the shoreline to the outer limit of the EEZ to a depth of 150 m.
	Juvenile/adult	All of the bottom habitat from the shoreline to a depth of 100 m.
Crustaceans, Deepwater shrimp	Egg/larval	The water column and associated outer reef slopes between 550 and 700 m.
	Juvenile/adult	The outer reef slopes at depths between 300 and 700 m.
Bottomfish, Shallow stocks: *Aprion virescens*	Egg	Pelagic zone of the water column in depths from the surface to 240 m, extending from the official US baseline to a line on which each point is 50 miles from the baseline.
	Post-hatch pelagic	Pelagic zone of the water column in depths from the surface to 240 m, extending from the official US baseline to the EEZ boundary.
	Post-settlement	Benthic or benthopelagic zones, including all bottom habitats, in depths from the surface to 240 m bounded by the official US baseline and 240 m isobath.
	Sub-adult/adult	Benthopelagic zone, including all bottom habitats, in depths from the surface to 240 m bounded by the official US baseline and 240 m isobath.

FEP, Fishery, Stock or Stock Complex	Life Stage(s)	EFH Designation
Bottomfish, Intermediate stocks: *Aphareus rutilans, Pristipomoides filamentosus, Hyporthodus quernus*	Eggs	Pelagic zone of the water column in depths from the surface to 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*) extending from the official US baseline to a line on which each point is 50 miles from the baseline.
	Post-hatch pelagic	Pelagic zone of the water column in depths from the surface 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*), extending from the official US baseline to the EEZ boundary.
	Post-settlement	Benthic (*H. quernus* and *A. rutilans*) or benthopelagic (*A. rutilans* and *P. filamentosus)* zones, including all bottom habitats, in depths from the surface to 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*) bounded by the 40 m isobath and 100 m (*P. filamentosus),* 280 m (*A. rutilans*) or 320 m (*H. quernus*) isobaths.
	Sub-adult/adult	Benthic (*H. quernus*) or benthopelagic (*A. rutilans* and *P. filamentosus)* zones, including all bottom habitats, in depths from the surface to 280 m (*A. rutilans* and *P. filamentosus*) or 320 m (*H. quernus*) bounded by the 40 m isobath and 280 m (*A. rutilans and P. filamentosus*) or 320 m (*H. quernus*) isobaths.
Bottomfish, Deep stocks: *Etelis carbunculus, Etelis coruscans, Pristipomoides sieboldii*, *Pristipomoides zonatus*	Eggs	Pelagic zone of the water column in depths from the surface to 400 m, extending from the official US baseline to a line on which each point is 50 miles from the baseline.
	Post-hatch pelagic	Pelagic zone of the water column in depths from the surface to 400 m, extending from the official US baseline to the EEZ boundary.
	Post-settlement	Benthic zone, including all bottom habitats, in depths from 80 to 400 m bounded by the official US baseline and 400 m isobath.
	Sub-adult/adult	Benthic (*E. carbunculus* and *P. zonatus*) or benthopelagic (*E. coruscans*) zones, including all bottom habitats, in depths from 80 to 400 m bounded by the official US baseline and 400 m isobaths.
Bottomfish, Seamount Groundfish	Eggs and post-hatch pelagic	Pelagic zone of the water column in depths from the surface to 600 m, bounded by the official US baseline and 600 m isobath, in waters within the EEZ that are west of 180°W and north of 28°N.

FEP, Fishery, Stock or Stock Complex	Life Stage(s)	EFH Designation
	Post-settlement	Benthic or benthopelagic zone in depths from 120 m to 600 m bounded by the 120 m and 600 m isobaths, in all waters and bottom habitat, within the EEZ that are west of 180°W and north of 28°N.
	Sub-adult/adult	Benthopelagic zone in depths from 120 m to 600 m bounded by the 120 m and 600 m isobaths, in all waters and bottom habitat, within the EEZ that are west of 180°W and north of 28°N.
Precious Coral, Deep water	Benthic	Six known precious coral beds located off Keahole Point, Makapuu, Kaena Point, Wespac bed, Brooks Bank, and 180 Fathom Bank.
Precious Coral, Shallow-water	Benthic	Three beds known for black corals in the MHI between Milolii and South Point on the Big Island, the Auau Channel, and the southern border of Kauai.
Pelagic FEP		
All pelagic fisheries, Tropical and temperate	Egg/larval	The water column down to a depth of 200 m from the shoreline to the outer limit of the EEZ.
	Juvenile/adult	The water column down to a depth of 1,000 m.
PRIA FEP		
Bottomfish, Shallow-water and deep-water complexes	Egg/larval	The water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Labridae	Egg/larval	The water column and all bottom habitat from the shoreline to the outer boundary of the EEZ to a depth of 100 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Octopodidae	Egg	All coral, rocky, and sand-bottom areas to a depth of 100 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Carcharhinidae	Egg/larval	No designation.
Coral Reef Ecosystem, All other currently harvested coral reef taxa	Egg/larval Egg/larval/juvenile –Kyphosidae only Larval – Octopodidae only	The water column from the shoreline to the outer boundary of the EEZ to a depth of 100 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Carcharhinidae, Labridae	Juvenile/adult	All bottom habitat and the adjacent water column to a depth of 100 m to the outer extent of the EEZ.

FEP, Fishery, Stock or Stock Complex	Life Stage(s)	EFH Designation
Coral Reef Ecosystem, Currently harvested coral reef taxa, Holocentridae and Muraenidae	Juvenile/adult	All rocky and coral areas and the adjacent water column to a depth of 100 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Kuhliidae	Juvenile/adult	All bottom habitat and the adjacent water column to a depth of 50 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Kyphosidae	Adult	All rocky and coral bottom habitat and the adjacent water column to a depth of 30 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Mullidae, Octopodidae, Polynemidae, Priacanthidae	Juvenile/adult	All rocky/coral bottom and sand bottom habitat and the adjacent water column to a depth of 100 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Mugilidae	Juvenile/adult	All sand and mud bottom and the adjacent water column to a depth of 50 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Scombridae (dogtooth tuna), Sphyraenidae	Juvenile/adult	Only the water column from the shoreline to the outer boundary of the EEZ to a depth of 100 m.
Coral Reef Ecosystem, Currently harvested coral reef taxa, Aquarium Species/Taxa	Juvenile/adult	Coral, rubble, and other hard-bottom features and the adjacent water column to a depth of 100 m.
Coral Reef Ecosystem, All other currently harvested coral reef taxa	Juvenile/adult	All bottom habitat and the adjacent water column to a depth of 100 m.
	All life stages	The water column and all bottom habitat from the shoreline to the outer boundary of the EEZ to a depth of 100 m.
Crustaceans, Kona crab	Egg/larval	The water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m.
	Juvenile/adult	All of the bottom habitat from the shoreline to a depth of 100 m.
Crustaceans, Lobster complex: *Panulirus marginatus, P. penicillatus, P. spp., Scyllarides haanii, Parribacus antarcticus*	Egg/larval	The water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m.
	Juvenile/adult	All of the bottom habitat from the shoreline to a depth of 100 m.

3.1.2 Biological Environment

The Final EIS for the Pelagic FEP describes the biological environment of the pelagic realm of the PIR, including the species addressed in this PEIS, and is incorporated herein by reference (WPFMC 2009d).

Benthic and Sessile Organisms

Marine invertebrates are a diverse group that includes corals, jellyfish, sponges, gastropods, cephalopods, bivalves, sea cucumbers, sea urchins and crustaceans. Most invertebrates are mobile, and can move freely in the environment. However, corals and sponges remain in one location upon settling out of the water column as larvae. In shallower nearshore areas corals, sponges and invertebrates occur in much higher densities than those in deeper offshore habitats. This section focuses on corals, which provide foundational habitat both in shallow and deep waters.

Deep Ocean Floor

The deep ocean floor is composed of mostly mud and sand, supporting very low densities of deposit feeders and suspension feeders. Photosynthesis-related primary productivity is near zero and most organisms rely on food from the surface waters that sinks to the bottom. Some areas of the deep ocean contain an accumulation of the shells of marine microbes composed of silicates and calcium carbonates, termed ‘biogenic ooze’ (Chester 2003). The prevalence of carnivorous species is extremely low due to the lack of available prey (Levington 1995).

Nearshore Reefs

Corals in nearshore (i.e., intertidal to 3nm from shore) habitats are primarily the well-known reef-building types in the class Anthozoa. These corals extract calcium from seawater to construct limestone skeletons that form reefs. Reef-building corals have a symbiotic relationship with photosynthetic algae, called zooxanthellae. Zooxanthellae provide corals with food and nutrients generated by photosynthesis, and in return, the corals provide a protected living environment for the algae. This relationship requires clear waters with low productivity to allow for photosynthesis (Sumich 1996). It also limits the depth at which reef-building corals can live. Maximum growth occurs at depths of 16 to 50 ft (5 to 15 m), with maximum species diversity occurring at 33 to 100 ft (10-30 m) (WPFMC 2009d). One hundred feet (30 m) is the depth at which growth rates slow, and may inhibit corals from adapting to a changing sea level. Reef-building corals generally do not occur at depths greater than 330 ft (100 m) (WPFMC 2009d), though there are limited examples of corals growing at depths of up to 984ft (300m). These Mesophotic corals are not well understood, though research on mapping their locations throughout the PIR is ongoing (Bauer et al. 2016, Blyth-Skyrme et al. 2013, Boland et al. 2020, Costa et al. 2012, Costa et al. 2015, Montgomery et al. 2019, Pyle et al. 2016, Rooney et al. 2010, Spalding et al. 2019, Suke and Rooney 2017). Corals can supplement their nutrition by actively feeding on zooplankton and absorbing dissolved organic nitrogen in the water column (WPFMC 2009d).

A coral reef ecosystem is one of the most productive systems in the world, despite being located in nutrient poor waters. The estimate for number of organisms associated with a coral reef is ranges from one to ten million (WPFMC 2009d). Coral reefs around the world are in decline for a wide range of reasons: disease, impacts from human activity, the effects of climate change, and aquatic invasive species (Brainard et al. 2011). The most notable threats associated with climate change resulting in warmer water temperatures cause corals to expel algae (zooxanthellae) living in their tissue. The coral turns white (called 'bleaching') and may survive the event, but is more susceptible to other threats like disease and pollution. As immobile or sessile organisms, corals cannot move away from these threats and are generally experience adverse impacts. Likewise, mobile organisms that depend on the coral reef habitat for survival experience adverse impacts from these threats.

Offshore Reefs

Offshore reefs (beyond 3nm from shore) are comprised of different classes of corals, although these organisms often constitute much of the habitat complexity on the deep ocean floor. Deep sea corals occur at depths to 10,000 ft (3050 m). These are complex and fragile organisms typically growing on continental shelves and slopes, in offshore canyons, and oceanic slopes and seamounts (NOAA 2010). Deep sea corals and sponges lack the symbiotic algae of shallow water corals, and do not rely on sunlight to grow (Lumsden 2007). They are typically found in areas swept by strong bottom currents greater than 0.5 kt (>25 cm/sec), which prevent the accumulation of sediments that could smother them (WPFMC 2009d).

Deep sea corals are slow growing and long lived (WPFMC 2009d). Two corals species observed in Hawaii waters have estimated ages exceeding 1,000 years. The age estimate for a species of gold coral (*Gerardia* spp.) was 2,742 years old, while a species of black coral (*Leiopathes* spp.) was estimated at 4,265 years old. These corals can form colonies over 300 ft (91 m) tall, creating important deep-sea habitats utilized by many different organisms (Lumsden 2007). Deep sea corals include over 3,000 species (Lumsden 2007). Black corals are most frequently found in vertical drop offs, which typically occur in depths of 98 to 328 ft (30-100 m). Pink, bamboo, and gold corals are typically found in deeper water ranging from 1,312 to 5,000 ft (400-1,500 m) (Grigg 1993).

Deep sea corals are also valuable resources. Red and pink corals (Family Coralliidae), black corals (Order Antipatharia) and gold corals (Family Gerardiidae) are prized as jewelry products. Bamboo coral (Family Isididae) could act as a potential aid for bone grafts and other medical uses thanks to their collagen-like skeleton. The medical field may also benefit from the bioactive compounds contained in several species of deep sea corals (Lumsden 2007).

Potential Aquaculture Species

This section describes the life history characteristics of Pacific MUS that are most likely to be cultured under this action, either because they are currently cultured (in either state or Federal waters) or may be commercially important if cultured. The annual Stock Assessment and Fishery Evaluation (SAFE) reports contain full descriptions of these species (WPFMC 2020a, WPFMC 2020b, WPFMC 2020c, WPFMC 2020d, and WPFMC 2020e). In the near term, culture of oysters, algae, and aquarium fish in the western Pacific region is expected to occur nearshore or on land.

Species Currently or Previously Cultured in State and Federal Waters of the PIR

Almaco Jack (Amberjack, Kahala) (*Seriola rivoliana*)

Under a permit from the State of Hawaii, Kona Blue /Blue Ocean Mariculture have commercially cultured Almaco jack (amberjack, kahala) off the Kona coast of the island of Hawaii since 2005. To distinguish the fish from the wild caught species, Kona Blue Water Farms renamed the cultured species "kampachi," which has later been revised to "kanpachi" to better represent the Japanese characters in the original spelling.

Under a Federal special permit for new gear type, Forever Oceans raises Almaco jack in a research facility located 5.5 nm (10 km) west of Keauhou Bay on the island of Hawaii. The current permit authorizes the culture and harvest of 120,000 lbs. (54,400 kg) of kanpachi over roughly 1 year (SCREFP no. WP-CRSP-03).

Almaco jack range throughout the Pacific, occurring in deep seaward reefs (16 to 525 ft (5 - 160 m) deep), while occasionally entering shallower waters (WPFMC 2020c). Due to its prey preference, this species is susceptible to carrying ciguatera fish poisoning (CFP), which is a human foodborne illness that causes gastrointestinal and neurological symptoms (Tamaru et al. 2016). Culturing almaco jack greatly reduces the risk of carrying this disease, since their controlled diet reduces exposure to ciguatoxin, the causative agent (Friedman et al. 2017).

NMFS manages Almaco jack as part of the jack family in the PIR; however, they are not currently subject to annual catch limits.

Forktail Rabbitfish (*Siganus argenteus*)

Forktail rabbitfish live throughout the Marianas Archipelago and American Samoa, inhabiting coastal seagrass beds, shallow reefs, and lagoons (WPFMC 2009a, WPFMC 2009b). This is an herbivorous species, feeding on red and green algae in shallow water up to 131 ft (40 m).

Currently the Northern Marianas College in the CNMI is culturing this species. The study focuses on improvements to larval culture with the goal of providing fingerlings to local grow-out facilities. Rabbitfish are an important foodfish and successful aquaculture would provide an additional food supply to the islands (Ogo 2015).

Within the Marianas, rabbitfish are one of the most harvested coral reef species groups. They are most common in Guam, decreasing in abundance moving northward along the Marianas Archipelago. There are six species of rabbitfish within the Marianas and the annual catch limit (ACL) is for the whole group. The 2016 ACL in the CNMI was 10,200 lbs (4,600 kg) and in Guam was 18,600 lbs. (8,437kg) (WPFMC 2017b). The most recent SAFE report does not include ACLs for this species (WPFMC 2020b).

Forktail rabbitfish are also in lower abundance around American Samoa (Carpenter et al. 2016). The American Samoa ACL specifically for rabbitfish was 163 pounds in 2016 (WPFMC 2017a). NMFS has not conducted a stock assessment on this species or species group.

Pacific Threadfin (Moi) (*Polydactylus sexfilis*)

Pacific threadfin, known as moi in Hawaii, is a coastal species that occupies mangrove, lagoon, estuarine, soft substrate, and surf zone areas and occur throughout the PIR. Filaments under their jaws help them search for prey, crustaceans or small fish, in soft sediments (WPFMC 2009c).

In 2000, a pilot open-ocean aquaculture operation cultured moi in an Ocean Spar Sea Station 3000 cage at a depth of 100 ft (30 m) off the coast of Honolulu, Hawaii. This operation cultured roughly 70,000 moi from fingerlings to harvest over the course of a year. This study demonstrated that shallow water species could survive culture in deeper water (Helsley 2000). Moi are not currently commercially cultured in the PIR, although the species was included on an experimental permit for Kona Blue Water Farms in 2011.

There are neither ACLs nor stock assessment established for this species. Historically, commercial catches diminished extensively from the 1950s-1970s, though there have been restocking efforts through the Oceanic Institute on Oahu (Friedlander and Ziemann 2003). In Hawaii state waters, size and bag limits, as well as a closed season are part of the state management of moi (DLNR n.d.).

Species with Commercial Importance in the PIR

There are no operations currently culturing the following species in the PIR; however, there is likely to be regional interest in developing aquaculture programs due to their commercial importance. With the exception of yellowfin tuna and dolphinfish, the current state of science regarding these species viability as aquaculture species (from egg to harvest) is either minimal or non-existent.

Albacore (*Thunnus alalunga*)

There are two main albacore stocks in the Central and South Pacific: the northern and southern stocks. Each stock has separate spawning areas and seasons (150°E to 120°W). Albacore are concentrated between 10°S and 30°S; in the west they may be found as far as 50º S. They spawn in the summer in subtropical waters; however, they are absent from the equatorial eastern Pacific. Hawaii appears to be at the southern edge of their range (WPFMC 2009d).

Albacore are both surface dwelling and deep swimming. Deep-swimming albacore are generally more concentrated in the western Pacific but with eastward extensions along 30°N and 10°S (Foreman 1980). The 15.6° to 19.4° C SST isotherms mark the limits of abundant distribution although deep-swimming albacore tuna have been found in waters between 13.5° and 25.2° C (Saito 1973). Generally, albacore have different temperature preferences according to size, with larger fish preferring cooler water, although the opposite is true in the northeast Pacific. They are considered epi- and mesopelagic in depth range. While the stock has exhibited a long-term decline, the stock is not in an overfished state and overfishing is not taking place (WCPFC 2019a).

Bigeye tuna (*Thunnus obesus*)

Bigeye tuna are widely distributed across the Pacific between 40°N and 30°S. Relative to yellowfin, bigeye tuna inhabit cooler, deeper waters with temperatures of 55°F - 84°F (13°C - 29°C), where they forage on cephalopods and crustaceans. In summer months, data have shown bigeye tuna congregating around 30°N in a highly stratified area with large plankton blooms (WPFMC 2009d). There is a single Pacific stock for bigeye tuna; however, studies indicate isolated populations with restricted gene flow. Low catch rates between principal fishing grounds and limited data indicate minimal mixing of tag populations from each of the eastern and western/central areas, which provides evidence for two separate populations (WPFMC 2009d).

Researchers have observed a semi-resident juvenile and sub-adult bigeye tuna population around the islands and seamount of Hawaii, and Johnston and Palmyra Atolls (WPFMC 2009d), likely expanding into the oceanic environment and tropical spawning grounds as adults. The most recent stock assessment for this species indicates that the stock is not in an overfished state and overfishing is not taking place (WCPFC 2019b).

Skipjack tuna (*Katsuwonus pelamis*)

Morphological and genetic research indicates that skipjack tuna is one worldwide species, and no subspecies are recognized (WPFMC 2009d). The species is genetically heterogeneous and found in large schools across the Pacific. They prefer warm, well-mixed surface waters, particularly areas where a shallow salinity maximum occurs seasonally or permanently (Barkley 1969, Barkley et al. 1978)

Skipjack tuna spawn year-round in tropical waters so it is not uncommon to find eggs and larvae present much of the time. Pre-recruits disperse from the central Pacific, arriving in the eastern Pacific at 1-1.5 years old and return to the central Pacific at 2-2.5 years old (Wild and Hampton 1994). The most recent stock assessment for Western and Central Pacific skipjack stock indicates that the stock is currently moderately exploited and the level of fishing mortality is sustainable (WPFMC 2020e).

Yellowfin Tuna (*Thunnus albacares*)

Yellowfin tuna occur worldwide in tropical waters, moving freely across ocean basins following favorable water temperatures, including migrating to high latitudes as water temperatures increase in summer. Yellowfin tuna tend to occupy shallower and warmer waters within the upper mixed layer, with an ideal temperature range between 64.4°F to 87.8°F (18°C - 31°C) (WPFMC 2009d). Within the Pacific yellowfin is widely distributed from 35°N - 33°S in the Eastern Pacific Ocean and 40°N - 35°S in the Western Central Pacific Ocean (WPFMC 2009d). While no known physical or physiological barriers exist, tagging data suggest restricted movement between the eastern and western central Pacific, possibly restricting gene flow. Demonstrating two separate Pacific populations requires further research (Schaefer 1989, 1991 as cited in WPFMC 2009d).

Drifting flotsam, anchored buoys, or FAD are known attractants for juvenile and adult yellowfin. Adult yellowfin also aggregate in areas of higher productivity and high zooplankton density, including seamounts, areas of upwelling, and convergence zones surface waters (Blackburn 1969; Cole 1980; Wild 1994; Suzuki 1994 all as cited in WPFMC 2009d). The most recent stock assessment for this species indicates that the stock is not experiencing overfishing and the stock is not in an overfished condition (WCPFC 2019c).

Giant Trevally (*Caranx ignobilis*) and Bluefin Trevally (*Caranx melampygus*)

The giant trevally and bluefin trevally occur in American Samoa, Hawaii, and the Marianas Archipelago (Smith-Vaniz and Williams 2017). These two species were included as potential aquaculture species in the Hawaii State aquaculture permit originally issued to Kona Blue Water Farms (now Blue Ocean Mariculture).

Both species occur along rocky shorelines, embayments, and reefs in shallow or deep-waters. Their habitat within the EEZ extends from the shoreline to the outer limit of the EEZ down to 400 m depth (WPFMC 2009d). Peak spawning occurs around the full moon in summer months. The giant trevally and bluefin trevally are carnivorous fish, and ciguatera poisoning is common in these apex predators. Surveys conducted between 2009 and 2014 found that bluefin trevally had a lower abundance around populated islands (i.e., southern Mariana Islands and Main Hawaiian Islands). The giant trevally was less abundant than the bluefin trevally across its range, exhibiting high densities in the Northwestern Hawaiian Islands (Smith-Vaniz and Williams 2017). The most recent stock assessment for this species indicates that the stock is not experiencing overfishing and the stock is not in an overfished condition (WPFMC 2020b, WPFMC 2020c).

Dolphinfish (*Coryphaena hippurus*)

Dolphinfish, or mahi, occurs worldwide in tropical to sub-tropical waters, typically in open waters near coastal areas in ~280 ft (85 m) deep and are known to congregate around fish aggregating devices (FAD) (Collette et al. 2011). Dolphinfish are fast-growing, early maturing and short-lived, feeding on squid and small fish (Froese and Pauly 2015).

Significant research has been, and is currently being, conducted to develop aquaculture production of mahi, which was determined to be technically feasible in the 1970s (Benetti 2001). Although there is an advanced state of knowledge surrounding mahi maturation, spawning, larval husbandry, nursery, growout, diseases, and bioenergetics, mahi have high nutritional and water quality requirements that can impact economic feasibility for aquaculture production. There is no current determination on whether dolphinfish are overfished or experiencing overfishing (WPFMC 2020d).

Additional Commercially-Important Species

Table 9 outlines additional commercially-important species that may garner regional interest as potential aquaculture species.

Table 9. Additional commercially-important species in the PIR.

Note: population status is stock-dependent. Some species have multiple stock status conditions, based on the location of the fishery. Some species are not assessed or caught in all island areas.

Common name	Scientific name	Population Status	Source
Blue marlin	*Makaira mazara*	Not currently overfished, not experiencing overfishing	WCPFC 2019d
Deepwater shrimp	*Heterocarpus* spp.	Undetermined, most recent assessment in 1992	WPFMC 2020c
Pink snapper	*Pristipomoides filamentosus*	Not currently overfished, not experiencing overfishing Currently overfished, experiencing overfishing	WPFMC 2020b, WPFMC 2020c WPFMC 2020a
Hawaiian sea bass	*Epinephelus quernus*	Not currently overfished, not experiencing overfishing	WPFMC 2020c
Kona crab	*Ranina*	Not currently overfished, not experiencing overfishing	WPFMC 2020c
Lavender snapper	*Pristipomoides sieboldii*	Not currently overfished, not experiencing overfishing	WPFMC 2020b, WPFMC 2020c
Long tailed pink snapper	*Aphareus rutilans*	Not currently overfished, not experiencing overfishing	WPFMC 2020b, WPFMC 2020c
Oblique banded snapper	*Pristipomoides zonatus*	Not currently overfished, not experiencing overfishing Currently overfished, experiencing overfishing	WPFMC 2020b, WPFMC 2020c WPFMC 2020a
Pacific striped marlin	*Tetrapturus auda*	Currently overfished, experiencing overfishing	WPFMC 2020d
Ruby snapper, red snapper	*Etelis carbunculus*	Not currently overfished, not experiencing overfishing Currently overfished, experiencing overfishing	WPFMC 2020b, WPFMC 2020c WPFMC 2020a
Longtail snapper	*Etelis coruscans*	Not currently overfished, not experiencing overfishing Currently overfished, experiencing overfishing	WPFMC 2020b, WPFMC 2020c WPFMC 2020a
Slipper lobster	*Scyllarides* spp., *Arctides* spp.	No stock assessment available.	
Spiny lobster	*Panulirus* spp.	No stock assessment available.	
Swordfish	*Xiphias gladius*	Not currently overfished, not experiencing overfishing	WPCFC 2019f

Common name	Scientific name	Population Status	Source
Wahoo	*Acanthocybium solandri*	Undetermined; unlikely to be overfished or experiencing overfishing	WPFMC 2020d; Zischke and Griffiths 2016

Protected Species

Federal waters of the PIR are home to the following protected species that could be impacted by aquaculture facilities. This analysis excludes other protected species occurring primarily in nearshore waters (0-3 nm) of the PIR.

Corals and Invertebrates

There are seven ESA-listed corals and invertebrates in the PIR, all of which are listed as 'threatened.' All of these species occur primarily in nearshore areas, with the exception of the *Acropora globiceps* coral and the chambered nautilus (*Nautilus pompilius*). These two species are infrequently encountered in the offshore areas of the PIR, though they have been sighted or captured in offshore waters around American Samoa. Section 3.2.2 discusses the life history characteristics and abundance of these two species in further detail.

Marine Mammals

The Marine Mammal Protection Act (MMPA) protects all marine mammals, and some mammal species receive additional protection under the Endangered Species Act (ESA). There are twenty-five marine mammals protected under MMPA and present within the action area (See Table 10). Of those, seven are endangered under the ESA: the blue whale (*Balaenoptera musculus*), Main Hawaiian Islands Insular false killer whale (MHI IFKW) (*Pseudorca crassidens*), fin whale (*Balaenoptera physalus*), Hawaiian monk seal (*Neomonachus schauinslandi*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*) and sperm whale (*Physeter macrocephalus*). With the exception of the Hawaiian monk seal and the MHI IFKW whose ranges are limited to Hawaii, all of these endangered species range throughout the PIR.

Table 10. Marine Mammals in the PIR

Order	Common Name	Scientific Name	Endangered?
Baleen Whales (suborder Mysticeti)	Blue Whale	*Balaenoptera musculus*	Yes
	Bryde's Whale	*Balaenoptera brydei*	No
	Fin Whale	*Balaenoptera physalus*	Yes
	Humpback Whale	*Megaptera novaeangliae*	Yes
	Minke Whale	*Balaenoptera acutorostrata*	No
	Sei Whale	*Balaenoptera borealis*	Yes

Order	Common Name	Scientific Name	Endangered?
Toothed Whales (suborder Odontoceti)	Blainville's Beaked Whale	*Mesoplodon densirostris*	No
	Cuvier's Beaked Whale	*Ziphius cavirostris*	No
	Dwarf Sperm Whale	*Kogia sima*	No
	False Killer Whale	*Pseudorca crassidens*	Yes[24]
	Ginkgo-Toothed Whale	*Mesoplodon ginkgodens*	No
	Killer Whale (Orca)	*Orcinus orca*	No
	Longman's Beaked Whale	*Indopacetus pacificus*	No
	Melon Headed Whale	*Peponocephala electra*	No
	Pygmy Killer Whale	*Feresa attenuata*	No
	Pygmy Sperm Whale	*Kogia breviceps*	No
	Short Finned Pilot Whale	*Globicephala macrorhynchus*	No
	Sperm Whale	*Physeter macrocephalus*	Yes
	Bottlenose Dolphin	*Tursiops truncatus*	No
	Fraser's Dolphin	*Lagenodelphis hosei*	No
	Pantropical Spotted Dolphin	*Stenella attenuata*	No
	Risso's Dolphin	*Grampus griseus*	No
	Rough Toothed Dolphin	*Steno bredanensis*	No
	Spinner Dolphin	*Stenella longirostris*	No
	Spotted Dolphin	*Stenella attenuata*	No
	Striped Dolphin	*Stenella coeruleoalba*	No
	Pacific White-Sided Dolphin	*Lagenorhynchus obliquidens*	No
Phocidae	Hawaiian Monk Seal	*Neomonachus schauinslandi*	Yes

The following are more details about the endangered marine mammals that occur within the PIR.

Blue Whale (*Balaenoptera musculus*)

The blue whale is a baleen whale in the suborder Mysticeti. It is the largest mammal on the planet, growing up to 109 ft (33 m) in length. It is endangered under the ESA and is considered depleted under the MMPA (NMFS 2016b). Blue whales range throughout all oceans except the Arctic, and some regional seas such as the Mediterranean, Okhotsk, and Bering Seas (Reilly et al. 2008a). These animals were once abundant throughout the ocean; however, due to whaling pressure, populations have seen a massive decline. From 1868-1976 industrial whaling killed an estimated 365,870 blue whales worldwide, with a majority taken near Baja California, Mexico and the South Aleutians (Stafford et al. 2001).

The current global population estimate for the species is between 10,000-25,000 individuals. This is about 3-11% of the population in 1911and is considered to be increasing (Reilly et al. 2008a). Blue whales found within the PIR are part of the Central Pacific stock (NMFS 2016b). This stock likely spends summers south of the Aleutians and the Gulf of Alaska, and migrates to

[24] Only the MHI IFKW distinct population segment is endangered.

lower latitudes in the Western Pacific, and less frequently the central Pacific, in the winter (Stafford et al. 2001).

Overall, the migration patterns of the blue whale are not well understood, with some whales remaining in the same area for years, while others travel from higher latitudes to lower latitudes. Blue whales are rare in the PIR, as waters that surround the islands are oligotrophic and typically lack the krill and copepods that blue whales eat. However, data collected during a 2010 systematic survey off Hawaii resulted in an abundance estimate of 81 blue whales within the EEZ around Hawaii during summer and fall (Bradford et al. 2013). Although the majority of blue whales range at higher latitude feeding grounds during summer/fall, this is the best abundance estimate for the Central North Pacific stock (Carretta et al. 2013). There are no recent sighting records for the blue whale around the Marianas Islands, although this area is in the distribution range for this species (WPFMC 2009b).

Blue whales feed almost exclusively on different types of zooplankton. Several stocks of blue whales exhibit a behavior called lunge feeding and consume approximately 6 tons of zooplankton per day (Reilly et al. 2008a). The whales feed at the surface and at depths of up to 1,090 ft (330 m), following their prey's diurnal vertical migrations (Reilly et al. 2008a).

Fin Whale (*Balaenoptera physalus*)

The fin whale is a baleen whale found throughout the world's oceans, typically between 20°-75°N and south latitudes. They are listed as endangered under the ESA and as depleted under the MMPA (Reilly et al. 2013). Pacific fin whale population structure is not well known, and NMFS has designated three stocks of fin whale in the North Pacific: The Hawaii stock; the California/Oregon/Washington stock; and the Alaska stock (Carretta 2013).

Data suggests that there is year-round movement, with marked seasonal distribution for the Pacific, but no specific migration patterns (Watkins et al. 2000). These whales are rare in Hawaii waters, with no sightings in the CNMI, Guam or American Samoa (Hamilton 2009, Oleson 2013, WPFMC 2009c, and WPFMC 2009d). However, acoustic testing within the Mariana Islands confirmed that fin whales transit within the region (Oleson 2013). The most recent North Pacific fin whale population assessment is from 1973. This estimate showed a decline from 44,000 individuals to 17,000 in 1975 (Reilly et al. 2013). Campbell et al. (2015) reported no significant changes to the fin whale population off the coast of Southern California, which indicates the population is potentially stable.

Fin whales are opportunistic feeders, preying heavily on fish and crustaceans, including krill when available (NMFS 2015a). These whales most likely feed on the source that is available at the time, and will shift should another prey source become more available (Reilly et al. 2013).

Humpback Whale (*Megaptera novaenagliae*)

The humpback whale is a baleen whale found throughout the world's oceans. Humpback whales are filter feeders, consuming up to 3,000 lbs. (1360 kg) of krill and small fish each day (Reilly et al. 2008b). The Hawaii, Western North Pacific, and Oceania stocks found in the PIR are three of the fourteen global humpback whale stocks (NMFS 2016c). Of these stocks, only the Western

North Pacific is listed as endangered and depleted under the MMPA. The Hawaiian stock was recently delisted, and this stock, along with the Oceania stock, is no longer considered depleted under the MMPA (NMFS 2016c). The Oceania Distinct Population Segment (DPS) consists of whales that breed/winter in the South Pacific Islands, including American Samoa (NMFS 2016c). Individuals in this population migrate to a largely undescribed Antarctic feeding area. A recent survey in 2008 estimated the Western North Pacific population at 1,100 individuals. Whaling also severely depleted this population before global protection measures were adopted in 1966. Evidence suggests that the population of the Western North Pacific stock is increasing, but a comprehensive assessment has not been completed (Reilly et al. 2008b). Humpback whales undertake a long annual migration from spring/summer feeding grounds in higher latitudes, to warm tropical and subtropical waters to calf and mate in the fall/winter. The Western North Pacific stock spends October - July in the warm waters with individuals sighted in the Mariana Archipelago (Reilly et al. 2008b). Recently, these sightings provide evidence to confirm a breeding ground in the Marianas for western North Pacific Humpback Whales (Hill et al. 2020). Humpback whales have excellent low frequency hearing. Though they are capable of producing frequencies between 25 Hz to 10 kHz, they may have sensitivity to frequencies between 40 Hz to 16 kHz (NMFS 2016g).

Sei Whale (*Balaenoptera borealis*)

The sei whale is a baleen whale found throughout the world's oceans, separated into a Northern Hemisphere subspecies, *Balaenoptera borealis borealis*, and a Southern Hemisphere subspecies, *B. b. schlegellii* (NMFS 2014a). The sei whale is endangered under the ESA and a depleted designation under the MMPA. Sei whales migrate between tropical and subtropical latitude during the winter and temperate and sub polar latitudes in the summer (NMFS 2014a). Population abundance in the in the North Pacific was estimated to be 58,000-62,000 in 1974, but whaling decreased the population to an estimated 9,110 individuals in the North Pacific as of 2004 (Reilly at al. 2008c; DOD 2015). In 2010, the sei whale abundance estimate within the EEZ around Hawaii was 93 individuals (NMFS 2014a). In 2007 there were sixteen sei whales sighted within the waters of the Mariana Archipelago, resulting in an abundance estimate of 166 individuals (DOD 2015). The global population and population trend is unknown, but a decrease in sightings indicates that these whales are rare and in low abundance (Reilly et al. 2008c).

In the north Pacific, sei whales feed on a diversity of prey, including copepods, krill, fish and cephalopods (Reilly et al., 2008c). Sei whales, like other large baleen whales, are susceptible to ship strikes and entanglement in fishing gear (Carretta et al. 2011). There are rare reports of human-caused deaths and this is likely due to their largely offshore distribution (Bradford and Lyman, 2013).

Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the largest toothed whale, has a global distribution, and typically lives in waters deeper than 3,280 ft (1,000 m). Females and young usually remain in latitudes lower than 40-50° where temperatures are warmer, while sexually immature males occur in colder waters, migrating to mate in warmer waters (Taylor et al. 2008). The sperm whale has an endangered listing under the ESA and depleted designation under the MMPA. The International Whaling

Commission divided the north Pacific into two management regions, western and eastern stocks (Donovan 1991).[25] NMFS designated three stocks in the north Pacific: (1) the Hawaii stock, (2) the California/Oregon/Washington stock, and (3) the Alaska stock (Carretta 2013). There is minimal information on sperm whales in American Samoa and the Mariana Archipelago. The global population is between 200,000 and 1,500,000 animals (NMFS 2014b). A 2010 population assessment estimated 3,354 whales in the EEZ around Hawaii (Bradford et al. 2013). Sperm whale sightings in American Samoa are year-round, except in February and March (WPFMC 2009a). A 2011 population assessment estimated 705 whales in the Mariana Islands (Fulling et al. 2011).

Sperm whales forage during deep dives that routinely exceed a depth of 1,314 ft (400 m) and 30-minute duration, feeding on squid, other cephalopods, sharks and bottom-dwelling fish and invertebrates (NMFS 2014b). Whaling between 1800 and 1987 harvested between 436,000 and 1,000,000 individuals (NMFS 2014b).

False Killer Whale (*Pseudorca crassidens*)

The false killer whale is a toothed whale found in tropical to warm temperate waters worldwide, generally in deep offshore waters (Taylor et al. 2008). Data are lacking for most populations. While the species is not rare, there are few identified areas of high density. NMFS currently recognizes five stocks of false killer whale in the Pacific (Carretta 2013):

- The main Hawaiian Islands insular stock (MHI IFKW) includes animals that occur in waters within 100 mi (140 km) of the MHI. This stock is ESA-listed.
- The Northwestern Hawaiian Islands stock, which includes animals inhabiting waters within 58 mi (93 km) of the Northwestern Hawaiian Islands and Kauai.
- The Hawaii pelagic stock includes animals that inhabit waters greater than 25 mi (40 km) from the MHI.
- The Palmyra Atoll stock.
- The American Samoa stock.

The false killer whale's diet is mainly comprised of large game fish like dolphinfish, tuna, and billfishes. They can also attack small cetaceans, humpback whales, and sperm whales (Taylor et al. 2008). False killer whale populations are susceptible to fishery entanglements due to overlap between fisheries and their preferred food (Carretta et al. 2011). Populations are in decline due to reduction in prey biomass by commercial fisheries, accumulation of anthropogenic contaminants, and interactions with near-shore and offshore longline fisheries (Oleson et al. 2010).

Sea Turtles

Five species of sea turtle occur in the action area (Table 11). All five species spend their early development in the pelagic (open ocean) environment, which lasts between 5 and 10 years (Carr

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[25] The management regime boundary consists of a zigzag pattern: 150°W at the equator, 160°W between 40 and 50°N, 180°W north of 50°N.

1987). Two species (green and hawksbill turtles) then migrate to nearshore habitats where they remain for the majority of their lives. The other three sea turtle species (leatherback, loggerhead, and olive ridley sea turtles) are primarily pelagic throughout their lives, undergoing trans-Pacific migrations between nesting and feeding habitats.

Table 11. Sea Turtle Status and Distribution

Common Name	**Scientific Name**	**ESA Status**	**Open Ocean?**	**Coastal?**
Green	*Chelonia mydas*	Endangered/ Threatened	Yes	Primary
Hawksbill	*Eretmochelys imbricata*	Endangered	Yes	Primary
Leatherback	*Dermochelys coriacea*	Endangered	Primary	Rarely
Loggerhead	*Caretta caretta*	Endangered	Primary	Rarely
Olive Ridley	*Lepidochelys olivacea*	Endangered/ Threatened	Primary	Rarely

Green Sea Turtle (*Chelonia mydas*)

The green sea turtle has a worldwide distribution across tropical and subtropical coastal waters between 45°N and 40°S (SWOT 2011). There are major nesting beaches throughout the western and eastern Atlantic, Indian, and western Pacific Oceans, and in more than 80 countries (Hirth 1997). The breeding populations of the green sea turtle on the Pacific coast of Mexico has an endangered listing, and all other populations have a threatened listing. Both threatened and endangered populations exist in the action area.

On April 6, 2016, NOAA divided the green sea turtle population into 11 DPSs, three of which occur in the action area (81 FR 20058). The Central West Pacific DPS includes green sea turtles found in Guam and the Commonwealth of the Northern Mariana Islands. The Central South Pacific DPS includes turtles found in American Samoa and the Pacific Remote Island Areas (except Johnston Atoll). The Central North Pacific DPS includes turtles found in Hawaii and Johnston Atoll. The Central West Pacific and Central South Pacific DPS are listed as endangered and the Central North Pacific DPS is listed as threatened (NMFS 2016d).

Based on population assessments that are reliant on nesting beach and nearshore data, the green sea turtle is the most abundant sea turtle species in the PIR. Based on habitat preference, the green sea turtle is likely to occur in the nearshore waters around the islands, outside of the action area. The species is less likely to occur in the deeper offshore waters that constitute the action area. The latest status review (Seminoff et al. 2015) outlines the population trends for each DPS:

Central West Pacific DPS: There are insufficient data to establish population trends for this DPS as a whole. However, based on the most data-rich nesting area (Chichijima, Japan), the population has increased from a mean of approximately 100 females/year in the late 1970s/early 1980s to a mean of approximately 500 per year since 2000; with an estimated annual population growth rate of 6.8% per year.

Central South Pacific DPS: Partial and inconsistent monitoring from the largest nesting site in this DPS (Scilly Atoll) suggests significant nesting declines, while abundance is reported to be stable to increasing at Rose Atoll, Swains Island, Tetiaroa, Tikehau, Tongareva and Maiao.

Central North Pacific DPS: There has been a marked increase in annual green turtle nesting at East Island, French Frigate Shoals. During the first 5 years of monitoring (1973-1977), the mean annual nesting abundance was 83 females. During the most recent 5 years of monitoring (2009-2012), the mean annual nesting abundance was 464 females; indicating an annual increase of 4.8%.

Green sea turtles are highly migratory in certain phases throughout their lives. They may travel thousands of kilometers between their juvenile developmental grounds and adult breeding and nesting grounds (Mortimer and Portier 1989). When they reach sexual maturity, green sea turtles begin migrating regularly between feeding grounds and nesting areas on average once every 4 years (Hirth 1997). Aside from early life stage movements and migrations to nesting grounds, green turtles demonstrate strong foraging site fidelity and spend the overwhelming majority of their lives within a specific foraging ground smaller than 1km^2 (Gaos et al. 2020).

Green sea turtles prefer shallow waters, usually less than 164 ft (50m) and regularly haul out to bask on sandy beaches throughout the MHI (Parker and Balazs 2011, Gaos et al. 2020). This species is herbivorous, foraging on a variety of macroalgae and seagrass. Red algae is a dietary staple, with the introduced algae *Acanthophora spicifera*, *Hypnea musciformis*, and *Gracilaria salicornia* making up 44% of all stomach contents (Arthur and Balazs 2008). Seagrasses, sponges, crustaceans, and other invertebrates are also occasionally eaten (Russell et al. 2011).

Post-hatchlings live at the surface in the open ocean for approximately 3 years (Hirth 1997; Reich et al. 2007), after which they move to neritic habitats. Green sea turtles typically become confined to the coasts around age 5-6 years, settling into areas rich in seagrass and algae (Bresette et al. 2006; Musick and Limpus 1997). A small number of green sea turtles appear to remain in the open ocean for extended periods, perhaps never moving to coastal feeding sites, though the reasons for this behavior is not yet understood (NMFS and USFWS 2007; Pelletier et al. 2003).

Hawksbill Sea Turtle (*Eretmochelys imbricate*)

Hawksbill sea turtles are distributed throughout the tropics, ranging from 30°N to 30°S latitude in the Pacific. The hawksbill is the most coastal of the marine turtles, with juveniles and adults preferring coral reef habitats (NMFS 2010). In the Pacific, the pelagic habitat of hawksbill juveniles is unknown.

Though the hawksbill is federally listed as endangered throughout its range; no critical habitat has been designated in the PIR. The hawksbill has a single global population and at this time, NMFS and USFWS are not reviewing the DPS (NMFS and USFWS 2013a). However, a recent study included new sampling sites in Hawaii, American Samoa, the CNMI, Palau, and Australia (Banerjee et al. 2019). The study found support for at least three populations, West Pacific, East Pacific and Atlantic. The results suggest a finer subpopulation structure in the West Pacific, but also a need for increasing sample sizes to confirm this separation.

The population in the PIR is estimated to be decreasing, both on a recent timescale (within the last 20 years) and on a historical time scale. There are currently no total population estimates for this species; however, we estimate the total population of the hawksbill sea turtles in Oceania at 3,440,725 sea turtles (juveniles greater than one-year-old and adults) (NMFS and USFWS 2013a).

Hawksbill sea turtles remain in the oceanic environment until reaching a carapace length of approximately 15 inches (38 cm), interpreted as 7 to 10 years, at which point they recruit into coastal habitats and transition from a pelagic to a benthic diet, foraging mainly on sponges and macroalgae (NMFS and USFWS 2013a). Reefs provide shelter and food for resting and foraging hawksbills, and individuals visit the same resting spot repeatedly. The hawksbill habitat is around rocky outcrops and high-energy shoals—optimum sites for sponge growth—and mangrove-lined bays and estuaries (NMFS 2010). Adult hawksbill turtles can migrate long distances between nesting beaches and foraging areas, including a documented 1,160 mi (1,866 km) traverse in the Atlantic (Spotila 2004). While the home range appears to be less than 0.8 mi^2 (2 km^2) in Hawaii (Parker et al. 2009), they are known to traverse between the MHI (Seitz et al. 2012; Ligon and Bernard 2000; Parker et al. 2009).

Unlike other marine turtles, hawksbills are not generally deep divers, which may be a reflection of the shallow depths of their primary food (NMFS and USFWS 2013a). Coral reefs and hardbottom areas are their preferred habitats, which are seldom found in waters deeper than the shelf break.

Leatherback Sea Turtle (Dermochelys coriacea)

The leatherback has an endangered classification throughout its range. The Western Pacific leatherback, which is the sub-population that occurs in the action area, has declined more than 80% over the last three generations.

While the leatherback is a single global population, data appear to indicate possible population segments in each ocean basin (NMFS and USFWS 2013b). The Western Pacific DPS is the only DPS found in the PIR and it continues to exhibit a declining nest trend (NMFS and USFWS 2020a). NMFS conducted a population viability analysis on West Pacific leatherback sea turtles, finding that the population is declining at a rate of 6% per year (Martin et al. 2020).

The leatherback status review (NMFS and USFWS 2020a) conservatively estimates adult female abundance at 1,277 individuals. This study only included nesting at Jamursba-Medi and Wermon beaches in Papua Barat, Indonesia as these are the only beaches with long-term modeling. These two beaches likely represent between 50 and 75% of all nesting for this population (NMFS and USFWS 2020a).

Leatherback turtles lead a completely pelagic existence and forage almost exclusively for sea jellies and other soft-bodied animals. They can dive to depths of 4,200 ft (1,280 m)—deeper than any other turtle—and can stay down for up to 85 minutes. In the Pacific, leatherbacks migrate between nesting habitats in Indonesia and Papua New Guinea to feeding grounds in the neritic eastern North Pacific, including habitat off Washington/Oregon and Northern California that have been designated critical habitat (77 FR 4170). There is no designated critical habitat within the PIR.

Loggerhead Sea Turtle (*Caretta caretta*)

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Two of the nine DPS occur in the Pacific, the endangered North Pacific and South Pacific DPS, and could occur in the action area, but would be uncommon transient visitors.

Abundance continues to be small for the North Pacific Ocean DPS. Although this DPS demonstrated an increasing trend between 1999 and 2013, current levels of nesting likely do not exceed historical levels, and several beaches exhibit stable or declining nesting trends (NMS and USFWS 2020b). As documented in the Hawaii-based shallow set fishery Biological Opinion (NMFS 2018), Jones estimated that there are approximately 328,744 juveniles in the population, and adding in adults results in a total population estimate of about 340,000 North Pacific loggerhead sea turtles (T. Jones pers. comm. 2019 as cited in NMFS 2018).

Abundance for the South Pacific DPS has been on a downward trend since monitoring began in the 1970s (Conant et. al 2009). Within the action area, the species is pelagic, transiting between breeding and feeding areas in more nearshore areas of Japan, South China Sea, and Baja, Mexico. Juvenile and adult loggerheads are opportunistic omnivores, feeding on floating prey, such as pelagic crabs, cnidarians and gastropods (WPFMC 2009d). Some DPS outside the action area are threatened.

Olive Ridley Sea Turtle (*Lepidochelys olivacea*)

The olive ridley sea turtle is the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually. Olive ridleys have a global distribution in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. Olive ridley breeding populations on the Pacific coast of Mexico are endangered and all other populations are threatened, though data appear to indicate possible population separation by ocean basin. At this time there is no DPS review for this species (NMFS and USFWS 2014). Both threatened and endangered populations could occur in the study area.

Abundance and population trends for endangered Olive Ridley populations are exhibiting an overall increase, with weighted average annual abundance at 1.39 million individuals. For threatened populations, nesting is either unreported or minimal with a general decreasing trend (NMFS and USFWS 2014).

It is possible that young turtles move offshore and occupy areas of surface-current convergences to find food and shelter among aggregated floating objects until they are large enough to recruit to the nearshore benthic feeding grounds of the adults. The olive ridley sea turtle is omnivorous, and identified prey include a variety of benthic and pelagic prey items such as shrimp, jellyfish, crabs, snails, and fish, as well as algae and seagrass (WPFMC 2009d).

While olive ridleys generally have a tropical range, individuals do occasionally venture north, some as far as the Gulf of Alaska (Hodge and Wing 2000). The post-nesting migration routes of olive ridleys, tracked via satellite from Costa Rica, traversed thousands of kilometers of deep oceanic waters ranging from Mexico to Peru and more than 3,000 kilometers out into the central Pacific (Plotkin 1994).

Seabirds

Table 12 contains the four ESA-listed seabird species known to occur within the PIR. Table 13 shows other non-ESA listed seabirds within the PIR.

This assessment does not include permanent shore birds and terrestrial birds due to the low likelihood of these species occurring more than 3 nm (5.6 km) offshore.

Table 12. ESA Listed Seabirds in the PIR

Common Name	Scientific Name	Conservation Status	Range	Open Ocean?
Band-rumped Storm Petrel	*Hydrobates castro*	Endangered	Hawaii, the CNMI, Guam	Yes
Hawaiian Petrel	*Pterodroma sandwichensis*	Endangered	Hawaii	Yes
Newell's Shearwater	*Puffinus newelli*	Threatened	Hawaii, American Samoa, the CNMI	Yes
Short-tailed Albatross	*Phoebastria albatrus*	Endangered	Hawaii, the CNMI, Guam	Yes

Table 13. Non-ESA Seabirds Protected Under the Migratory Bird Treaty Act Occurring in the PIR

Family	Common Name	Scientific Name
Diomedeidae	Blackfooted Albatross	*Phoebastria nigripes*
	Laysan Albatross	*Phoebastria immutabilis*
	Audubon's Shearwater	*Puffinus lherminieri*
	Bonin Petrel	*Pterodroma hypoleuca*
	Black-winged Petrel	*Pterodroma nigripennis*
	Bulwer's Petrel	*Bulweria bulwerii*
	Christmas Shearwater	*Puffinus nativitatis*
	Collared Petrel	*Pterodroma brevipes*
Procellariidae	Cook's Petrel	*Pterodroma cookii*
	Herald Petrel	*Pterodroma heraldica*
	Mottled Petrel	*Pterodroma inexpectata*
	Short-tailed Shearwater	*Puffinus tenuirostris*
	Sooty Shearwater	*Ardenna grisea*
	Tahiti Petrel	*Pseudobulweria rostrata*

Family	Common Name	Scientific Name
	Wedge-tailed Shearwater	*Puffinus pacificus*
Hydrobatidea	Leach's Storm Petrel	*Oceanodroma leucorhoa*
	Matsudaira's Storm Petrel	*Oceanodroma matsudairae*
	Black-naped Tern	*Sterna sumatrana*
	Black Noddy	*Anous minutus*
	Blue-Grey Noddy	*Procelsterna cerulea*
Laridae	Brown Noddy	*Anous stolidus*
	Grey-backed Tern	*Onychoprion lunatus*
	Grey-blue Noddy	*Procelsterna cerulea*
	Sooty Tern	*Onychoprion fuscatus*
	White Tern	*Gygis alba*
Fregatidae	Lesser Frigatebird	*Fregata ariel*
	Great Frigatebird	*Fregata minor*
	Masked Booby	*Sula dactylatra*
Sulidae	Red-footed Booby	*Sula sula*
	Brown Booby	*Sula leucogaster*
Phaethontidae	Red-Tailed Tropicbird	*Phaethon rubricauda*

The following are more details about the endangered seabird species that occur in more than one region within the PIR. Section 3.5 contains information about the Hawaiian Petrel since it is only found in Hawaii.

Band-rumped Storm Petrel (*Hydrobates castro*)

The endangered band-rumped storm petrel (*Hydrobates castro*, previously known as *Oceanodroma castro*), is found in Hawaii, Guam and the CNMI (Birdlife International 2016b). Adults are blackish-brown with pale in bars and a clear curved white band across the rump. Birds are 7.5 to 9 inches (19-23 cm) in length with a wingspan of about 16.5 to 18 inches (42-45 cm) (BirdLife International 2016b). This species as a whole has localized populations spread throughout the world's tropical and subtropical oceans. In 2002, the population estimate was around 171-221 pairs. These birds prefer to nest on rugged cliffs and slopes, where correctly assessing the population size is difficult (Pyle and Pyle, 2009). The population is declining due to predation by invasive species, habitat degradation, and unsustainable levels of exploitation (BirdLife International 2016b). Breeding occurs in the spring and summer; however, there is limited knowledge of this species' life history as the population is small and lives in remote areas of the islands.

This bird is pelagic, approaching land to breed or take a rare rest. It feeds mainly on planktonic crustaceans, fish and squids. Feeding mainly occurs during the day via seizing prey from the surface or dipping (BirdLife International 2016b).

Newell's Shearwater (*Puffinus newelli*)

Newell's shearwater, listed as threatened under the ESA, is primarily found in Hawaii, with rare sightings in American Samoa and the CNMI (USFWS, 201c). Adults are black with white underparts and short sharply hooked beaks. Birds are medium sized, 13 in. (33 cm) long with a wingspan of 12-14 in. (30-35 cm). The population estimate is 84,000 individuals, with 16,700-19,300 breeding pairs (BirdLife International 2016d). Populations are declining at an estimated 3.2% per year since 2005.

Newell's shearwater typically nest in burrows associated with root structure of trees on Kauai, but smaller colonies exist on Maui, Molokai, Lehua Islet, and possibly Oahu. Birds reach maturity at six to seven years and breeding pairs only produce one egg in early June, with the chicks leaving the nest by November (BirdLife International 2016d). The birds' diet is not well known, but it is presumably comprised of fish and squid, with birds foraging hundreds of kilometers offshore in large mixed species flocks. Newell's shearwaters typically follow large predatory fish, which will drive the small prey fish to the surface. To catch prey, the bird dives into the water using its wings to swim down to 32 ft (10 m) (Mitchell et al. 2005).

Short Tailed Albatross (*Phoebastria albatrus*)

The short-tailed albatross, listed as endangered by the ESA, is a large pelagic seabird ranging across the North Pacific, including Hawaii and the Marianas. Adults are distinguishable by their white heads and body, a golden color around their heads and neck, and large pink bill. Bodies are 33 to 36 inches (84-91 cm) long with a wingspan of 84 to 90 inches (213-229 cm), and an average life span of 12-45 years. The highest densities are in Japan, the location of the primary nesting colony. The current population estimate is 4,354 individuals (USFWS 2014), less than 1% of the estimated historical population (BirdLife International 2016a). These birds only breed on the Japanese islands of Torishima and Minami-kojima. Single nests occasionally occur on Midway Atoll, Hawaii (BirdLife International 2016a).

Pairs lay a single egg in late October or November and hatch in late December or January. Chicks remain at the nest for about five months before moving to the feeding areas in the Northern Pacific (USFWS, 2008). The population is increasing, with pairs recently nesting on other islands in Japan, in addition to a steady increase of birds returning to the two main colonies (BirdLife International 2016a). Short-tailed albatross spend a majority of their life in the open ocean, foraging for prey on the surface, typically squid, fish, flying fish eggs and shrimp (BirdLife International 2016a).

Sharks and Rays

This section provides information on sharks and rays present throughout the PIR, focusing particularly on the three species protected under the Endangered Species Act (ESA). The scalloped hammerhead shark (*Sphyrna lewini*) is endangered. The oceanic whitetip shark (*Carcharhinus longimanus*) and the giant manta ray (*Manta birostris*) are threatened.

Scalloped Hammerhead Shark (*Sphyna lewini*) - Indo West Pacific DPS

The scalloped hammerhead shark lives in coastal warm temperate and tropical seas throughout the world. Its range includes continental and insular shelves, as well as adjacent deep waters. Scalloped hammerhead sharks rarely occur in waters cooler than 22° C (Compagno 1984, Schulze-Haugen and Kohler 2003). It ranges from the intertidal and surface to depths of up to

450-512 m (Sanches 1991, Klimley 1993), with occasional dives to even deeper waters (Jorgensen et al. 2009). It has also been documented entering enclosed bays and estuaries (Compagno 1984). The population is overfished with a declining population trend, which led to the initial ESA listing (Miller 2014).

NMFS issued a final determination in July 2014 to list the Indo-West Pacific DPS of scalloped hammerhead shark as threatened species under the Endangered Species Act (ESA). This range of this DPS includes the U.S. Pacific territories and the Pacific Remote Island Areas [excluding Johnston Atoll]). On November 17, 2015, NOAA Fisheries published a notice (80 FR 71774) announcing that no areas meet the definition of critical habitat for the scalloped hammerhead shark.

Oceanic Whitetip Shark (*Carcharhinus longimanus*)

Oceanic whitetip sharks are large sharks found in tropical and subtropical oceans throughout the world. They are long-lived, late maturing, and have low to moderate productivity. Tremblay-Boyer et al. (2019) estimate the abundance of oceanic white tip sharks is 264,318 individuals. In January 2018, NMFS published a final rule to list the oceanic whitetip shark as a threatened species under the Endangered Species Act (ESA) (83 FR 4153). After completing a comprehensive status review, and after taking into account current efforts to protect the species, NMFS concluded that this shark is likely to become endangered throughout all or a significant portion of its range within the foreseeable future. In March 2020, NMFS determined that critical habitat designation for this species is not prudent, as there are no identifiable physical or biological features that are essential to the conservation of the oceanic whitetip shark within areas under U.S. jurisdiction (85 FR 12898).

Giant Manta Ray (*Manta birostris*)

Manta birostris, the giant manta ray, has a worldwide distribution in tropical, subtropical, and temperate bodies of water. It commonly resides offshore, in oceanic waters, and near productive coastlines. This ray is a migratory species, with estimated travel distances up to 1,500 km. Yet, despite their large range, fisheries do not frequently encounter the species (with the exception of a few areas noted for manta ray aggregations). There are no current or historical estimates of the global abundance of *M. birostris*, with most estimates of subpopulations based on anecdotal diver or fisherman observations (Miller and Klimovich 2017). These populations potentially range from around 100-1,500 individuals. On January 22, 2018, NMFS published a final rule to list the giant manta ray as a threatened species under the Endangered Species Act (ESA) (83 FR 2916). After completing a comprehensive status review, and after taking into account efforts to protect these species, NMFS listed the species as threatened because the giant manta ray is likely to become an endangered species within the foreseeable future throughout a significant portion of its range. NMFS also concluded that critical habitat is not determinable due to lack of data sufficient to perform the required analyses (84 FR 66652).

3.1.3 Social and Economic Environment

This description of the economic and social environment is largely focused on island areas (American Samoa, Hawaii, Marianas, and PRIA). Unless otherwise noted, the information provided in this section comes from the 2019 SAFE Reports for the Pelagic FEP, American Samoa FEP, Hawaii FEP, Marianas FEP, and Pacific Remote Island Area FEP. This section includes relevant information on the past and present aquaculture business operations and some discussion of economic implications. Description of aquaculture activities that occur only in American Samoa, Hawaii, Marianas (the CNMI and Guam), and PRIA can be found in their respective sub-regional sections later in this chapter.

It is likely that many species of interest for culture in the PIR would be high value species currently managed as wild fisheries, which could include albacore (*Thunnus alalunga*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), dolphinfish (*Coryphaena hippurus*), and Pacific Bluefin tuna (*Thunnus orientalis*). In addition, forktail rabbitfish (*Siganus argenteus*) are a potential product in the CNMI and Guam due to their higher relative value in local markets. There is some potential mollusks, edible algae, and crustaceans to be cultured through aquaculture, although these are most likely to be cultured nearshore, rather than in Federal waters.

A primary motivation for further development of U.S. aquaculture production is to increase self-sufficiency, as the estimated import deficit required to meet U.S. demand for seafood products is $16.8 billion. U.S. per capita seafood consumption is comprised of a combination of domestic and imported products, with roughly 85% of the total consumption represented by imported products annually since 2010 (NMFS 2020c). The U.S. is not a major aquaculture producer, ranking 17th globally in finfish and shellfish production, though nearly 50% of the seafood consumed within the U.S. is from both domestic and foreign aquaculture operations. By volume, U.S. aquaculture production comprises only 7% of the total seafood production, whereas it accounts for 21% of the sector’s value, due to U.S. aquaculture’s focus on producing high-value species.

While there are a number of historical and archaeological resources in the PIR EEZ, there are no known sites that are listed or eligible for listing on the National Register of Historic Places where aquaculture is likely to occur described in this PEIS. Review and permitting for prospective aquaculture facilities in the area could consider any future World War II era shipwrecks or other object discoveries.

State of Industry and Science in Offshore Aquaculture

The following sections describe past and ongoing offshore aquaculture research and commercial ventures globally. The discussion focuses on open ocean aquaculture, most relevant to any aquaculture management program. Information regarding each sub region is located in their respective sections later in this document.

Globally, offshore aquaculture is a nascent industry and a growing field. While nearshore and land-based aquaculture practices date back centuries, commercial-scale cage culture became prevalent in the mid-20th century and commercial offshore aquaculture operations only became active in the early 2010s. Commercial operations currently exist in at least seven countries, with research efforts in at least an additional five. Although many of these operations are still relatively small, the sector is expected to grow in the future. In the US, there are several offshore aquaculture projects permitted or in process for permitting in Federal waters off the coast of California, in the Gulf of Mexico and off the coast of New England.

As with near-shore and land-based aquaculture, ideal candidate species for commercial offshore aquaculture are fast growing and successfully reproduced in hatcheries (i.e., there is complete control over the entire life cycle). Commercial and pilot offshore facilities are currently raising a variety of high-value finfish, mollusks, and seaweeds. These species could be raised in monoculture; however, there is also potential for integrated multitrophic aquaculture, which would involve raising finfish alongside mollusks and/or seaweeds, which extract nutrients from the environment, in an effort to increase efficiency, improve ecosystem functioning and provide alternate harvestable revenue streams. In the PIR, these species could include several species of shellfish, edible algae and crustaceans.

While there is great potential for culturing extractive species[26] in the offshore environment, there is limited information and experience for this in the PIR. In other regions, developing mussel, oyster, and kelp aquaculture in nearshore waters could be promising for offshore culture. Currently, there is one facility permitted for culturing an extractive species in the EEZ off the coast of California.

Reef fish and coastal migratory species are also potential aquaculture candidates, as exemplified by raising almaco jack culture offshore of Hawaii. Typically, ideal species for culture in an offshore system would be those commanding the highest value or exhibiting the highest growth rates. Section 3.4.3 contains further information about the history of culturing almaco.

Other potential candidates for aquaculture in the PIR include several tuna species and dolphinfish, and research on these species is ongoing. Many tunas are currently ‘ranched,’ where wild juveniles are caught and held in a netpen until they reach a marketable size, primarily in Australia, Mexico, and the Mediterranean. However, the alternatives listed in this action prohibit this form of aquaculture due to its heavy reliance on wild broodstock, as well as direct reliance on pelagic fisheries for feed. To successfully rear fish from hatchery to harvest, the life cycle of the fish must be fully under control of the producer. Currently, the only tuna species with consistent hatchery reproduction is the Pacific bluefin tuna, though research is ongoing for several other species.

Dolphinfish have been successfully reproduced under hatchery conditions and research into commercial rearing has been ongoing for more than 30 years. For dolphinfish and bluefin tuna, challenges to commercial production beyond closing the life cycle include addressing technical and physical specifications (e.g., precise water quality for larval rearing, collisions with tank walls), and disease (e.g., the ‘puffy snout’ syndrome experienced by tunas held in captivity). These constraints have hampered commercial efforts for these species but research is ongoing.

[26] In this context, extractive species do not require feed inputs during the growout phase. Common examples include mussels, oysters, clams, and seaweeds.

In the PIR, almaco jack is the only species currently cultured in offshore net pens, though Pacific threadfin was cultured in net pens in the past. Section 3.1.2 contains details on the life histories of these species. Section 3.4.3 outlines details on these operations and research.

Aquaculture in the Open Ocean: Gear Types and Technology

Siting aquaculture facilities in an offshore environment brings a unique set of challenges. In addition to the optimal siting characteristics related to water quality for most nearshore aquaculture (e.g., temperature, dissolved oxygen, salinity, current direction and speed), offshore facilities also have to contend with extreme weather conditions. Offshore facilities require access to land-based services, including vessels and harbors, hatchery facilities, and facilities for staff. The respective section for each subregion of the PIR outlines these considerations.

This action focuses primarily on cage and net pen culture, with a general discussion of other gear types and technologies. Open ocean aquaculture could use a wide variety of nets and cages, some of which are established gear types while others are new to the industry.

Federally Managed Sanctuaries, Monuments and Wildlife Refuges

Federally managed sanctuaries, monuments and wildlife refuges are discussed in detail in their respective sub-regions; however, Figure 4 gives a broad overview of the Marine National Monuments throughout the PIR.

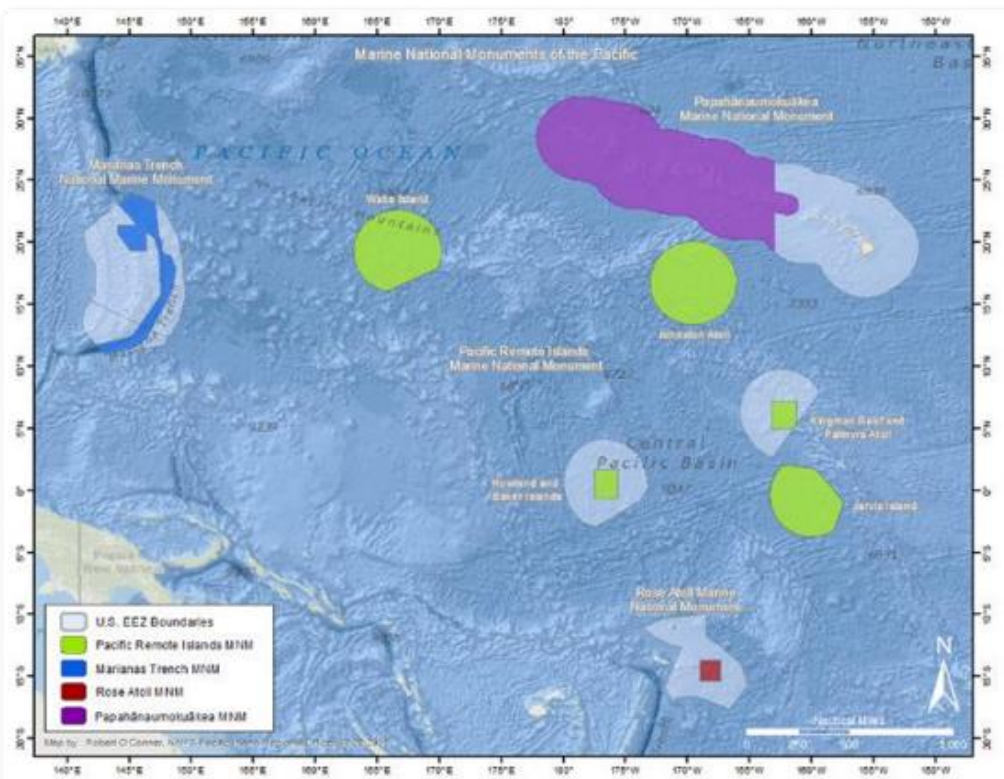

Figure 4. Marine National Monuments of the Pacific Islands Region

3.2 American Samoa

The Samoa archipelago consists of seven major volcanic islands distributed between the Independent State of Samoa and American Samoa. This section will describe the relevant environment only for American Samoa.

American Samoa consists of five inhabited, volcanic islands (Tutuila, Aunuu, Ofu, Olosega, and Tau) and two uninhabited islands (Swains Island and Rose Atoll). Tutuila, the largest island (55 mi^2 [143 km^2]), is the center of government and business. Aunuu is a small island that lies one-quarter mile off the coast of Tutuila. The three islands of Ofu, Olosega, and Tau are collectively referred to as the Manua islands (with a total land area of less than 20 mi^2 [52 km^2]) and lie 70 mi (113 km) east of Tutuila. Swains Island has a landmass of 0.6 mi^2 (1.5 km^2) and lies 225 mi (40 km) north of Tutuila. Rose Atoll is a small atoll centered in the 13,436 mi^2 (35,000 km^2) Rose Atoll Marine National Monument (MNM), which prohibits commercial fishing, including aquaculture. American Samoa's total land mass is about 77 mi^2 (200 km^2), and its EEZ is approximately 150,580 mi^2 (390,000 km^2).

The FEP for the American Samoa Archipelago (WPFMC 2009a) provides a complete description of the affected environment.

3.2.1 Physical Environment

Geological Features

Coastline

American Samoa is an oceanic archipelago without a continental shelf. Therefore, shallow water habitats generally only occur within 0.5 to 2 mi (0.8 to 3.2 km) from shore because of the steep slope of the seafloor (Craig 2009). American Samoa has one sheltered, deep-draft harbor, Pago Pago, on the island of Tutuila. Nearshore benthic (bottom) habitats include coral reefs and reef slopes, seagrass beds, mangrove forests, and sandy, hard, and rubble substrate in the subtidal and intertidal zones. Figure 5 shows shallow waters, 160 to 328 ft (50 to 100 m) deep, extending into the EEZ to the east and west of Tutuila (PIBHMC 2008). The figure shows an elevated ridge around the seaward rim of Tutuila's insular shelf, likely a drowned barrier reef complex where there are areas of high coral cover (PIFSC 2008). The seafloor drops off into deep waters within the 3 nm (5.6 km) territorial seas for the islands of the Manua group (Figure 6).

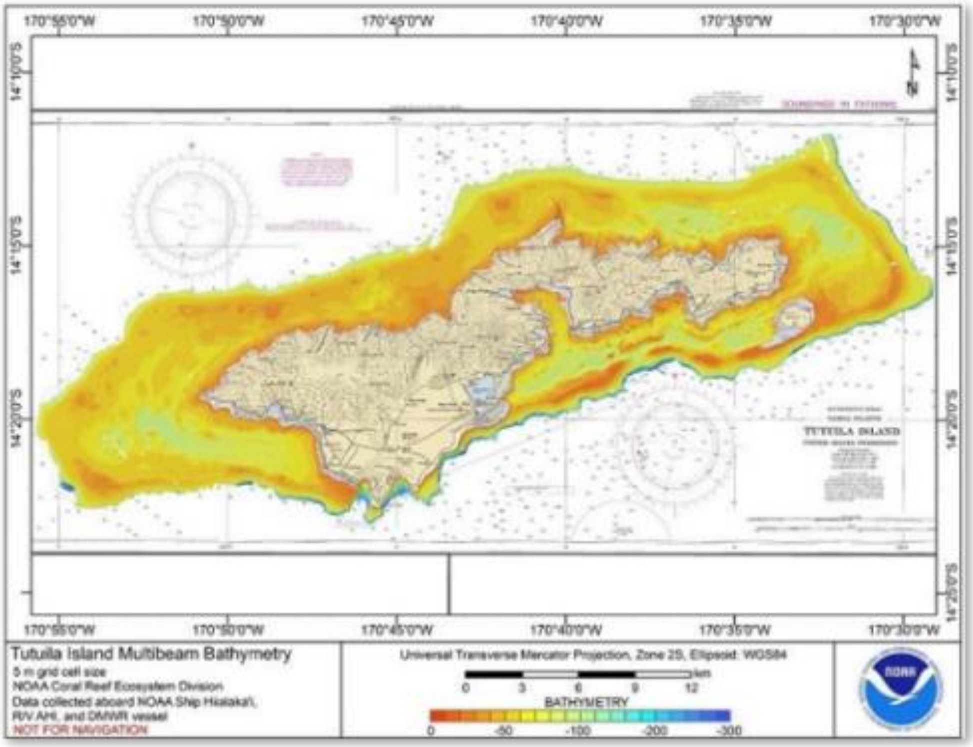

Figure 5. Bathymetry of Nearshore Tutuila Island. Source: PIBHMC-UH

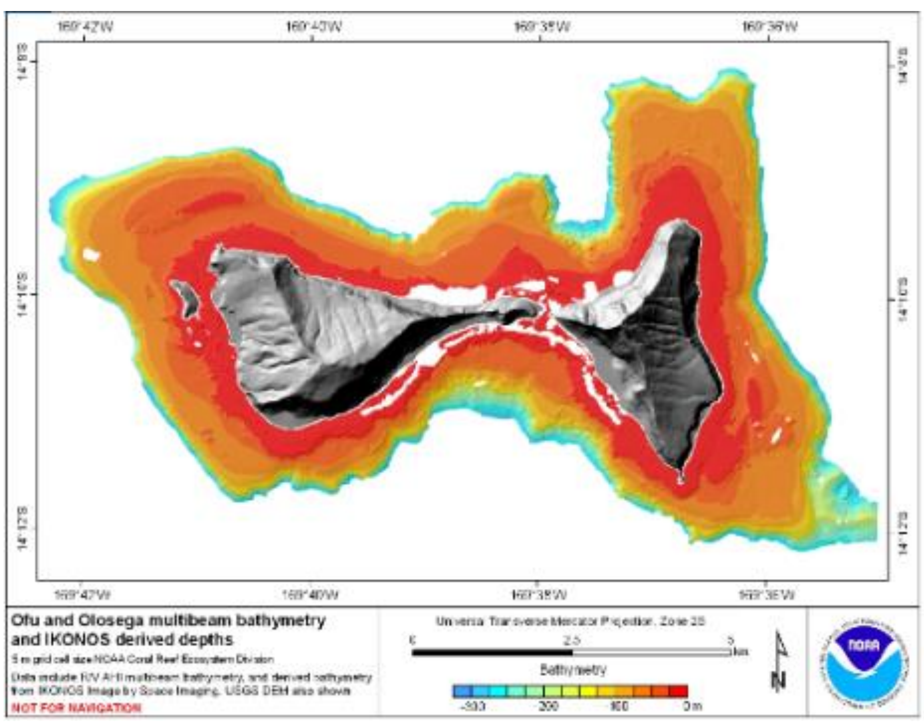

Figure 6. Bathymetry of Nearshore Ofu and Olosega Islands (Manua Islands) in American Samoa. Source: PIBHMC-UH.

Open Ocean

In general, the waters in the EEZ of American Samoa are oceanic, with average depth greater than 3300 ft (1000 meters). Deep ocean benthic habitat includes hard, soft, and biogenic habitats at water depths below 655 ft (200 m), and is by far the largest benthic habitats in the world (Neighbors and Wilson 2006). Soft sediments made mostly of mud and sand are generally low in biological productivity.

There are 48 seamounts within the EEZ of American Samoa (Kendall and Poti 2011), with the majority rising from depths around 13,123 feet (4,000 m) (WPFMC 2009a). Vailuluu seamount is the only hydrothermally active seamount within the EEZ (Koppers et al. 2010).

Banktops (defined as all submerged marine habitats at depths between the shoreline and 328 ft [100 m]) are greatest around Tutuila and Aunuu, where the depth interval declines gradually from shoreline to about 328 ft (100 m). Tau has significantly smaller surrounding banktop habitat, with depth intervals descending much more steeply from shoreline to about 328 feet. Rose Atoll and Swains Island have only limited shallow banktop, with depths that descend rapidly from 66 to 328 ft (20 to 100 m).

Oceanographic Features

At the broadest scale, the Samoan archipelago lies along the northern edge of the South Pacific Gyre, a series of connected ocean currents with a counter-clockwise flow that spans the Pacific basin (Alory and Delcroix 1999; Tomczak and Godfrey 2003; Craig 2009). At a regional scale centered on the Samoan Archipelago, the major surface currents and eddies that affect the archipelago are the westward flowing South Equatorial Current, which occurs throughout the year between 5° and 15°S; the South Equatorial Counter Current, which interrupts the South Equatorial Current between 9° and 12°S by during the summer; and the Tonga Trench Eddy, an eddy that regularly occurs between September and December south of the archipelago (Kendall and Poti 2011). Of these, the South Equatorial Counter Current is the most prominent current feature in the region, occurring at approximately 656 ft (200 m) depth, and strongest in January and February (Kessler and Taft 1987; Chen and Qui 2004)

The entire Samoan Archipelago experiences relatively high and stable ocean temperatures throughout the year, with an average range from 81°F (27.2°C) in August to 85°F (29.5°C) in March.

Wave power exposures are typically highest on the eastern- and southern-facing coasts of Samoan islands but can vary seasonally and among years (Barstow and Haug 1994). Ocean swell from the south and wave power in general are highest during May to September (6.5 to 9.8 ft [2 to 3 m] wave height is common) with the increased intensity of the Trade Winds and frequency of swell producing storms at higher latitudes (Barstow and Haug 1994; PIFSC 2008).

Extreme Weather

American Samoa's tropical climate is characterized by year-round mild air temperatures, high humidity, persistent trade winds, infrequent but severe cyclonic storms, and is influenced by global climate trends and inter-annual variability associated with shifts in ocean-atmospheric conditions. Mean daily air temperature varies between 72°F (22°C) and 86°F (30°C) (SPSLCMP 2007). Maximum rainfall occurs in the austral summer (December to February), where it can exceed 12 inches (300 millimeters [mm]) per month. In winter (June to August), rainfall is 30% lower, at approximately 8 inches (200 mm) per month (Craig 2009).

Tsunamis are rare events caused by earthquakes or underwater landslides. On September 29, 2009, a tsunami devastated American Samoa, Samoa and Tonga with run-ups (height above ambient sea level) as high as 40 ft (12 m) (USGS 2009).

Cyclonic storms (also called tropical storms, hurricanes or typhoons) are infrequent but severe weather conditions. The EEZ around American Samoa lies along the eastern edge of a region conducive to development of cyclonic storms in the south Pacific (Craig 2009). American Samoa experiences major cyclones, which can yield maximum winds of 150 miles per hour (mph) (241 km/hr), approximately once every 5 years. They normally approach from the north, but occasionally approach from the east, southeast, or west. Six cyclones have struck or passed near the Samoan Archipelago in the past 30 years, including two recent and very powerful Category 5 storms with sustained winds over 155 mph (250 km/hr). The most recent cyclones have occurred at intervals of 1 to 13 years and have had varying impacts across the islands (Craig 2009).

3.2.2 Biological Environment

The biological environment of American Samoa, including the species addressed in this PEIS, are described in detail in the American Samoa Archipelago FEP, which we incorporate here by reference (WPFMC 2009a). This PEIS describes specific resources of concern identified during scoping and interagency informal consultations to the level necessary for appropriate analysis.

Benthic and Sessile Organisms

Nearshore Reefs

Coral reefs in American Samoa consist of fringing coral reef flats bordered by coral reef slope (or shelf). There are more than 250 species of corals in American Samoa in reef flats, reef crest, and reef slopes (NOAA 2012). Reef slope extending from depths of 164 to 328 feet (50 to 100 m) borders many coral reefs and consists primarily of carbonate rubble, algae, and microinvertebrate communities (WPFMC 2009a). Spur and groove reef formations (linear patterns of coral interspersed with sand channels) are common on slope habitats (Fenner et al. 2008b). Coral reefs at depths between 98 to 164 feet (30 and 50 m), or even deeper, have been found on several of the spurs extending seaward from corners of the Manua Islands (PIFSC 2008). There are mesophotic coral reefs that generally occur at depths from 98 feet (30 m) to more than 492 feet (150 m) around Tutuila (Bare et al. 2010). Tutuila has approximately 17.2 square miles (44.5 square km) of coral reef habitat, which constitutes more than half of the total coral reef habitat in the archipelago. The Manua Islands, Rose Atoll, and Swains Island combined have approximately 12.3 square miles (31.9 square km) of coral reef habitat (NCCOS 2005).

There are approximately 2,700 known species associated with coral reef habitat in American Samoa. The benthic communities are dominated by crustose calcareous algae, followed by live hard corals, dead corals (less common and almost none recently dead), and brown macroalgae (very rare). Invertebrate filter feeders are rare, small, and physically similar in appearance, making total species counts problematic. Small to medium-sized herbivores dominate fish fauna, with some large reef fish species uncommon to rare (Fenner et al. 2008b).

Offshore Reefs

Data on offshore reefs consisting of precious corals around American Samoa are lacking, though they likely occur in suitable habitats across the archipelago. Areas swept by strong currents at depths of 328 to 4,921 ft (100 to 1,500 m) characterize these habitats. Steep banks with high currents along Tau's southern shore are contain suitable coral habitat (NOAA 2012). The American Samoa FEP identifies eleven federally managed species: three pink corals, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009a).

Protected Species

Corals and Invertebrates

Acropora globiceps coral

Acropora globiceps is threatened under the ESA and its distribution ranges from the oceanic west Pacific to the central Pacific as far east as the Pitcairn Islands. The species has the 27th smallest range of 114 Acropora species in a large study. The species occurs on upper reef slopes, reef flats, and adjacent habitats in depths ranging from 0 to 8 m (79 FR 53851).

Figure 7. Confirmed distribution of Acropora globiceps coral. Source: www.coralsoftheworld.org

Acropora globiceps coral exists primarily in shallow areas and thus very rarely in the action area. The only confirmed sighting greater than 3nm from shore was recorded at South Bank off the island of Tutuila (NMFS 2020a).

Chambered Nautilus (*Nautilus pompilius*)

The chambered nautilus (*Nautilus pompilius*) is an externally shelled cephalopod with a distinctive coiled calcium-carbonate shell that is divided into chambers. The species is an extreme habitat specialist, physiologically limited by both temperature and depth. It lives in association with steep-sloped forereefs and cannot tolerate temperatures above approximately 25 °C or depths exceeding around 750-800 meters (m) (Miller 2017).

Within its range, the *N. pompelius* has a patchy distribution and is unpredictable in its area of occupancy (CITES 2016). Figure 8 outlines the geographical range of nautilus species, showing that *N. pompelius* is the most widely distributed. Though the map does not depict the range extending to American Samoa, the species has been sighted and captured in American Samoa waters, specifically at Taema Bank (NMFS 2020c). Hence, the waters of American Samoa comprise only a very small portion of the known range of *N. pompelius*, which falls predominantly outside of U.S. jurisdiction.

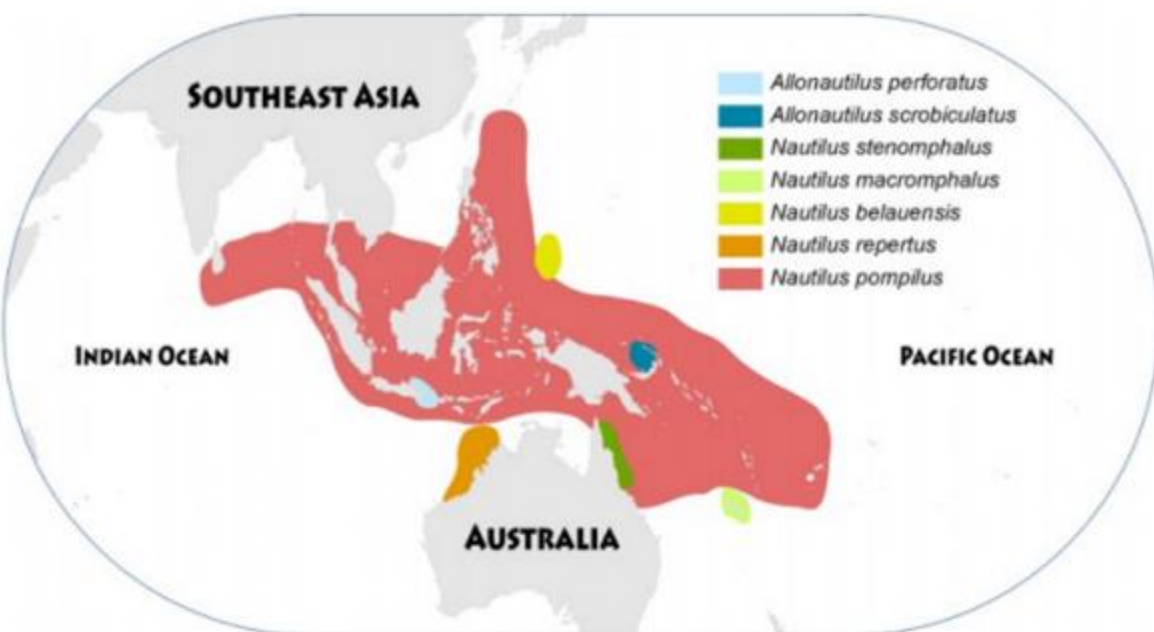

Figure 8. Geographical Range of Nautilus Species. Source: FAO (2016)

Note: American Samoa is not included as part of the shaded range of *N. pompilius* in this figure; however, the species is confirmed in American Samoa waters.

The global abundance of *N. pompilius* is unknown, with no available historical baseline population data. The species likely exists as small, isolated populations distributed throughout its range. Currently, there is no estimated population size for *N. pompilius* off American Samoa; however, population density estimates are roughly 0.16 individuals / km^2 for American Samoa (Miller 2017). On January 29, 2020, NOAA Fisheries published a notice (85 FR 5197) announcing that the designation of critical habitat for the chambered nautilus is not deemed prudent, since the species occurs primarily outside the jurisdiction of the United States.

Marine Mammals

Sperm whales, endangered throughout their range, have historically been observed around American Samoa throughout the year except February and March (Reeves et al. 1999). Sperm whales are occasionally seen in the Fagatele Bay Sanctuary as well. Population size in the area is unknown as there is no stock assessment for sperm whales in American Samoa. There have been no documented sightings of the endangered blue whale, fin whale or sei whale in America Samoa, though their range overlaps with the area.

Oceania DPS humpbacks occasionally migrate into waters around American Samoa during their winter migration; a majority of these animals remains near Tonga.

Table 14 outlines other marine mammal sightings in American Samoa. For further information on marine mammals occurring in the action area, please see the American Samoa FEP.

Table 14. Non-ESA Listed Marine Mammals of the Western Pacific

Common Name	Scientific Name	Common Name	Scientific Name
Blainsville beaked whale	*Mesoplodon densirostris*	melon-headed whale	*Peponocephala electra*
bottlenose dolphin	*Tursiops truncatus*	minke whale	*Balaenoptera acutorostrata*
Bryde's whale	*Balaenoptera edeni*	Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
common dolphin	*Delphinus delphis*	pygmy killer whale	*Feresa attenuata*
Cuvier's beaked whale	*Ziphius cavirostris*	pygmy sperm whale	*Kogia breviceps*
Dall's porpoise	*Phocoenoides dalli*	Risso's dolphin	*Grampus griseus*
dwarf sperm whale	*Kogia simus*	rough-toothed dolphin	*Steno bredanensis*
false killer whale	*Pseudorca crassidens*	short-finned pilot whale	*Globicephala macrorhynchus*
Fraser's dolphin	*Lagenodelphis hosei*	spinner dolphin	*Stenella longirostris*
killer whale	*Orcinus orca*	spotted dolphin	*Stenella attenuata*
Longman's beaked whale	*Indopacetus pacificus*	striped dolphin	*Stenella coeruleoalba*

Sea Turtles

With the exception of the loggerhead sea turtle, all sea turtle species within the PIR exist in American Samoa.

Green sea turtles appear to be most abundant in the waters of Rose Atoll, the largest nesting site in the archipelago. After nesting, females migrate to feeding grounds in Fiji and other South Pacific islands. After several years, the turtles will return to Rose Atoll to nest again (Craig 2002). Subadult and adult green sea turtles also occur in low abundance in nearshore waters around Tutuila, Ofu, Olosega, Tau and Swains Island, with sporadic, low-level nesting on Tutuila and Swains Island (Maison et al. 2010).

Hawksbill sea turtles are most commonly found at Tutuila and the Manua Islands, with an estimated 50 females nesting annually on Tutuila and 30 on the Manua Group (WPFMC 2009a). They also nest at Rose Atoll and Swains Island (Utzurrum 2002).

Though relatively rare, leatherback turtles have appeared in American Samoa fisheries observer data. In each of 2017 and 2018, American Samoa longline fisheries recorded one leatherback as 'released' and there were no leatherback interactions recorded for these fisheries in 2019.[27] The Solomon Islands are the nearest known leatherback nesting area to the Samoan archipelago (Grant 1994).

Olive ridley sea turtles are uncommon in American Samoa, although there have been at least three sightings. A necropsy of one recovered dead olive ridley found a shark injury, and evidence that the turtle may have recently laid eggs, indicating that there may be a nesting beach in American Samoa (Utzurrum 2002).

Seabirds

The only endangered seabird found in American Samoa is Newell's shearwater. The National Park Service identifies the Newell's shearwater, known as taio in Samoan, as a 'visitor' to Tutuila,[28] far from its common foraging grounds in the North Pacific to the north and west of the Hawaiian Islands.

Table 15 outlines other seabirds that occur in American Samoa. For further information on seabirds occurring in the action area, please see the American Samoa FEP and Section 3.1.

Table 15. Non-ESA Listed Birds that Occur in American Samoa

Common Name	Scientific name
Residents (i.e., breeding)	
wedge-tailed shearwaters	*Puffinus pacificus*
Audubon's shearwater	*Puffinus lherminieri*
Christmas shearwater	*Puffinus nativitatis*
Tahiti petrel	*Pseudobulweria rostrata*
herald petrel	*Pterodroma heraldica*
collared petrel	*Pterodroma brevipes*
red-footed booby	*Sula sula*

[27] Pacific Islands Longline Quarterly and Annual Reports https://www.fisheries.noaa.gov/pacific-islands/fisheries-observers/pacific-islands-longline-quarterly-and-annual-reports
[28] see https://www.nps.gov/npsa/learn/nature/upload/2nded05h.pdf

Common Name	Scientific name
brown booby	*Sula leucogaster*
masked booby	*Sula dactylatra*
white-tailed tropicbird	*Phaethon lepturus*
red-tailed tropicbird	*Phaethon rubricauda*
great frigatebird	*Fregata minor*
lesser frigatebird	*Fregata ariel*
sooty tern	*Sterna fuscata*
brown noddy	*Anous stolidus*
black noddy	*Anous minutus*
blue-gray noddy	*Procelsterna cerulea*
common fairy-tern (white tern)	*Gygis alba*
bristle-thighed curlew	*Numenius tahitiensis*
Visitors/vagrants:	
short-tailed shearwater	*Puffinus tenuirostris*
mottled petrel	*Pterodroma inexpectata*
phoenix petrel	*Pterodroma alba*
white-bellied storm petrel	*Fregetta grallaria*
Polynesian storm petrel (pratt - resident)	*Nesofregetta fuliginosa*
laughing gull	*Larus atricilla*
black-naped tern	*Sterna sumatrana*

Sharks and Rays

All sharks and rays that occur in American Samoa occur elsewhere in the PIR. Section 3.1 provides thorough descriptions of each species.

3.2.3 Social and Economic Environment

State of aquaculture industry

There is no salt-water aquaculture currently conducted in American Samoa. Land-based freshwater operations culture tilapia, and previous operations included work with freshwater prawns, limu, giant clam, and mangrove crab. The effort to raise mangrove crabs was partly successful, but is currently not in operation. A few operators are conducting aquaponics (K. Tagarino, personal communication, April 8, 2020).

Prior to 2010, the USDA Land Grant Program, NOAA Sea Grant Program, and the National Fish and Wildlife Foundation aided aquaculture efforts. Projects included the Center for Sustainable Integrated Agriculture and Aquaculture (CSIAA) research and development facility, and the Coral Farming for Village Industry and Coral Reef Rehabilitation Projects. The 2009 tsunami and loss of funding halted any continuation of these projects. However, the CSIAA remains in operation and provides demonstration systems (recirculating aquaculture and aquaponics), technical assistance, education/outreach, machinery, and most ingredients for making high quality tilapia feed free of charge to operators (King 2010; K. A. Tagarino, personal communication, 8 April 2020).

Characteristics and Economic Feasibility of Aquaculture Operations

Pago Pago harbor is a deep draft harbor important to the U.S. fishing industry, specifically purse seine vessels. The harbor is deep and wide enough to accommodate many of the largest class ships, including cruise ships and tankers, as well as personal yachts and sailboats (ASG Department of Port Administration 2017). The StarKist cannery is the primary business sited along the harbor's wharf.

The harbor infrastructure, presence of the cannery, a small longline fleet, and support for large distant-water fisheries could support aquaculture businesses and product development in American Samoa for both local and export markets.

Scope of Fishing Industry - Wild Stocks

American Samoa Pelagic Fisheries

The pelagic fishery in American Samoa is and has been an important component of the American Samoan culture and economy. American Samoan dependence on fishing undoubtedly goes back as far as the peopled history of the islands of the Samoan archipelago, about 3,500 years ago. Many aspects of the culture have changed in contemporary times, but American Samoans have retained a traditional social system that continues to strongly influence and depend upon the culture of fishing.

The American Samoa longline fishery is a limited access fishery with a maximum of 60 vessels under the Federal permit program. Vessels range in size from under 40 to over 70 ft long. Class A vessels are 40 ft long or smaller, Class B vessels are longer than 40 ft but no longer than 50 ft, Class C vessels are longer than 50 ft but no longer than 70 ft, and Class D vessels are longer than 70 ft. As of May 15, 2020, 43 vessels held American Samoa longline limited entry Class B, C, and D permits. The fishery primarily targets albacore for landings at the local Pago Pago cannery, although the fishery also catches and retains other tunas (e.g., bigeye, yellowfin, and skipjack) and MUS (e.g., billfish, mahimahi, wahoo, oilfish, moonfish (opah), and sharks) for local sale and home consumption.

The number of permitted and active longline vessels in this sector increased from three in 1997 to 31 in 2003. Over time, most of the small longline vessels became inactive, and in 2019, there were 3 small (Class A) vessels, and 14 active Class C and D (large) vessels in the fishery. These vessels fish predominantly in the EEZ around American Samoa. Seventeen total vessels were active in 2019. (WPFMC 2020d).

As for non-longline vessels, in 2019, there were 5 troll vessels in American Samoa. Skipjack and yellowfin tuna dominated troll catch. Figure 9 shows that the number of American Samoa boats landing pelagic species have generally declined overall for the longline boats, but almost every year, more participants used longline gear rather than troll to catch pelagic species.

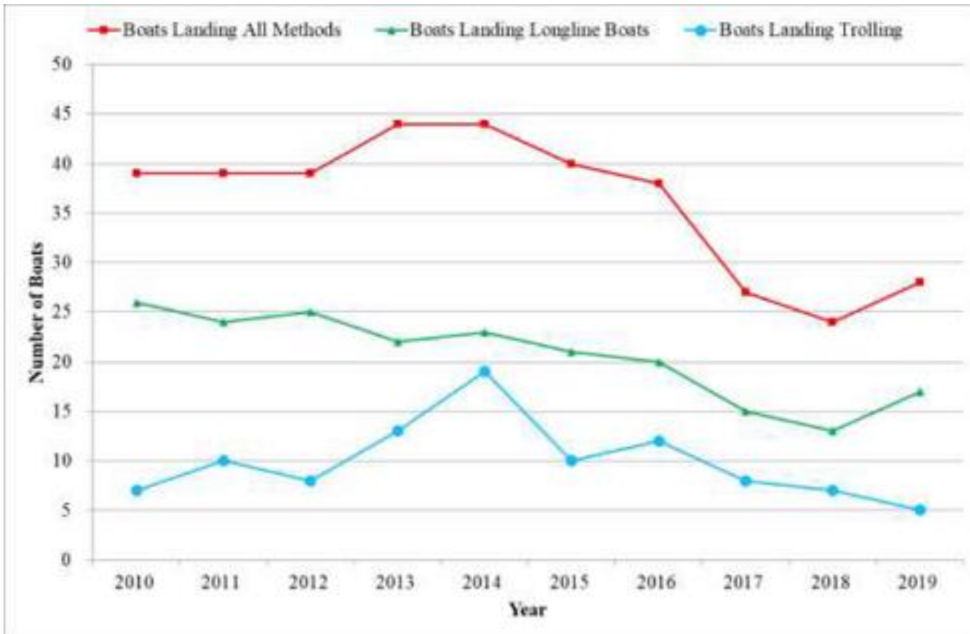

Figure 9. Number of American Samoa Boats Landing Any Pelagic Species (2010-2019). Source: WPFMC 2020d.

Table 16. Species Composition and Total Pelagic Landings (lbs.) by Gear Type (2019). Source: WPFMC 2020d.

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Skipjack tuna	149,917	12,958	0	162,875
Albacore tuna	2,232,098	0	0	2,232,098
Yellowfin tuna	399,298	3,140	0	402,438
Kawakawa	0	233	63	296
Bigeye tuna	66,547	0	0	66,547
Bluefin tuna	476	0	0	476
Tunas (unknown)	0	0	0	0
TUNAS TOTAL	**2,848,336**	**16,331**	**63**	**2,864,730**
Mahimahi	3,250	714	75	4,040
Black marlin	0	0	0	0
Blue marlin	62,905	834	0	63,739
Striped marlin	3,509	0	0	3,509
Wahoo	38,555	601	0	39,156
Swordfish	8,128	0	0	8,128
Sailfish	3,758	181	0	3,939
Spearfish	4,324	0	0	4,324
Moonfish	1,185	0	0	1,185
Oilfish	19	0	143	162
Pomfret	554	0	151	706
Pelagic thresher shark	0	0	0	0

Species	Longline Pounds	Troll Pounds	Other Pounds	Total Pounds
Thresher shark	1,357	0	0	1,357
Shark (unknown pelagic)	0	0	0	0
Snake mackerel	0	0	0	0
Bigeye thresher shark	0	0	0	0
Silky shark	0	0	0	0
White tip oceanic shark	0	0	0	0
Blue shark	0	0	0	0
Shortfin mako shark	90	0	0	90
Longfin mako shark	0	0	0	0
Billfishes (unknown)	0	0	0	0
NON-TUNA PMUS TOTAL	**127,634**	**2,330**	**369**	**130,335**
Pelagic fishes (unknown)	40	0	0	40
Double-lined mackerel	0	0	0	0
Mackerel	0	9	0	9
Long-jawed Mackerel	0	0	0	0
Barracudas	784	0	10	795
Great barracuda	0	0	118	118
Small barracudas	0	0	0	0
Rainbow runner	0	24	57	81
Dogtooth tuna	0	336	832	1,167
OTHER PELAGICS TOTAL	**824**	**369**	**1,017**	**2,210**
TOTAL PELAGICS	**2,976,794**	**19,030**	**1,449**	**2,997,275**

American Samoa bottomfish fisheries

American Samoa's bottomfish industry was relatively large in the 1980s. However, beginning in 1988, the nature of American Samoa's fisheries changed dramatically with a shift in importance from bottomfishing to trolling. Since 2010, the dominant fishing method has been longlining (by weight). Bottomfishing has been declining for years, but the 2009 tsunami dealt a devastating blow to the industry. The U.S. declared a fishery failure, and the U.S. Congress allocated $1 million to revive the fishery. The fishery used this fund to repair damaged boats, maintain the alia boats floating docks, and build a boat ramp. In 2013, the American Samoan government also implemented a subsidy program that provided financial relief associated with rising fuel prices; the fuel price has since become notably lower (WPFMC 2020a).

Fishermen generally target bottomfish in deep waters, but some catch bottomfish over reefs or at shallower depths. The eteline snappers (*Etelis* and *Pristipomoides* spp.) primarily inhabit high-relief, deep slopes ranging from 80 - 400 m deep. Fishermen catch bottomfish with a vertical handline. In addition to the deep-water eteline snappers, fishermen catch other species such as jacks, emperors, and lutjanid snappers at shallower depths. Fishermen also catch the gray jobfish (*Aprion virescens*) by vertical handline, but fishermen may use drifting or slowly moving vessels and trolling gear and fish over relatively flat-bottom areas for this species. Commercial and non-commercial fisheries for bottomfish occur primarily in nearshore waters from 0-3 nm, although some fishermen make longer trips to specific offshore bank areas (Brodziak et al. 2012).

Commercial Catch and Landings of Species with Aquaculture Potential

Historical catch, landings and/or pounds kept, in some cases by gear type, for species with the greatest potential to be grown and harvested in an aquaculture operation in American Samoa are presented in the following figures.

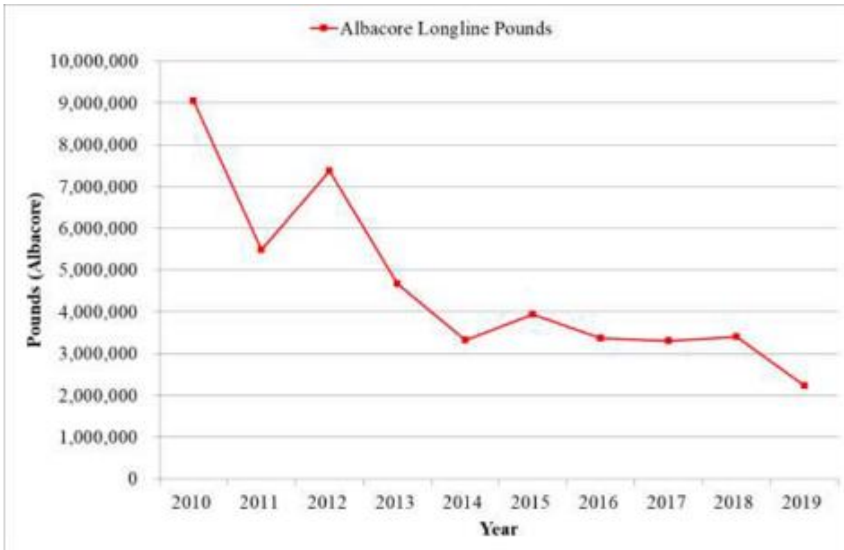

Figure 10. American Samoa Annual Estimated Albacore Total Landings by Longliners (2010-2019). Source: WPFMC 2020d

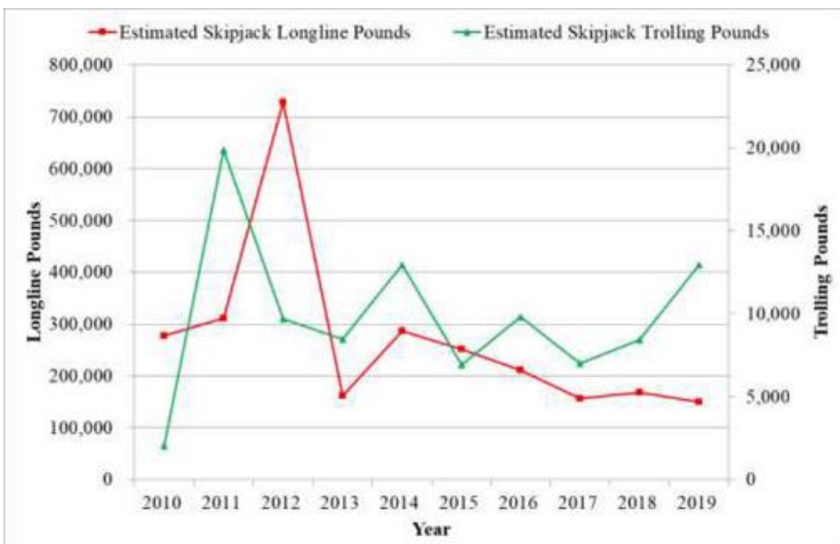

Figure 11. American Samoa Annual Estimated Total Landings of Skipjack Tuna from 2010-2019.

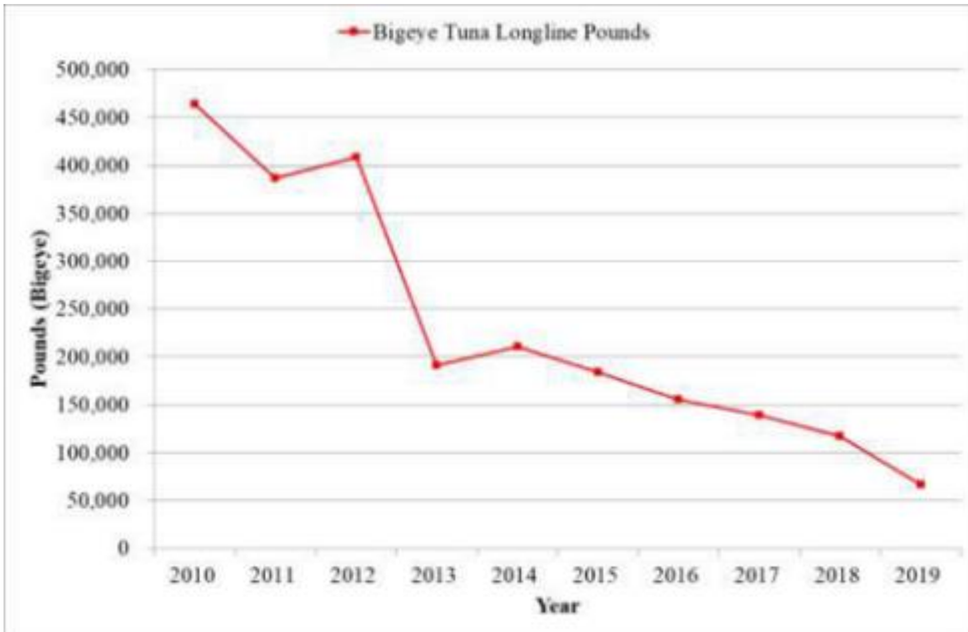

Figure 12. American Samoa Estimated Annual Total Bigeye Tuna Landings by Longline (2009-2018). Source: WPFMC 2020c.

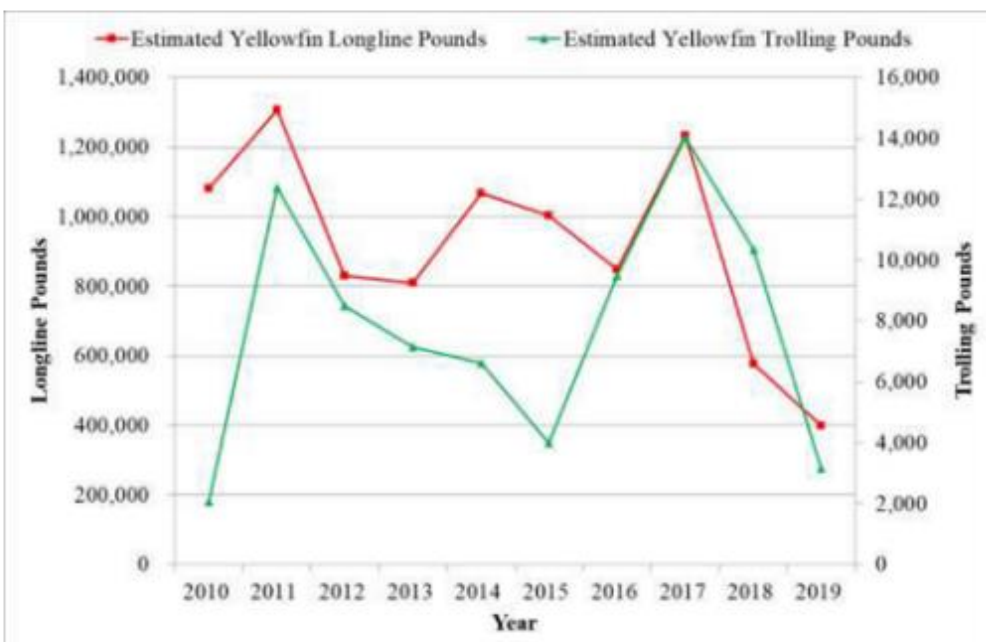

Figure 13. American Samoa Estimated Annual Total Yellowfin Tuna Landings by Longline and Troll (2009-2018). Source: WPFMC 2020.

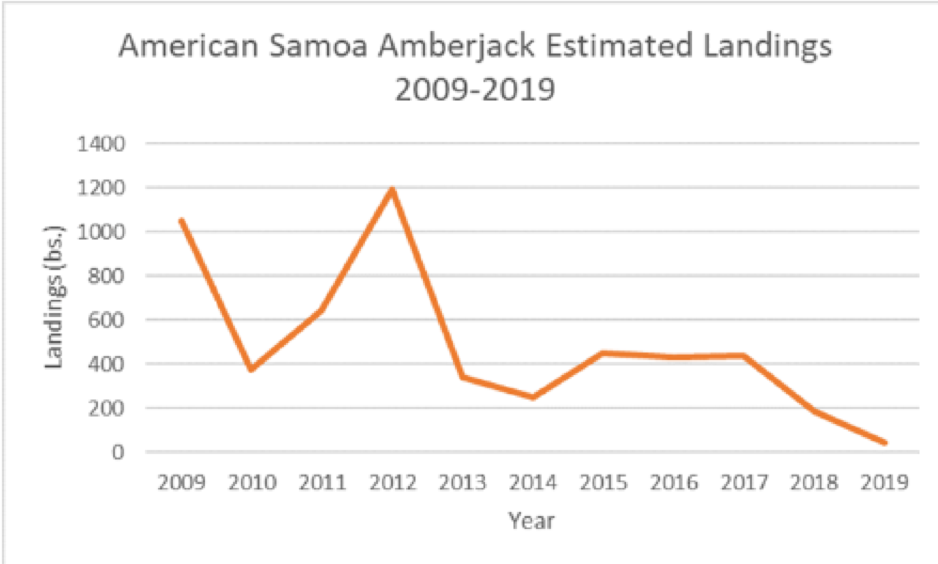

Figure 14. American Samoa Estimated Annual Amberjack Total Landings (2009-2019). Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Amberjack species include *Seriola dumerili*, *S. lalandi,* and *S. rivoliana.*

Revenue from Commercial Fisheries

The estimated annual pelagic landings have varied widely, from 4.1 to nearly 11 million lbs. since 2009. The total estimated 2019 landings were approximately 4.1 million lbs., the lowest in the past decade, which contributes to the declining trend since recent peak landings in 2009-2010 (Figure 15). In 2019, the total fleet revenue (estimated landed value sold to cannery) was $3.9 million, and albacore composed of over 89% of the total landed value. Other main species included yellowfin, bigeye, skipjack, and wahoo.

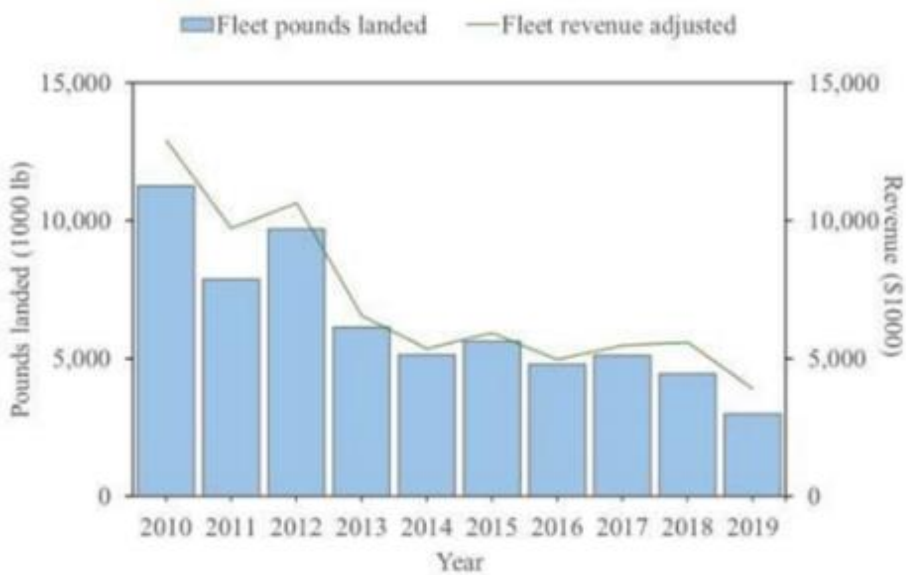

Figure 15. Commercial Landings and Revenues of the American Samoa Longline Fishery from 2010-2019 Adjusted to 2019 Dollars. Source: WPFMC 2020d.

Figure 16 provides annual estimated revenue information for amberjack sold to commercial vendors in American Samoa.

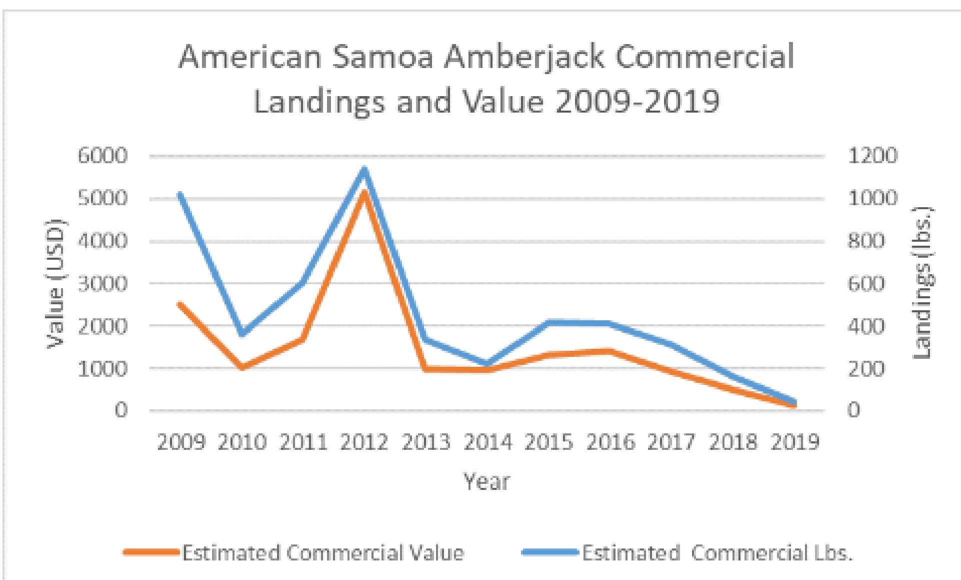

Figure 16. American Samoa Estimated Annual Amberjack Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Amberjack species include *Seriola dumerili, S. lalandi,* and *S. rivoliana.*

Commercial Fishery Suppliers and Markets

The pelagic fishery in American Samoa continues to be an important component of the American Samoan domestic economy. American Samoa is a landing and canning port for the U.S. purse seine fishery for skipjack and yellowfin tuna, with the largest catch of all U.S. pelagic fisheries in the region. The U.S. longline fishery for South Pacific albacore conducted primarily in the EEZ around American Samoa comprises the second largest of the U.S. longline fisheries in the FEP after Hawaii. Albacore is the primary longline species, with the bulk of the longline catch sold to the Pago Pago cannery. Fishermen sell the remaining catch to stores, restaurants and local residents or donate for customary trade or traditional functions.

Pago Pago Harbor on the island of Tutuila is a regional base for the trans-shipment and processing of tuna taken by domestic fleets from other South Pacific nations, the distant-waters longline fleets, and purse seine fleets in part due to its exemption from the Nicholson Act, which prohibits foreign ships from landing their catches in U.S. ports (WPFMC 2020a). American Samoa is unique in the Western Pacific region in its development of domestic industrial-scale fisheries, including tuna processing, transshipment, and home port industries. Purse seine vessels land skipjack, yellowfin and other tunas, with little albacore.

The vast majority of American Samoans consume fish or seafood at least once a week, mostly purchased from stores or restaurants, but some obtained from roadside vendors or caught by family members.

Non-commercial Fishing Considerations

Fishing, for either subsistence or recreation, is an important activity throughout the Western Pacific Region, including American Samoa. Catch-and-release recreational fishing is virtually unknown in American Samoa, and providing fish to meet cultural obligations is very important (Tulafono 2001). Cultural, subsistence, and recreational fishing categories can be difficult to distinguish, as fishermen’s trips might have more than one source of motivation. “Cultural fishing” is a relatively new term and it lacks a formal definition.[29] American Samoa culture is often framed in terms of Faa Samoa, or the “Samoan Way,” which governs local social norms and practices. This includes core values and practices such as Tautua or “service” which involves the broad collective sharing of labor, resources, income, and social and political support to strengthen the Aiga (family groups), the village, and the role of chiefs in perpetuating Faa Samoa. In a fisheries context this may mean the distribution of catch within the Aiga, or the use of fish at specific ceremonial events. Cultural fishing would also encompass the day-to-day practices of subsistence. These values and practices endure in spite of significant technological change.

In addition to the 2019 Pelagics SAFE report (WPFMC 2020d), and the 2019 American Samoa SAFE report (WPFMC 2020a), Levine and Allen (2009) and Grace-McCaskey (2015) provide additional background on subsistence, cultural and recreational fishing in American Samoa.

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[29] Kleiber and Leong (2018) found zero references to the term within the academic literature.

Boat-based recreational fishing revolves primarily around fishing clubs and fishing tournaments, with most participants operating 28-foot alia catamarans and small skiffs (Tulafono 2001). Typically, 7 to 14 local boats carrying 55 to 70 fishermen participated in each tournament, held two to five times per year (Craig et al. 1993). The Pago Pago Game Fishing Association (PPGFA) is the driving force for recreational fishing, with a membership that includes approximately 15 recreational fishing vessels ranging from 10-foot single engine dinghies to 35-foot twin diesel engine cabin cruisers. The PPGFA has annually hosted international tournaments with fishermen from neighboring Samoa and Cook Islands attending. The recreational vessels use anchored FAD extensively, and venture to the various outer banks during tournaments (Tulafono 2001).

Relevant Socio-economic Profile

American Samoa's population is about 49,437 (July 2020 estimate) composed of about 92.6% Pacific Islanders (the vast majority of whom are Samoan), 3.6% Asian, 2.7% mixed (2010 estimate). The Samoan language is the primary language spoken at 88%, but most people are bilingual. The median age is 27.2 years old. Almost 90% of the total population lives in urban areas and the rate of urbanization is increasing, while the overall population size is declining. Agriculture comprised 27.4% of the GDP, with products including bananas, coconuts and other crops. The estimated GDP per capita in 2016 was $11,200. In 2013, American Samoa exported an estimated $428 million in products, primarily canned tuna (93%) and imported an estimated $615 million, primarily raw materials for canneries, food and petroleum.[30]

The two most important economic sectors of the American Samoa economy are the American Samoa Government, which receives income and capital subsidies from the Federal government, and tuna canning. Although the vast majority of cannery workers are not American Samoa citizens, the canneries play a large role in the economy through delivery of goods or services to tuna processors, as well as cannery employee income and local expenditures. The viability of the single remaining American Samoa cannery has been questionable in recent years as American Samoa experienced several cannery closures over the past decade.

Fishing and other marine resources have played a crucial role in cultural, economics and subsistence aspects of Samoan village life. Traditional Samoan culture held fishing in high esteem, with fishing skill bringing high social status. The tautai, or master fisherman, of the village was a key decision maker with higher status than others (who might otherwise outrank him) when it came to matters of fishing.

Over the last fifty or so years, fishing has become less prominent as a central and organizing community force. During this time, fishermen were using modern fishing gear and tuna canneries became a major economic force, along with a rapid increase in population. As a result, American Samoa has experienced a shift from a subsistence-oriented economy where sharing of fish catch was extremely important, to a cash-based economy, where fishing is often viewed as a more commercial venture. However, village-level governance systems and resource tenure are

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[30] CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/print_aq.html, accessed April 03, 2020

still largely intact. These systems emphasize reciprocity over individual accumulation and gifts of food (especially fish and other marine resources) mark every occasion, which maintains Samoan social structure to this day.

Additional information about the role of fishing and marine resources across American Samoa, as well as information about the people who engage in fishing or use fishing, can be found in the American Samoa FEP SAFE Report (WPFMC 2020a), Pelagics FEP SAFE Report (WPFMC 2020d) and Grace-McCaskey (2015).

American Samoa Administrative Environment

On April 2, 1900, chiefs of the islands of Tutuila and Anuu ceded and swore allegiance to the United States of America. On July 16, 1904, the chief of the island of Manua ceded the island to the United States. The islands now form American Samoa (Gurr n.d.). A Congressional act in 1929 accepted the Deeds of Cession of Tutuila and Aunuu and the Deed of Cession of Manua with special guarantees of protection of ceded waters and their marine resources for the American Samoan people (Sagapolutele 2016).

American Samoa is an unincorporated, unorganized, and self-governing territory of the U.S. Thus, it is excluded from some provisions of the U.S. Constitution and Congress has not provided it with an organic act, which would organize the government in the same manner as a constitution would. (Future Political Status Study Commission 2007). Instead, Congress gave plenary authority over the territory to the President of the U.S., who then delegated that authority to the Department of the Interior. The Secretary of the Interior enabled American Samoans to draft a constitution under which the American Samoa Government functions (Office of Insular Affairs 2017; USDOL 2017).

American Samoans are U.S. nationals rather than U.S. citizens. They cannot vote in national elections, but have freedom of entry into the United States. American Samoa has had an elected, nonvoting Member of Congress in the U.S. House of Representatives since 1981 (USDOL 2017).

The American Samoa Department of Marine Wildlife Resources provides marine resource management within territorial waters. Activities include conducting creel surveys, enforcing territorial fishing regulations, conducting water quality surveys, and participating in various marine wildlife and habitat research and monitoring projects.

Federally Managed Sanctuaries, Monuments and Wildlife Refuges

The National Marine Sanctuary (NMS) of American Samoa was originally designated in 1986 as the Fagatele Bay NMS. The NMS was expanded from its 0.25 mi^2 (0.65 square km^2) site at Fagatele Bay to five additional discrete units: Fagalua/Fogamaa, Swains Island, Tau, Aunuu and Muliāva (Rose Atoll), totaling 13,581 mi^2 (35,175 km^2) with the Rose Atoll unit accounting for 99% of the expansion (77 FR 43942).

Later, President George W. Bush designated the Rose Atoll Marine National Monument in 2009, which encompasses 13,436 mi^2 (34,800 km^2) of pelagic habitat surrounding the 0.08 mi^2 (0.214

km^2) Rose Atoll. This designation prohibits all extraction within 12 nm of the atoll and all commercial fishing within the boundaries of the Monument. The Monument also encompasses the Rose Atoll National Wildlife Refuge and is part of the NMS of American Samoa.

Department of Defense Jurisdictions

There are no Department of Defense (DOD) installations or known active DOD jurisdictions in the EEZ surrounding American Samoa.

3.3 Mariana Archipelago (Commonwealth of the Northern Mariana Islands and Guam)

The Mariana Archipelago composed of 15 volcanic islands with a total land area of 396 mi^2 (1,026 km^2) that are part of a submerged mountain chain that stretches nearly 1,500 mi (2,414 km) from Guam to Japan. Politically, the Mariana Archipelago contains the Territory of Guam and the CNMI (WPFMC 2009b).

The CNMI stretches over 400 nm (741 km) between 14-21°N latitude and 144-146°E longitude. The total land area of the CNMI is approximately 179 mi^2 (453 km^2). The CNMI is comprised of fourteen islands in the Archipelago. The southern islands are limestone and the northern islands are volcanic with several active volcanoes (WPFMC 2009b). The vast majority of the population resides on the islands of Saipan, Tinian, and Rota, with the center of government on Saipan.

Guam is located at 13°28'N latitude and 144°45'E longitude and has a total land area of 216 mi^2 (560 km^2). It is the southernmost and largest island in the Mariana Archipelago. Guam is the closest island to the Mariana Trench that lies east of the island chain (WPFMC 2009b).

The following is information relevant to any aquaculture management program; the Mariana Archipelago FEP contains a full description of the affected environment.

3.3.1 Physical Environment

Geological Features

Coastline

Coastlines within Mariana Archipelago contain rocky intertidal areas, steep cliffs and headlands, and the occasional sandy beach or mudflat (Eldredge 1983). The water erosion of rocky coastlines in the islands has produced cliffs and sea-level benches (Eldredge 1979, 1983). The island of Saipan has fine sand beaches protected by two barrier reefs (Scott 1993). On the western coastline of Saipan, the barrier reefs form two additional lagoons, creating the largest lagoon system in the Mariana Islands (Environmental Services Duenas & Associates 1997). For Guam, the majority of the coastline is comprised of rocky intertidal regions, with some beaches composed of calcareous and volcanic sands (Eldredge, 1983).

Open Ocean

The Mariana Archipelago is a chain of volcanic islands, and due to its topography has a relatively steep profile. This limits the neritic zone, or the zone where sunlight reaches the ocean floor, in the open ocean areas and EEZ. The waters surrounding the islands and that make up the EEZ are generally greater than 10,000 ft (3,050 m) deep, but are scattered with different bottom habitats.

The soft bottom habitat in the Mariana Archipelago is the Mariana Trough found in the open ocean around the islands. The Mariana Trough is comprised of an abyssal plain (large and relatively flat regions covered in a thick layer of fine silty sediments) with water depths ranging from approximately 11,500 to 13,100 ft (3,505 to 3,993 m) (Kennett 1982; Thurman 1997). While biomass is low in abyssal plains, research indicates they harbor thousands of species of invertebrates and fish (NOAA 2016).

There are two types of hard-bottom habitats found in the open ocean of the Mariana Archipelago - seamounts and flat-topped seamounts known as guyots. Seamount and guyot topography is a contrast to the Mariana Trough. Guyots are eroded, flat-topped undersea mountains over 984 ft (300 m) below the surface.

The Mariana Archipelago contains the following banks:

- Galvez bank located 12 mi (19.3 km) south of Guam.
- Santa Rosa Reef located 25 mi (40.2 km) south-southwest of Guam.
- Arakane Bank located 200 mi (321.9 km) west-northwest of Saipan.
- Tatsumi Reef located 1.2 mi (1.93 km) southeast of Tinian.
- Pathfinder Bank located 170 mi (273.6 km) west of Anahatan.
- Supply Reef located 11.5 mi (18.5 km) northwest of Maug Island (Starmer 2005).

There is also a large shallow (< 330 ft [100 m] deep) bank offshore the west coast of Saipan approximately 5 mi (8 km) long by 1 m (1.6 km) wide.

The Mariana Trench is the deepest part in the world’s ocean and lies about 124 mi (200 km) east of the Marianas Islands. It is nearly 36,000 ft (11 km) at its deepest point of the seafloor. The Pacific Plate and Philippine Plate convergence created the trench (Paulay 2003).

There are also hydrothermal vents surrounding the Mariana Archipelago and in the Mariana Trench. Hydrothermal vents are created when seawater permeates through the earth’s crust and upper mantle. As seawater percolates downward through the oceanic crust, it becomes super-heated and chemically rich, eventually reaching the seafloor surface. When the super-hot vent fluid meets with cold deep-sea water, minerals precipitate out of the fluid, forming vent chimneys (Amon and Glickson, 2016). On the Mariana Ridge there are three known hydrothermal vent fields: Forecast Vent site (13°24’N, 143°55’E), TOTO Caldera (12°43’N, 143°32’E) and the 13°N Ridge (13°05’N, 143°41’E) (Kojima 2002).

Oceanographic Features

Surface temperatures are relatively constant at 83°F (28.2°C), and decrease rapidly through a thermocline layer between water depths of approximately 490 to 1,310 ft (150 to 400 m). Salinity concentrations are constant in the mixed surface layer at 34.5 ppt. Turbidity values are relatively constant throughout the entire water column with minor changes. Turbidity ranges from 43.5 Nephelometric Turbidity Units (NTU) to 44.9 NTU in surface waters. DO concentrations in surface waters average approximately 5.98 mg/L, declining to 2.21 mg/L at a depth of 1,800 ft (549 m) (DOD 2015).

The major surface current affecting the CNMI and Guam is the North Equatorial Current, which flows westward through the islands. The Subtropical Countercurrent affects the Northern Islands and generally flows in an easterly direction (Eldredge, 1983). Seamounts and guyots affect the upwelling of nutrients to the surface, creating a hotspot of biodiversty (Rogers 1994; Lalli and Parsons 1997).

Extreme Weather

The Mariana Archipelago has a tropical marine climate, with seasonal northeast trade winds from November to March and easterly winds from May to October. The average year-round temperature is 84°F (28.9°C) with an average humidity of 79% (USDOI 2006). The Mariana Archipelago is located 600 mi (966 km) east of an area where cyclonic disturbances typically begin to form. As a result, the region remains in a weather condition "four" at all times, indicating 40 mph (64 km/hr) winds are possible within 72 hours. Cyclonic disturbances come quickly with winds up to 120 mph (193 km/hr) or greater (Pacific RISA, n.d., USDOI, 2006).

Typhoon season is from July to January. The CNMI is located in "Typhoon Alley" and is subject to at least one typhoon each year (Pacific RISA, n.d., USDOI, 2006). Typhoons are also frequent on Guam with up to five typhoons per year (Birkeland 1997, Eldredge, 1983, USDA 1995).

3.3.2 Biological Environment

The Mariana Archipelago FEP describes the biological environment of the Mariana Archipelago, including the species addressed in this PEIS, which we incorporate here by reference (WPFMC 2009b). This document describes specific resources of concern identified during scoping and interagency informal consultations to the level necessary for appropriate analysis.

Benthic and Sessile Organisms

See Section 3.1 for the general biology of benthic and sessile organisms in the nearshore and offshore habitat. This section only covers information specific to the Marianas Archipelago.

Nearshore Reefs

The total coral reef area in the CNMI is estimated at 48 mi^2 (124 km^2) of shallow reef habitat within the 10-fathom (18 m) contour. The older southern islands have fringing and barrier reefs, while the northern islands, which are still volcanically active, have minimal coral reef coverage

(Eldredge, 1983). Well-developed coral reefs surround approximately 50% of Guam's 95-mi (153-km) shoreline within the 108 square kilometers of habitat within a 10-fathom curve (Myers 1997; Randall and Myers 1983). Coral reefs also occur at offshore banks located in Federal waters. The total coral reef area in Guam is roughly between 42 and 107 mi^2 (108 and 276 km^2) (Rohmann et al. 2005).

The differences in coral reef development between islands in the archipelago are due to the age and geology of the islands. Faulting of large areas in the older islands has created oblique, shallow-water areas that support reef growth. While the younger islands have a vertical profile that is not conducive to reef development (Birkeland, 1997).

Coral reefs in the CNMI have experienced some damage from typhoons in the area and coral bleaching in 1994, 2001, and 2003. Some of the coral reefs also show signs of impact from human activity (WPFMC 2009b).

The health of Guam's coral reefs varies considerably with impacts ranging from anthropogenic to natural sources (WPFMC 2009b).

Offshore Reefs

Deep sea corals likely occur in suitable habitats across the archipelago. The Mariana Archipelago FEP identifies eleven federally managed species: three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009b).

Protected Species

Most of the protected species that occur in the Mariana Archipelago occur elsewhere in the PIR. Section 3.1 provides full descriptions of these species and this section contains only details specific to the Mariana Archipelago.

Marine Mammals

The three endangered marine mammals that occur within the Mariana Archipelago are the humpback whale, sei whale and sperm whale.

The humpbacks that winter in the Mariana Archipelago are part of the endangered Western North Pacific Distinct Population Segment, which also has wintering grounds off the Babuyan Islands in the Philippines, and off Okinawa and Ogasawara in Japan (Eldredge 2003, Calambokidis et al. 2008, Oleson et al. 2019, Hill et al. 2020a). Humpback whales have been sighted around Guam and the CNMI (Eldredge 2003, Deakos, Chen and Hill 2021), and primarily spend summers in the Commander Islands and Bering Sea (Hill et al. 2020a; Oleson et al. 2022)

According to the International Whaling Commission, there is one stock of sei whales in the North Pacific, but some evidence exists for multiple populations (Forney et al. 2000). Sei whale sightings are associated with steep bathymetric relief (e.g., steeply sloping areas), including sightings adjacent to the Chamorro Seamounts east of the CNMI (Fulling et al. 2011). All sightings in a 2007 survey were south of Saipan, indicating that this species occurs south of 20°N in the winter (Fulling et al. 2011).

Information is growing for the sperm whale stock in the Mariana Islands. Kasuya and Miyashita (1988) suggest that that there are two stocks of sperm whales in the western North Pacific, a northwestern stock with females that summer off the Kuril Islands and winter off Hokkaido and Sanriku, and the southwestern North Pacific stock with females that summer in the Kuroshio Current System and winter around the Bonin Islands. All available sperm whale encounter and satellite telemetry data demonstrate that sperm whales use both offshore and nearshore waters within the Mariana Archipelago (Hill et al. 2020b). Sperm whale encounters have been reported near islands from Guam to Pagan, as well as offshore within the Mariana Trough and north of Uracus. Additional reported sightings in the Marianas include around Guam in the 1980s, two individuals around Guam and Saipan in 2010, 23 individuals during a survey throughout the archipelago in 2011, and a group of 10 whales off western Guam in 3,949 feet (1,200 m) deep waters in 2012 (Fulling et al. 2011, HDR EOC 2012).

Table 17 outlines sightings of other marine mammals. A single dugong (*Dugong dugon*) was observed in Cocos Lagoon, Guam in 1975 (Randall et al. 1975). Dugongs are members of the Sirenia order, which include sea cows and manatees, and have a distribution from the east African coast to islands in the southwestern Pacific. Several sightings were reported in 1985 on the southeastern side of Guam (Eldredge 2003). Since that time, there have been no reports of dugong sightings in Guam. There are no reported observations of dugongs for the CNMI.

Table 17. Non-ESA Listed Marine Mammals Found in the Mariana Archipelago (source: DOD 2015)

Common Name	Scientific Name	Common Name	Scientific Name
Blainsville beaked whale	*Mesoplodon densirostris*	pygmy killer whale	*Feresa attenuata*
bottlenose dolphin	*Tursiops truncatus*	Risso’s dolphin	*Grampus griseus*
Bryde’s whale	*Balaenoptera edeni*	rough-toothed dolphin	*Steno bredanensis*
Cuvier’s beaked whale	*Ziphius cavirostris*	short-finned pilot whale	*Globicephala macrorhynchus*
false killer whale	*Pseudorca crassidens*	spinner dolphin	*Stenella longirostris*
melon-headed whale	*Peponocephala electra*	spotted dolphin	*Stenella attenuata*

Sea Turtles

All five Pacific sea turtle species can occur throughout the Pacific; however, there have been no reports of loggerhead sea turtles or olive ridley sea turtles in the Marianas. Section 3.1 contains a full description of each sea turtle species. The following provides Marianas-specific information on these species.

Green Sea Turtles

Surveys conducted throughout the Marianas under an interagency agreement between NOAA and the U.S. Navy between 2015-2019 included 357 non-capture observations, 258 (72.3%) of which were identified as green turtles, and 80 (22.4%) were identified as "unknown" species (but either green or hawksbill turtles (Gaos et al. 2020).

Based on nearshore surveys conducted jointly between the CNMI Department of Lands and Natural Resources, Division of Fish and Wildlife (DFW) and NMFS around the southern islands (Rota, Tinian, Saipan), an estimated 1,000 to 2,000 green sea turtles forage in these areas (Seminoff et al. 2015). The green sea turtle is a traditional food in the Marianas and, although harvesting them is now illegal, there have been some cases where they are still harvested illegally (NMFS and USFWS 1998b). Turtle eggs are also harvested in the CNMI. Nesting beaches and seagrass beds on Tinian and Rota are in good condition, but hotels, golf courses and general tourist activities have impacted beaches and seagrass beds on Saipan.

There are nesting surveys for green sea turtles on Guam since 1973, with the most consistent data collected since 1990. There have been up to 60 nesting females observed annually, with a generally increasing trend over the past 12 years. Aerial surveys done in 1999- 2000 also found an increase in green sea turtle sightings around Guam (Cummings 2002).

Hawksbill Sea Turtles

Hawksbills also inhabit waters around the Marianas, although their distribution and habitat use remain unclear. Surveys conducted throughout the Marianas under an interagency agreement between NOAA and the U.S. Navy between 2015-2019 included 357 non-capture observations, 19 (5.3%) of which were hawksbill turtles, and 80 (22.4%) were identified as "unknown" species (but either green or hawksbill turtles) (Gaos et al. 2020).

According to the 1998 Pacific Sea Turtle Recovery Team Recovery Plan for the hawksbill turtle (NMFS and USFWS, 1998b), there are no reports of nesting in the CNMI. This does not rule out the possibility of a few hawksbill nests, as there are no nesting surveys on small pocket beaches in remote areas of the CNMI. In 2019, researchers tracked an individual hawksbill that migrated from Tinian to Pohnpei but were unable to determine whether it was nesting in the CNMI or Pohnpei (Gaos et al. 2020).

A survey found one hawksbill sea turtle nest in November 1991 on Guam (NMFS and USFWS 1998c); however, this was highly unusual as nesting individuals are otherwise virtually unknown on Guam (Eldredge 2003).

Leatherback Sea Turtles

There have been occasional sightings of leatherback turtles around Guam (Eldredge 2003). However, to what extent (i.e., preferred location, abundance, seasonality) leatherback turtles are present around Guam and the CNMI is unknown.

Seabirds

During a recent survey along the Marianas archipelago, researchers counted 3,266 individual birds in 1,605 seabird sightings among 29 species (plus 12 additional taxa) over the course of 59 days (Yano et al. in press). The most frequently sighted seabird species included the Sooty Tern (*Onychoprion fuscata*, 654 individuals), Short-tailed Shearwater (*Ardenna tenuirostris*, 547 individuals), and Red-footed Booby (*Sula sula,* 368 individuals).

Seabirds considered residents of the CNMI include the wedge-tailed shearwater, white-tailed tropicbird, red-tailed tropicbird, masked booby, brown booby, red-footed booby, white tern, sooty tern, brown noddy, black noddy, and the great frigatebird (WPFMC 2009b).

Seabirds sighted and considered visitors (some more common than others) to the CNMI include the short-tailed shearwater (common visitor), Newell's shearwater (rare visitor), Audubon's shearwater, Leach's storm petrel, and the Matsudaira's storm petrel. Of these, only the Newell's shearwater is endangered. There have been no sightings of the endangered short-tailed albatross in the CNMI, although the CNMI is within the range of the primary breeding colony on Torishima, Japan (WPFMC 2009b).

According to Wiles (2003), the only resident seabirds on Guam are the brown noddy and the white tern. Common visitors to Guam include the black noddy and the short-tailed shearwater. Other less common or rare visitors include the brown and red-footed boobies, wedge-tailed shearwater, Matsudaira's storm-petrel, white-tailed and red-tailed tropicbirds, great frigatebird, gulls, and terns.

Sharks and Rays

All sharks and rays that occur in the Marianas occur elsewhere in the PIR. Section 3.1 contains thorough descriptions of each species.

3.3.3 Social and Economic Environment

Species most likely to be cultured in the Mariana Archipelago under this action include yellowfin tuna, bigeye tuna, dolphinfish, almaco jack, giant trevally, bluefin trevally, pacific threadfin, and rabbitfish. Section 3.2 describes the life history characteristics of these species. The focus of the discussion with regard to the economic and social environment potentially affected by this action would be fisheries that catch these species, supporting industries and surrounding fishing communities. The potential for rabbitfish as an aquaculture species is specific to the CNMI due to strong local demand for rabbitfish, which is only available seasonally.

State of Aquaculture Industry

Both Guam and the CNMI have an academic and government support structure for aquaculture, including the CNMI Aquaculture Strategic Plan, the Northern Marianas College Aquaculture Development Center, and the Guam Aquaculture Development Training Center. Guam has developed more aquaculture, producing 122 tons (111 mt) of eel, carp, catfish, marine shrimp and tilapia in 2012.

Until 2011, most aquaculture activity in the CNMI focused on tilapia and marine shrimp aquaculture (SPC Aquaculture Portal, 2011). Currently there is active tilapia aquaculture, albeit in a limited commercial capacity and some tentative future plans to start operating mud crab facilities. In an effort to promote aquaculture in the region, specifically finfish aquaculture, the CNMI launched an Aquaculture Strategic Plan (2011-2015), which identified potential and emerging commodities for further development in the CNMI. Funding from the USDA provided finfish aquaculture training at the Oceanic Institute in Hawaii where individuals from Saipan came and studied finfish aquaculture techniques (Ogo, 2015). This launched the Saipan rabbitfish aquaculture project (2015-2018) with the goal to establish a commercially available rabbitfish product to the markets of the CNMI (Ogo, 2015). In February of 2017, the Northern Marianas College Cooperative Research, Extension, and Education Service program (CREES) officially opened a new aquaculture development center. This center is currently the second in the world to perform rabbitfish aquaculture research, having completed successful larval rearing and offers training services (Encinares, 2017).

There is one aquaculture facility on Guam, located at the University of Guam in Mangilao. The Guam Aquaculture Development and Training Center currently cultures tilapia, marine shrimp and catfish, though in the past it has also cultured eel, freshwater prawn, carp, milkfish, mangrove crab, mullet and ornamental carp (CTSA 2012; Jiang n.d.). As with the facility in the CNMI, the Guam Aquaculture Development and Training Center is also associated with extension activities and can provide training services.

Characteristics and Economic Feasibility of Aquaculture Operations

While there have been no offshore aquaculture projects in the Mariana Archipelago, important support structure for development currently exists. Guam has a relatively large, part-time fishing fleet that could provide services to offshore cages, including deployment, facility maintenance, stocking and harvesting, feeding, and cage retrieval. The University of Guam and local environmental consulting operations may be able to provide environmental services, including surveys and monitoring, as well as facilitate hatchery technology and the development of a dependable source of broodstock. As described above, both the University of Guam and the Northern Marianas College have aquaculture training services. While some of these services are in early development, they are likely to grow with the growing interest in aquaculture.

The area should be well situated to accommodate both local and export demand for aquaculture products, with a relatively high annual seafood consumption rate of 56 lbs. (25 kg) per capita in Guam and 51 lbs. (23 kg) per capita in the CNMI, (WPFMC 2009b and Rhodes et al. 2011, respectively) and proximity to Japanese and other Asian markets. Guam’s status as a major regional fish transshipment center (WPFMC 2018d) is also useful for developing and meeting export demand.

Scope of Fishing Industry - Wild Stocks

Pelagic Fisheries

The CNMI

Commercial fishing in the Mariana Archipelago is primarily trolling with small boats in nearshore waters. The CNMI pelagic troll fishery occurs primarily from the island of Farallon de Medinilla south to the island of Rota, mostly by vessels less than 24 feet in length, that generally take day trips within 30 nm (56 km) to primarily target skipjack tuna (WPFMC 2020d). The number of boats involved in the CNMI pelagic fishery has been steadily decreasing since 2001, when there were 113 reporting commercial pelagic landings. In 2016, a decade-high 73 boats reported landings, a significant increase from 12 in the previous year. In 2019, 49 boats reported landing pelagic species, a decrease of 12.5% from the 56 boats in 2018 (WPFMC 2020d).

Figure 17 and Figure 18 include information on the number of the CNMI commercial fishermen and annual pelagic landings from 2010 to 2019. Table 18 shows the species composition of commercial catch in 2019.

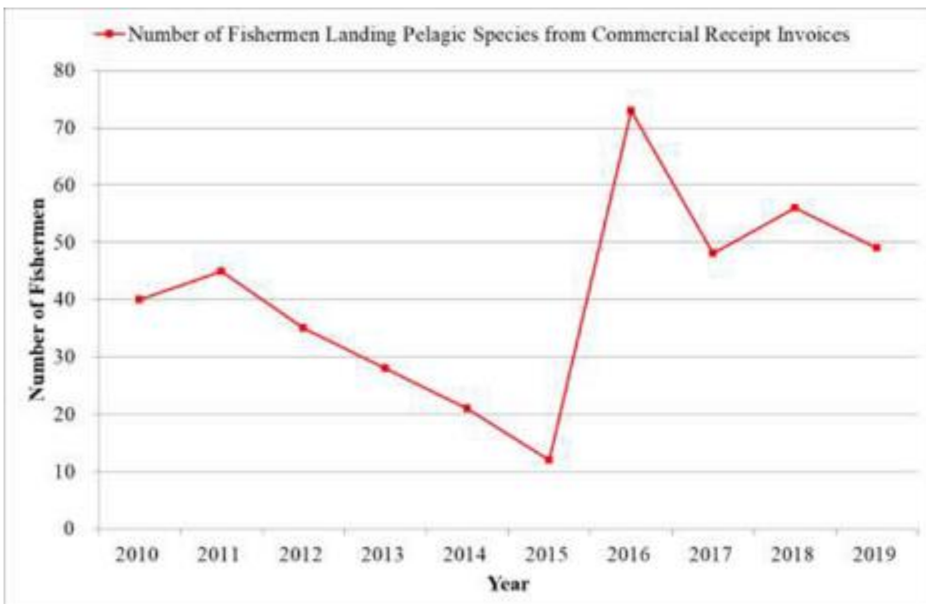

Figure 17. Number of the CNMI Fishermen (Boats) Making Commercial Pelagic Landings (2010-2019). Source: WPFMC 2020d

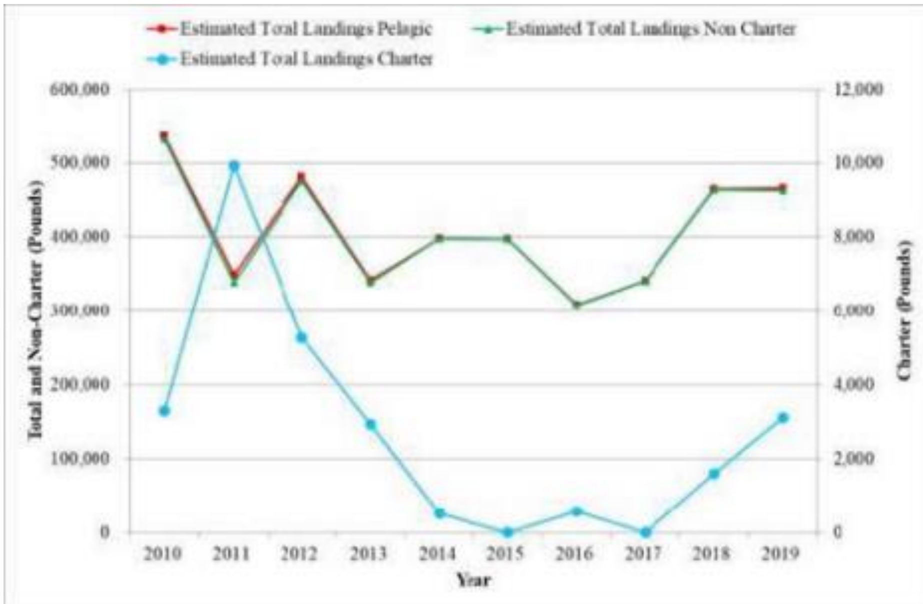

Figure 18. The CNMI Annual Estimated Total Pelagic Landings, Non-Charter and Charter (2009-2018). Source: WPFMC 2020d.

Table 18. Species Composition and Landings (lbs.) from Creel Surveys Performed in the CNMI in 2019. Source WPFMC 2020d.

Species	Total Landings	Non Charter	Charter
Skipjack Tuna	345,172	342,431	2,741
Yellowfin Tuna	36,473	36,473	0
Saba (Kawakawa)	0	0	0
Tunas (misc.)	0	0	0
TUNAS Total	**381,645**	**378,904**	**2,741**
Mahi mahi	71,791	71,791	0
Wahoo	2,448	2,448	0
Blue Marlin	3,855	3,855	0
Sailfish	0	0	0
Spearfish	0	0	0
Sharks	0	0	0
Sickle Pomfret (w/woman)	124	124	0
NON-TUNA PMUS Total	**78,218**	**78,218**	**0**
Dogtooth Tuna	3,965	3,965	0
Rainbow Runner	2,251	1,867	384
Barracuda	190	190	0
Troll fish (misc.)	0	0	0
OTHER PELAGICS Total	**6,406**	**6,022**	**384**
TOTAL PELAGICS	**466,269**	**463,144**	**3,125**

Guam

Guam's pelagic fishery consists of approximately 400 small, primarily recreational, trolling boats that fish within the local waters of the EEZ around Guam or the adjacent EEZ around the CNMI. The majority of the fishing boats are less than 30 ft in length and are usually owner-operated by fishermen who earn a living outside of fishing. The number of boats involved in Guam's pelagic fishery gradually increased from 193 in 1983 to a high of 496 in 2013. There were 472 boats involved in Guam's pelagic fishery in 2019, an increase of 18.6% from 2018. The majority of the fishing boats are less than 10 m (33 ft) in length. Most fishermen sell a portion of their catch, and it is difficult to make a distinction between recreational, subsistence, and commercial fishers. A small but economically significant segment of the pelagic group (approximately 5-10%) is comprised of marina-berthed charter boats with full-time captains and crews (WPFMC 2020d).

Skipjack tuna is the principal species landed in Guam, comprising nearly over 57% of the entire pelagic landings in 2019 based on creel survey data. Figure 20 provides annual total weight of pelagic landings in Guam from 2010 to 2019. Table 19 provides 2019 charter and non-charter landings by species and weight.

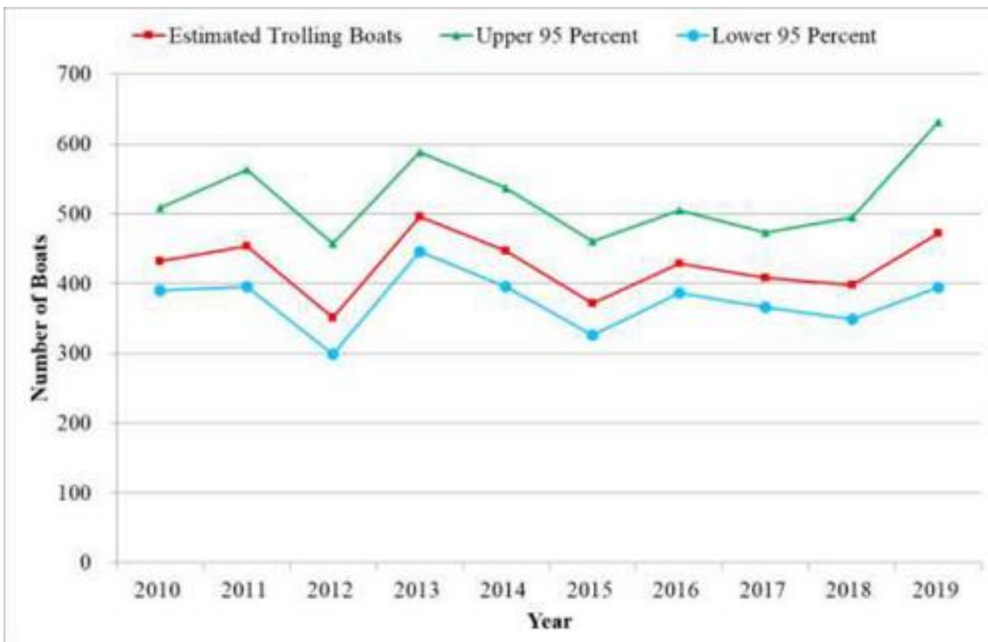

Figure 19. Total Estimated Vessels in Guam Pelagic Fisheries from 2010-2019. Source WPFMC 2020d.

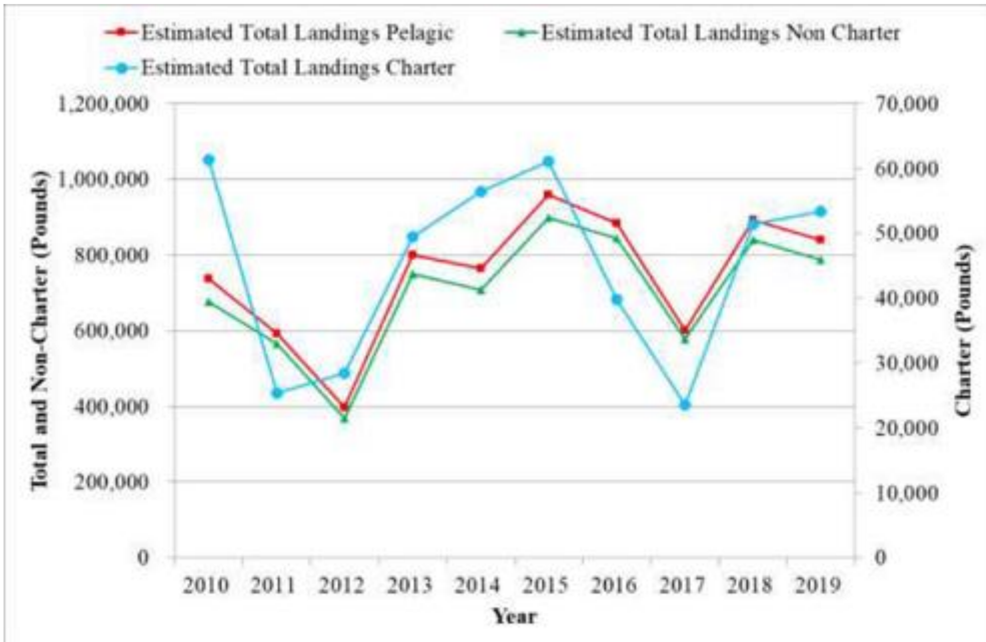

Figure 20. Guam Annual Estimated Total Pelagic Landings, Non-Charter and Charter (2010-2019). WPFMC 2020d.

Table 19. Species Composition and Total Estimated, Non-Charter, and Charter Landings (lbs.) for Guam in 2019. Source: WPFMC 2020d.

Species	Total Landings	Non Charter	Charter
Skipjack Tuna	479,966	466,653	13,313
Yellowfin Tuna	84,825	82,705	2,120
Kawakawa	95	95	0
Albacore	0	0	0
Bigeye Tuna	0	0	0
Other Tuna PMUS	0	0	0
TUNAS Total	**564,886**	**549,453**	**15,433**
Mahimahi	162,541	136,431	26,109
Wahoo	32,600	29,094	3,506
Blue Marlin	56,020	47,995	8,025
Black Marlin	0	0	0
Striped Marlin	0	0	0
Sailfish	1,459	1,459	0
Shortbill Spearfish	0	0	0
Swordfish	0	0	0
Oceanic Sharks	0	0	0
Pomfrets	82	19	64
Oilfish	0	0	0
NON-TUNA PMUS Total	**252,702**	**214,998**	**37,704**
Dogtooth Tuna	6,922	6,922	0
Rainbow Runner	11,383	11,084	300

Species	Total Landings	Non Charter	Charter
Barracudas	4,428	4,428	0
Double-lined Mackerel	11	11	0
Misc. Troll Fish	0	0	0
OTHER PELAGICS Total	**22,744**	**22,445**	**300**
TOTAL PELAGICS	**840,332**	**786,896**	**53,437**

Bottomfish Fisheries

The CNMI

The two distinct types of bottomfish fisheries in the CNMI are shallow-water bottom fishing, which targets fish at depths down to 150 m, and deepwater bottom fishing, which targets fish at depths greater than 150 m. Relatively small (<25ft) fishing vessels are used to access bottom fishing grounds around Saipan and Tinian, while the larger (>25ft) vessels are used to access bottomfish resources in the Northern Islands. Only a handful of these larger bottom fishing vessels are operating within the CNMI. Vendors own most of the small bottomfishing vessels. However, a few subsistence bottomfishers participate in the fishery intermittently. More recently, improved technologies, such as sophisticated electronics to locate fish and various types of reels replacing handlines, have entered the CNMI bottomfish fishery (WPFMC 2020b).

The number of boats participating in the CNMI bottomfish fishery peaked in 2010 at 6,300 fishers, saw a marked decrease to roughly 600-800 fishers from 2012-2017, and in 2018 increased to 1,195 fishers. The coral reef boat-based troll fisheries have remained steady in the same timeframe, with roughly 600-800 fishers between 2010 and 2018 (WPFMC 2019).

Guam

Bottomfishing in Guam is a combination of recreational, subsistence, and small-scale commercial fishing. Bottomfishing consists of two distinct fisheries separated by depth and species composition. The shallow water complex (< 500 feet) comprises the largest portion of the total bottomfish harvest and effort, though in recent years, deep water species (>500 feet) have made up a significant portion of the total expanded bottomfishing catch. The majority of bottomfishing around Guam takes place on offshore banks, though practically no information exists on the condition of the reefs on offshore banks (WPFMC 2020b). Based on anecdotal information, most of the offshore banks are in good condition due to their isolation. The banks are fished using hook and line, and jigging at night for bigeye scad (*Selar crumenophthalmus*; Myers 1997).

The number of participants in Guam's bottomfish fishery peaked in 2010 at 6,300 fishers, saw a marked decrease to roughly 600-800 fishers from 2012-2017, and in 2018 increased to 1,195 fishers.

Commercial Catch and Landings of Species with Aquaculture Potential

The CNMI

Skipjack tuna is the principal species landed in the CNMI, comprising over 74% of the entire pelagic landings in 2019 based on creel survey data (Table 18 above). Dolphinfish (mahi mahi) and Yellowfin tuna ranked second and third, respectively, by weight of landings in 2019.

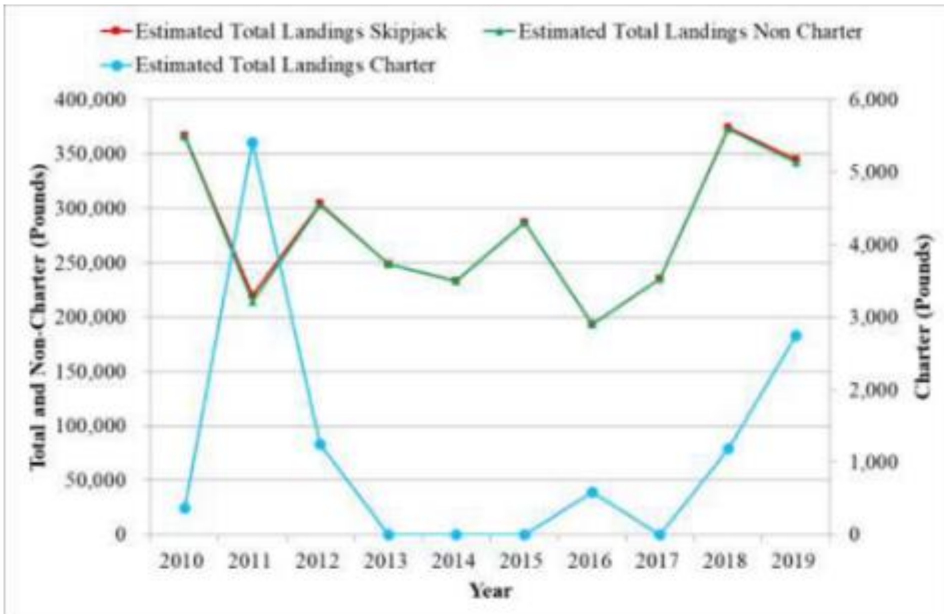

Figure 21. Total Estimated Annual Catch for Skipjack in the CNMI from 2010-2019. Source: WPFMC 2020d.

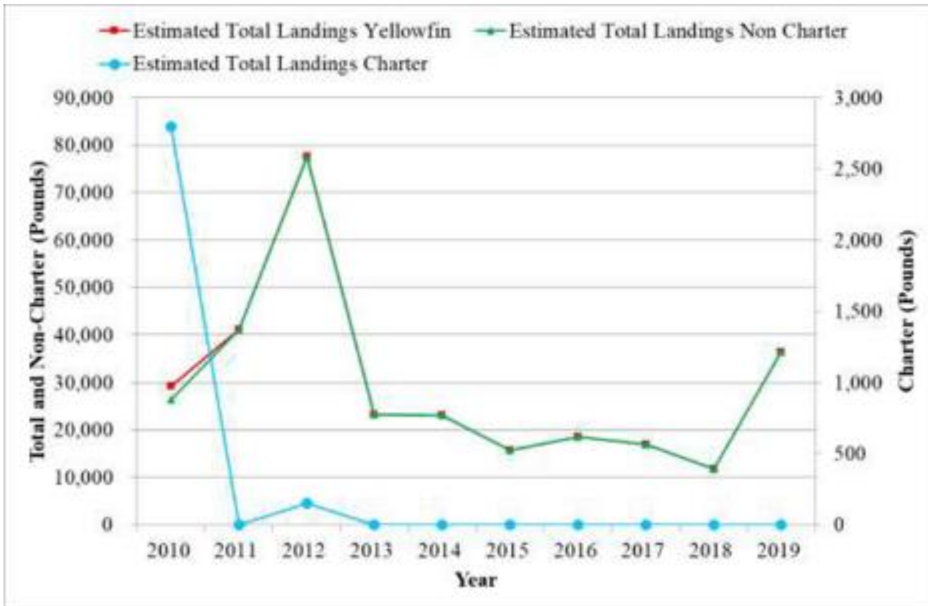

Figure 22. The CNMI Annual Estimated Total Yellowfin Landings, Non-Charter and Charter (2010-2019). Source WPFMC 2020d.

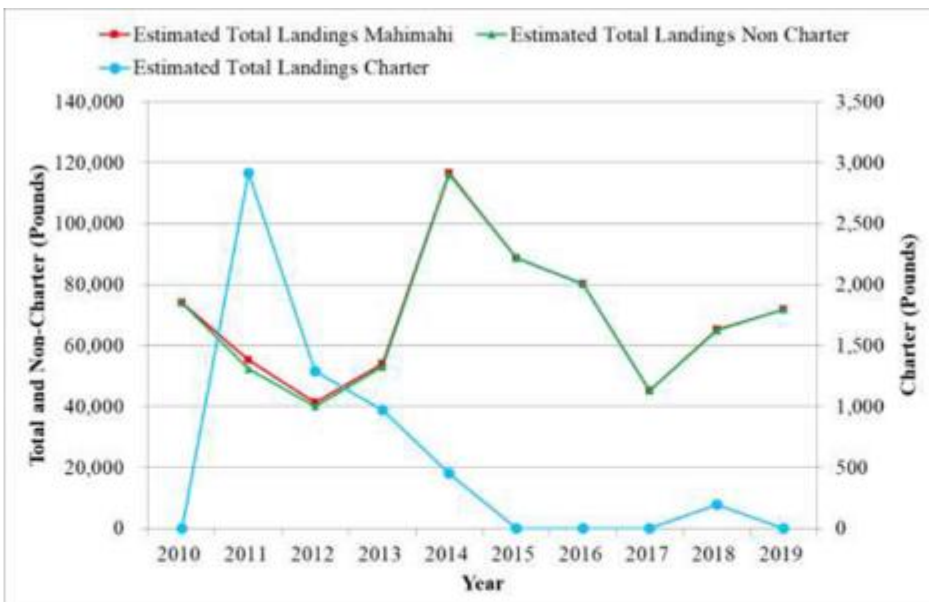

Figure 23. The CNMI Estimated Annual Total Mahi Mahi Landings, Non-Charter and Charter (2010-2019). Source WPFMC 2020d.

Amberjack and rabbitfish are also potential aquaculture species in the CNMI. Though total commercial landings volume are not available,[31] the "Revenue from Commercial Fisheries" section below outlines commercial value and volume sold.

Guam

The 2019 total expanded pelagic landings were 840,332 lbs., a slight decrease of 5.77% when compared to 2018. Tuna PMUS landings were 564,886 lbs., while non-tuna PMUS were 252,702 lbs. Landings consisted primarily of five major species: mahimahi, wahoo, bonito or skipjack tuna, yellowfin tuna, and Pacific blue marlin, with skipjack comprising over 57% of total landings (WPFMC 2020d).

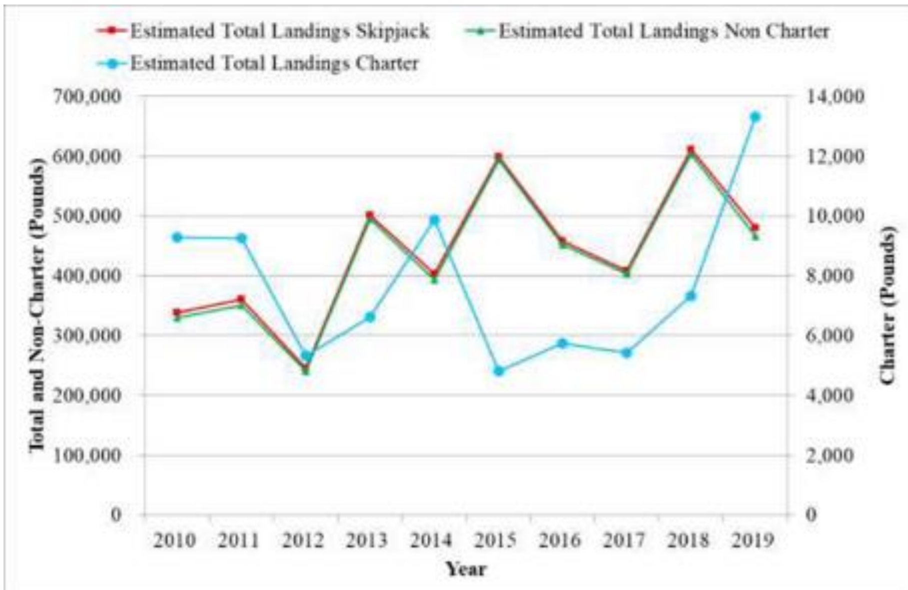

Figure 24. Total Estimated Annual Skipjack Tuna Landings in Guam from 2010-2019. Source WPFMC 2020d.

[31] https://apps-pifsc.fisheries.noaa.gov/wpacfin/home.php

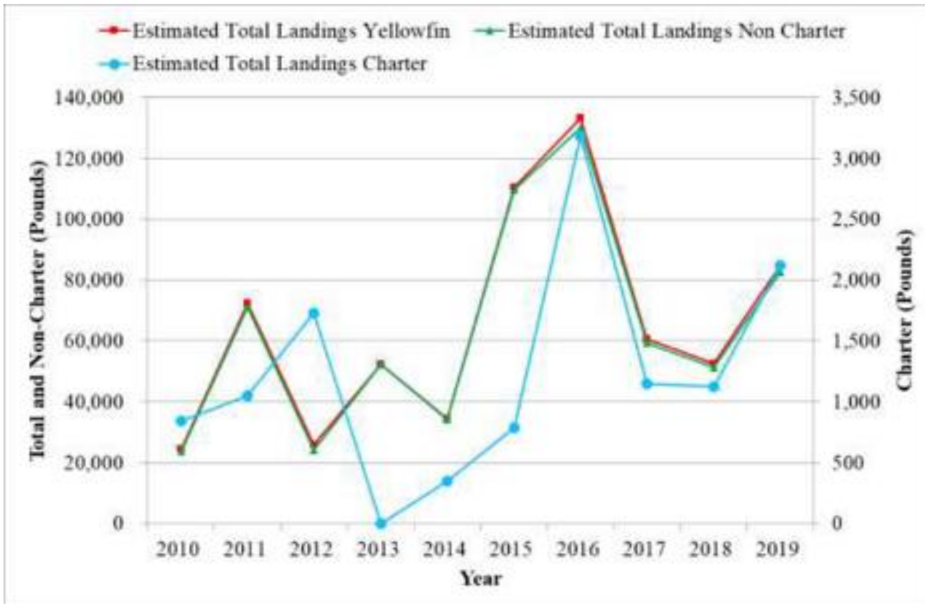

Figure 25. Total Estimated Annual Yellowfin Tuna Landings in Guam from 2010-2019. Source WPFMC 2020d.

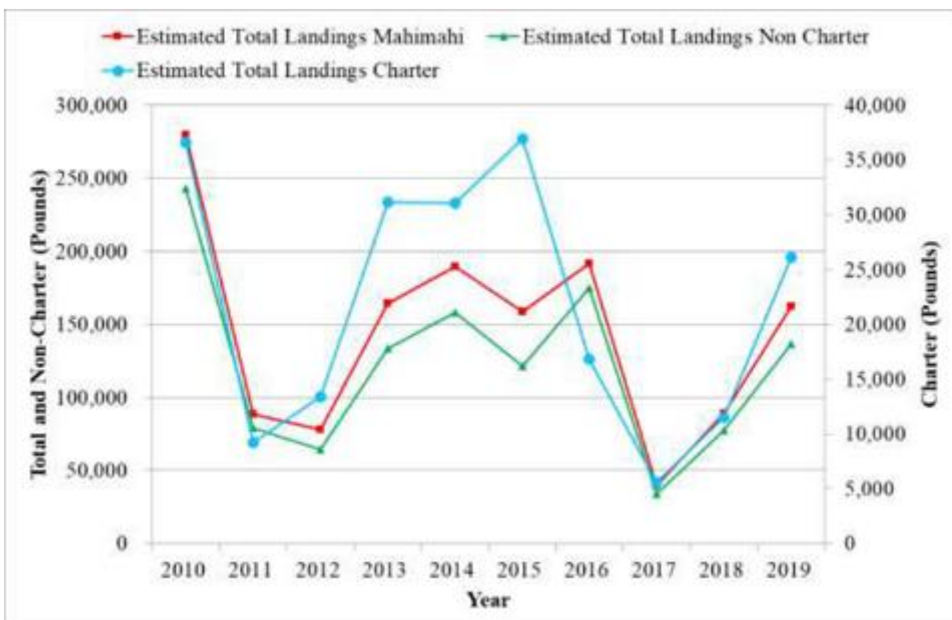

Figure 26. Estimated Annual Total Mahi Mahi Landings in Guam, Non-Charter and Charter (2010-2019). Source WPFMC 2020d.

Amberjack and rabbitfish are also potential aquaculture species in Guam. Though total commercial landings volume are not available,[32] the "Revenue from Commercial Fisheries" section below outlines commercial value and volume sold.

Revenue from Commercial Fisheries

The CNMI

The primary target and most marketable species for the pelagic fleet in the CNMI is skipjack. Schools of skipjack tuna have historically been common in near shore waters, providing an opportunity to catch numerous fish with a minimum of travel time and fuel costs. CNMI residents readily consume skipjack and serve it in restaurants, primarily as sashimi. Yellowfin tuna and dolphinfish are also easily marketable species, but are seasonal. During their seasonal runs, these fish are usually found close to shore and provide easy targets for local fishermen.

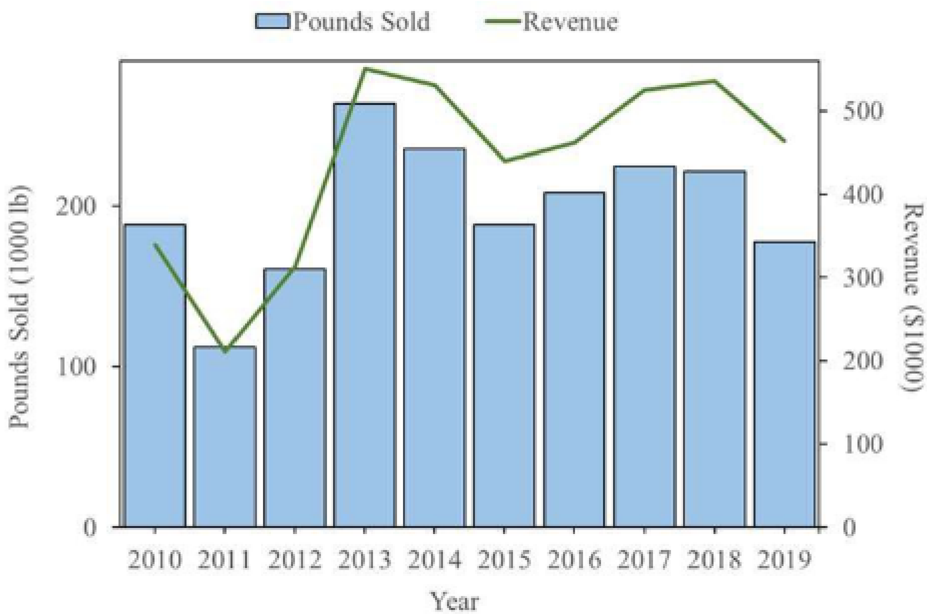

Figure 27. Total PMUS Annual Pounds Sold and Revenues in the CNMI for all Gears from 2010- 2019 Adjusted to 2019 Dollars. Source: WPFMC 2020d.

The following figures represent estimated revenue of amberjacks and rabbitfishes in the CNMI over the period 2009-2019.

[32] https://apps-pifsc.fisheries.noaa.gov/wpacfin/home.php

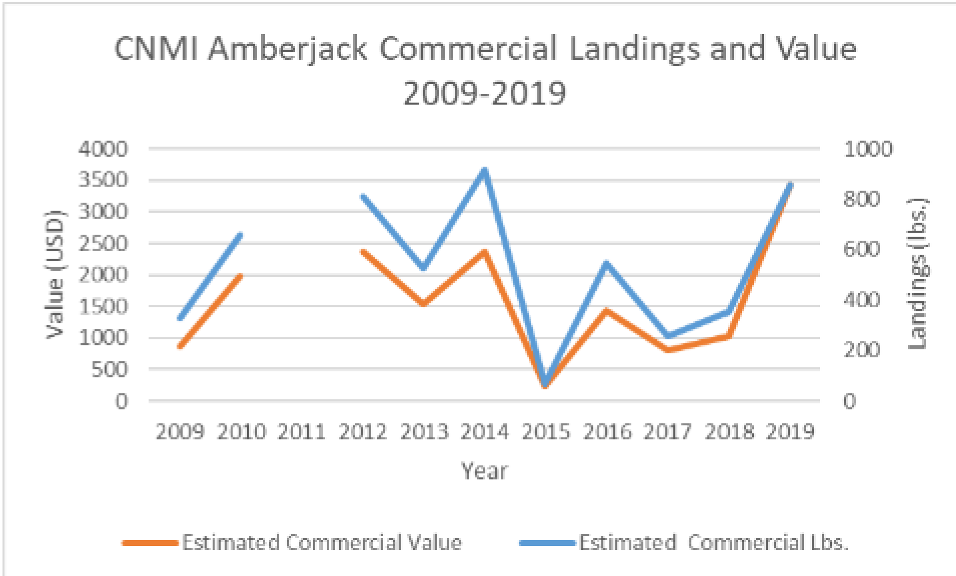

Figure 28. The CNMI Annual Amberjack Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Amberjack species include *Seriola dumerili*, *S. lalandi*, and *S. rivoliana.*

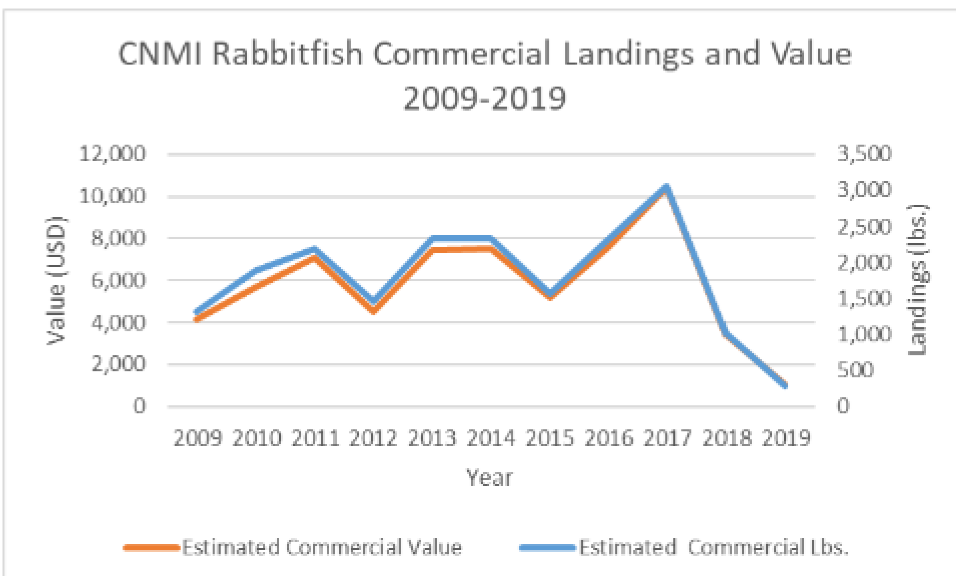

Figure 29. The CNMI Annual Rabbitfish Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Rabbitfishes include *Siganus argenteus*, *S. guttatus*, *S. punctatus*, *S. spinus*, *S. stellatus*, *S. vermiculatus*, and *Siganus* spp.

Guam

Figure 30 represents the pounds sold and revenue from all pelagic species sold in Guam from 2009-2018. Figure 31 and Figure 32 represent estimated revenue of amberjacks and rabbitfishes in the CNMI over the period 2009-2019.

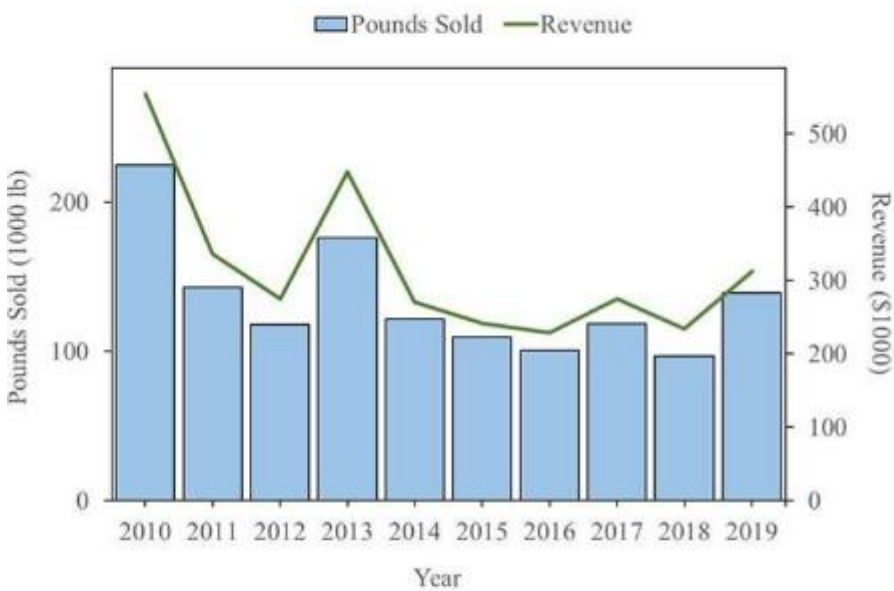

Figure 30. Total PMUS Annual Pounds Sold and Revenue in Guam from 2010-2019 Adjusted to 2019 U.S. Dollars. Source WPFMC 2020d.

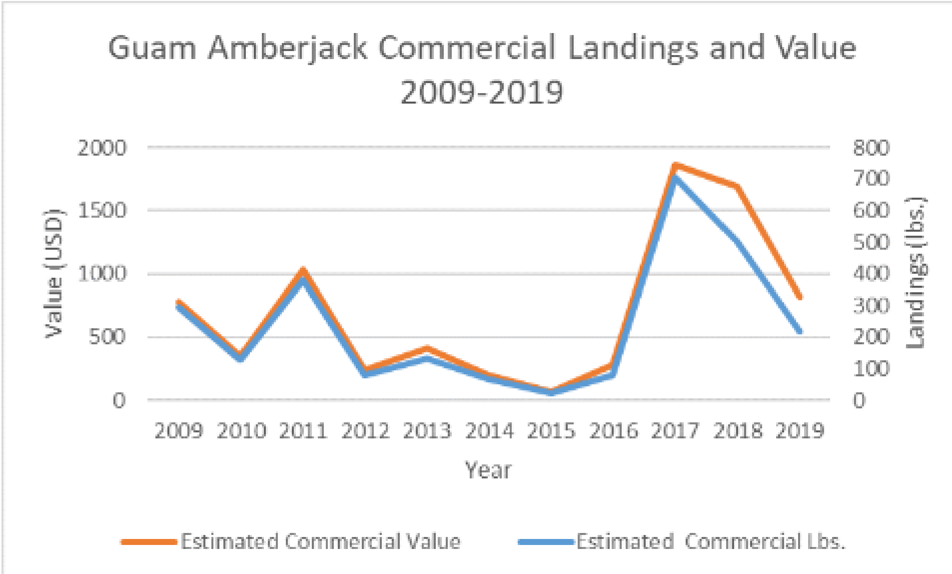

Figure 31. Guam Annual Amberjack Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Amberjack species include *Seriola dumerili*, *S. lalandi*, and *S. rivoliana.*

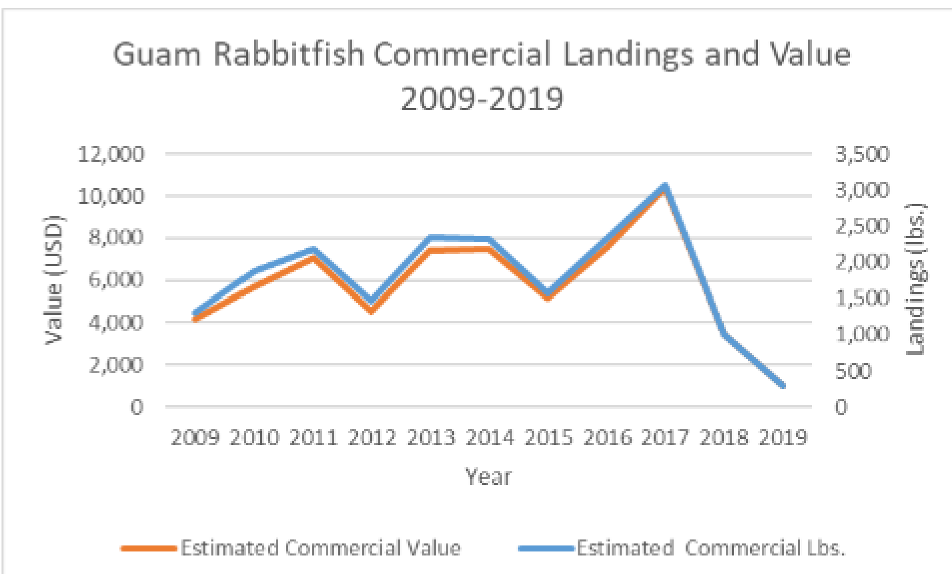

Figure 32. Guam Annual Rabbitfish Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Rabbitfishes include *Siganus argenteus*, *S. guttatus*, *S. punctatus*, *S. spinus*, *S. stellatus*, *S. vermiculatus*, and *Siganus* spp.

Commercial Fishery Suppliers and Markets

The CNMI government's volunteer database collection system records 36 fish vendors in Saipan in 2019. Fisheries managers report that the system of seafood distribution has undergone significant changes in the past decade because of the establishment of large seafood vendors. In contrast to individual fishermen/vendors who only market their own catch, large vendors typically own and operate a number of vessels and purchase catch from independent fishermen.

The Guam Fishermen's Cooperative Association (GFCA) is a central component of the Guam offshore fishing industry that continues to pursue and broaden its original mission of providing marketing services, fuel, and ice for its small-boat fishermen members. A primary GFCA service is the retailing and wholesaling of ocean-caught fish and aquaculture products of local origin to the general public (cash sales), local restaurants, and government institutions (credit sales). GFCA's influence has become pervasive, providing a variety of benefits not just to its members, but also for fisheries conservation, marine education, and the greater Guam community. Prior to the GFCA establishment, which formed in 1976 and incorporated in 1977 to assist its small-scale fishermen members in marketing their catch, commercial fishermen sold catch at farmer's markets and roadside locations.

Non-commercial Fishing Considerations

The CNMI has few fishing clubs. The Saipan Fishermen's Association, established in 1985, is the sponsor of the annual Saipan International Fishing Tournament which is usually held in August or September. Charter fishing in the CNMI is limited, with about ten boats operating on Saipan, and a few vessels on Tinian conducting occasional fishing charters. (WPFMC 2020b).

In both the CNMI and Guam, small boat fisheries are a complex mix of subsistence, cultural, recreational, and quasi-commercial fishermen whose fishing behaviors provide evidence of the importance of fishing to the island of the Guam. For nearly all fishery participants, the social and cultural motivations for fishing far outweigh any economic prospects. Nearly all fishermen supplement their income with other jobs and are predominantly subsistence fishermen, selling occasionally to recover trip expenses (WPFMC 2020b).

Relevant Socio-economic profile

The population of the CNMI is about 51,433 (July 2020 estimate) composed of about 50% Asian (including 35.3% Filipino), 34.9% Pacific Islander (including 23.9% Chamorro), and 12.7% mixed (2010 estimate). English and Chamorro are the official languages, but more residents (32.8%) primarily speak Tagalog compared with Chamorro (24.1%) or English (17%). The median age is 33.6 years old. Almost 90% of the total population lives in urban areas and the rate of urbanization is increasing, while the overall population size is declining. The Northern Mariana Islands' economy benefits from financial assistance from the U.S. In fiscal year 2016, Federal grants accounted for 26% of the Commonwealth's total revenues. A small agriculture sector consists of cattle ranches and small farms producing coconuts, tomatoes, breadfruit, and melons. Tourism continues to grow with the tourist industry employing approximately a quarter of the work force and accounts for roughly a quarter of the gross domestic production (GDP). The estimated GDP per capita in 2016 was $24,500. In 2016, the CNMI exported an estimated

$914 million in products, primarily garments and imported an estimated $893 million, primarily food and construction equipment and materials, and petroleum products.[33]

The population of Guam is about 168,485 (July 2020 estimate) composed of about 37.3% Chamorro and 26.3% Filipino (2010 estimate). English, Filipino, and Chamorro are the primary languages. The median age is 29.4 years old. Almost 95% of the total population lives in urban areas (large villages or municipalities) and the rate of urbanization is increasing, as is the overall population. The main driver of Guam's economy is defense spending, followed by tourism and other services. The estimated GDP per capita in 2016 was $35,600. In that same year, Guam exported an estimated $1.124 billion in products, primarily transshipments of refined petroleum products, construction materials, and fish. Estimated imports for 2016 are $2.964 billion, primarily petroleum and petroleum products.[34]

In both Guam and the CNMI, fish and marine resources have played a central role in shaping the social, cultural, and economic fabric that continues today. Residents fish for both reef and pelagic species, collect mollusks and other invertebrates, and historically have caught sea turtles.

Additional information about the role of fishing and marine resources across the Marianas Archipelago, as well as information about the people who engage in fishing or use fishing can be found through the Marianas FEP 2019 SAFE Report (WPFMC 2020b), Pelagic FEP 2019 SAFE Report (WPFMC 2020d), Allen and Bartram (2008) and Allen and Amesbury (2012).

CNMI and Guam Administrative Environment

Politically, the Mariana Islands contain the Territory of Guam and the Commonwealth of Northern Mariana Islands, both of which are U.S. possessions. The CNMI was part of the U.S. Pacific Trust Territory since 1947, and has been a U.S. commonwealth since 1986. The island of Guam has been an unincorporated U.S. territory since 1949.

The CNMI Department of Land and Natural Resources, Division of Fish and Wildlife is tasked with conserving, protecting and enhancing the fish, game and wildlife resources of the islands for the benefit of the citizens of the CNMI. In Guam, the Department of Agriculture, Division of Aquatic and Wildlife Resources is comprised of three sections, Wildlife, Fisheries, and Law Enforcement that together undertake management actions to sustain and recover fish and wildlife resources.

Federally managed sanctuaries, monuments and wildlife refuges

The CNMI management subarea includes all Federal waters of the EEZ from 3 to 200 nm (6 to 370 km) around the CNMI, except for the three northernmost islands of Uracus, Maug, and Asuncion, and the island of Farallon de Medinilla, where Federal jurisdiction extends to the

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[33] CIA World Factbook https://www.cia.gov/library/publications/the-world-factbook/geos/cq.html, accessed April 08, 2020

[34] CIA World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/gq.html, accessed April 08, 2020

shoreline. In these areas, waters within 3 nm of the shoreline are restricted from public access at all times due to safety reasons based on military activities. At Tinian, Federal waters also extend to the shoreline around certain lands leased by the U.S. government.

There are two National Wildlife Refuges (NWR) in the Mariana Archipelago - the Mariana Arc of Fire NWR and the Mariana Trench NWR. These designations followed the establishment of the MNM, per Secretarial Order 3284. The NWR boundaries and regulations are identical to the MNM.

In January 2009, President George W. Bush created the Marianas Trench Marine National Monument., encompassing three units: the Islands, Trench, and Volcanic Units (Figure 33). The Islands Unit includes the waters and submerged lands of the three northernmost Mariana Islands of Farallon de Pajaros (also known as Uracus), Maug, and Asuncion.

The Trench Unit/Refuge encompasses the submerged lands extending from the northern limit of the EEZ around the CNMI to the southern limit of the EEZ around Guam. The Volcanic Unit/Arc of Fire Refuge includes the submerged lands within 1 nm (1.9 km) of 21 designated volcanic sites. The waters above the seafloor in the Volcanic and Trench Units are not included in the Monument and the CNMI Government maintains all authority for managing the terrestrial environment of the three islands within the Islands Unit.

The total Monument area consists of approximately 96,714 mi^2 (250,487 km^2) of submerged lands and waters of the Mariana Archipelago. NOAA and the U.S. Fish and Wildlife Service (USFWS) manage the Monument, in cooperation with the U.S. Department of Defense (DOD) and the CNMI Government. The Monument prohibits commercial fishing, including commercial aquaculture. Regulations allow for non-commercial fishing by permit and customary exchange in non-commercial fisheries in the Islands Unit.

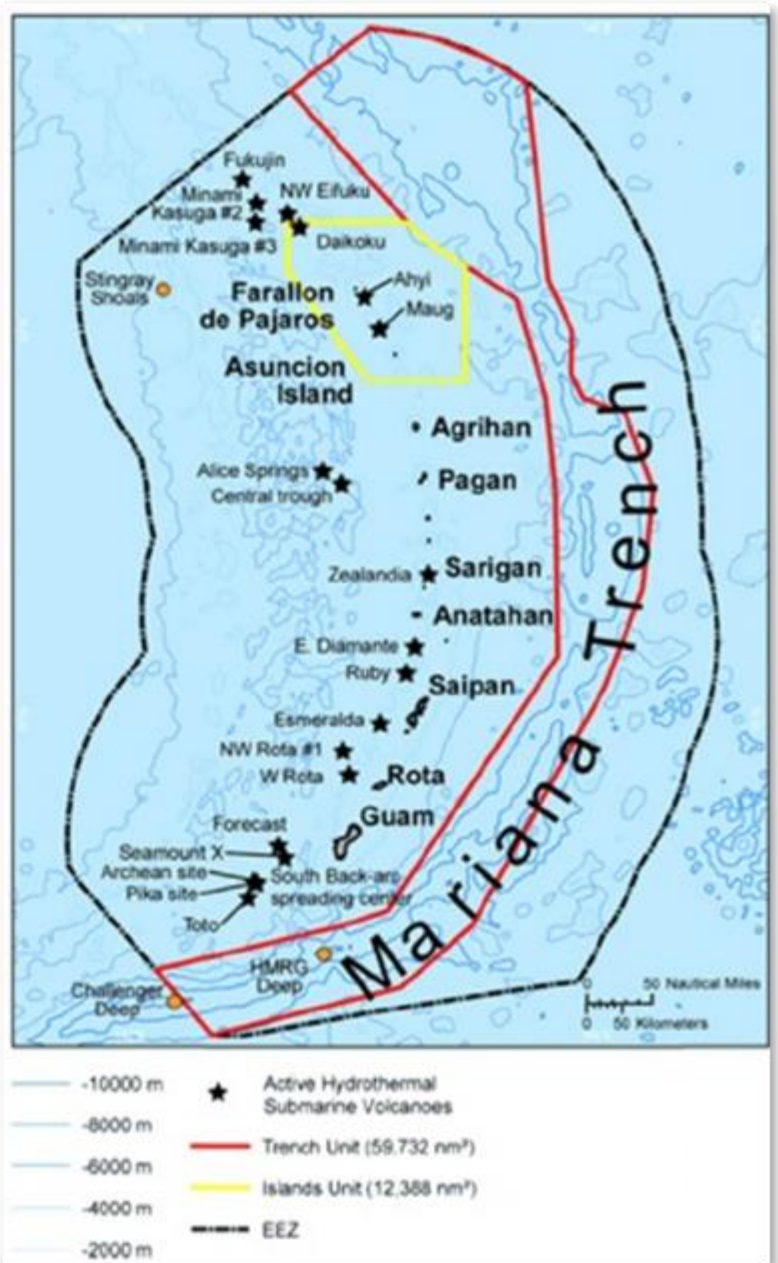

Figure 33. Marianas Trench Marine National Monument.

Department of Defense Jurisdictions

With the large military presence in Guam, there are numerous restricted areas and other training zones, all of which would be incompatible with aquaculture. In particular, the Mariana Archipelago hosts a long-term training and testing area for the U.S. Navy (U.S. Navy 2020). The DOD operates a year-round 3 nm restricted zone around the Farallon de Medinilla (R-7201). During military range operations involving live fire or other hazardous training, this restricted zone temporarily extends to 12 nm for the duration of the exercise (R-7201A). Relevant training/testing areas and ranges in the CNMI and Guam include:

- Naval Base Guam: Apra Harbor Complex including but not limited to: Reserve Craft Beach, Orote Point Small Arms range & Multi-Purpose Range offshore surface danger zone (SDZ) and Danger Zone (charted).
- Naval Base Guam Telecommunication Site: Finegayan Small Arms Range (rifle) Danger Zone (charted).
- Andersen AFB: Combat Arms and Training Maintenance Range and EOD Pit Danger Zone (charted) and SDZ.
- Special Use Airspace, surface, and subsurface: Warning Areas: W-11AB, W-517, W-12, and W-13ABC.
- Restricted Airspace, surface and subsurface: R-7201, R-7201A.
- Tinian: Unai Dankulo Landing Beach, Unai Masalok Landing Beach.
- Saipan: Marpi Maneuver Area (out to 3 nm).
- Naval Base Guam nearshore training areas and other operating areas, including:
    - Thunder
    - Lightning
    - Shark SW/SE/NW/HOT
    - Arson
    - Icebox
    - Agat Bay Mine Neutralization Site
    - Piti Mine Neutralization Site
    - Outer Apra Harbor Underwater Detonation Site
    - Tipalao Beach
    - Dadi Beach
    - Spanish Steps
    - Reserve Craft Beach
    - Outer Apra Harbor
    - Water Drop Zones at Agat Bay

The following figures provide the broader Mariana Islands Training and Testing Study Area, as well as the detailed Guam Training and Testing map (U.S. Navy 2020).

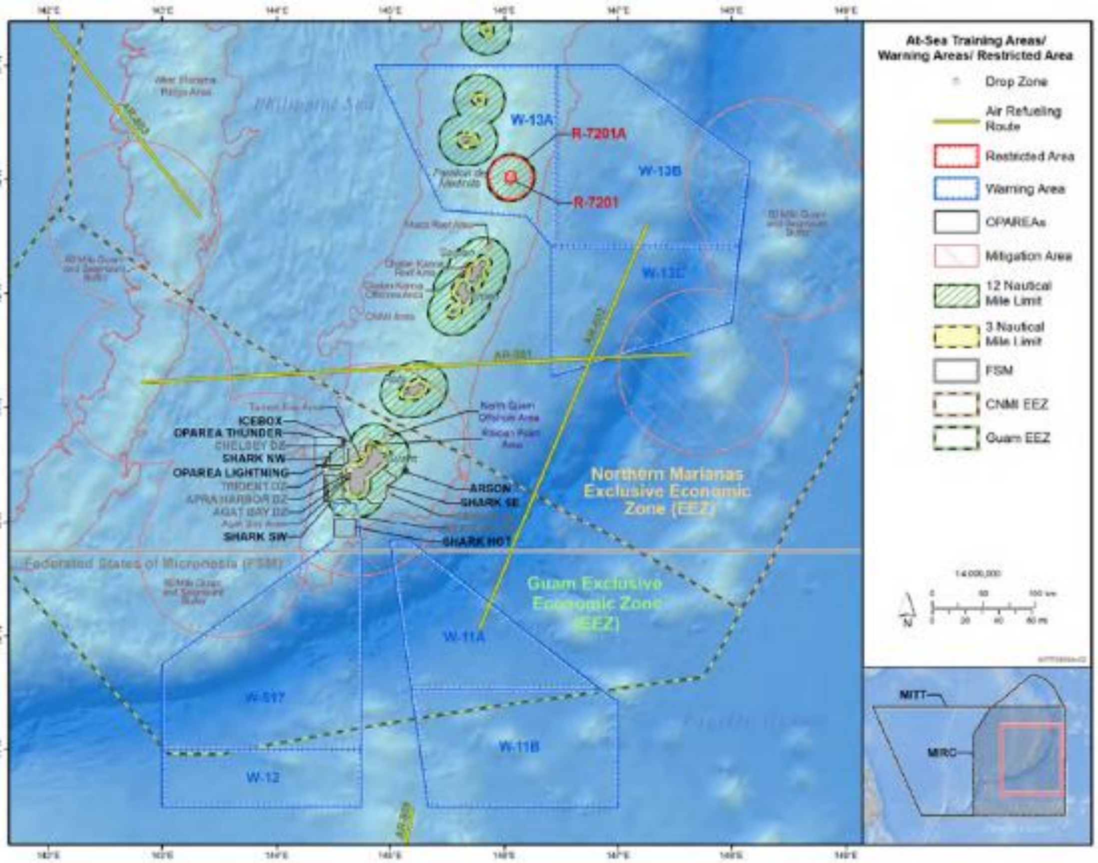

Figure 34. DOD Jurisdictions around the CNMI and Guam. Source: U.S. Navy 2020.

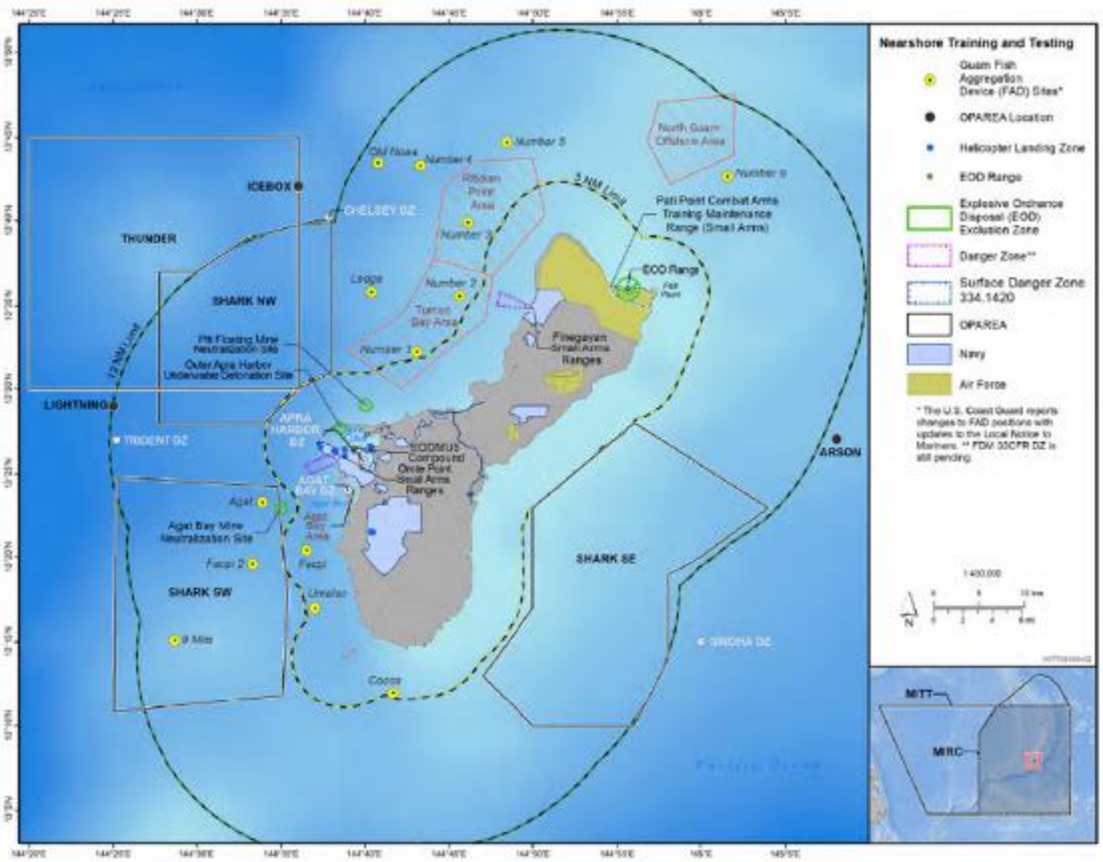

Figure 35. DOD Jurisdictions around Guam. Source: U.S. Navy 2020.

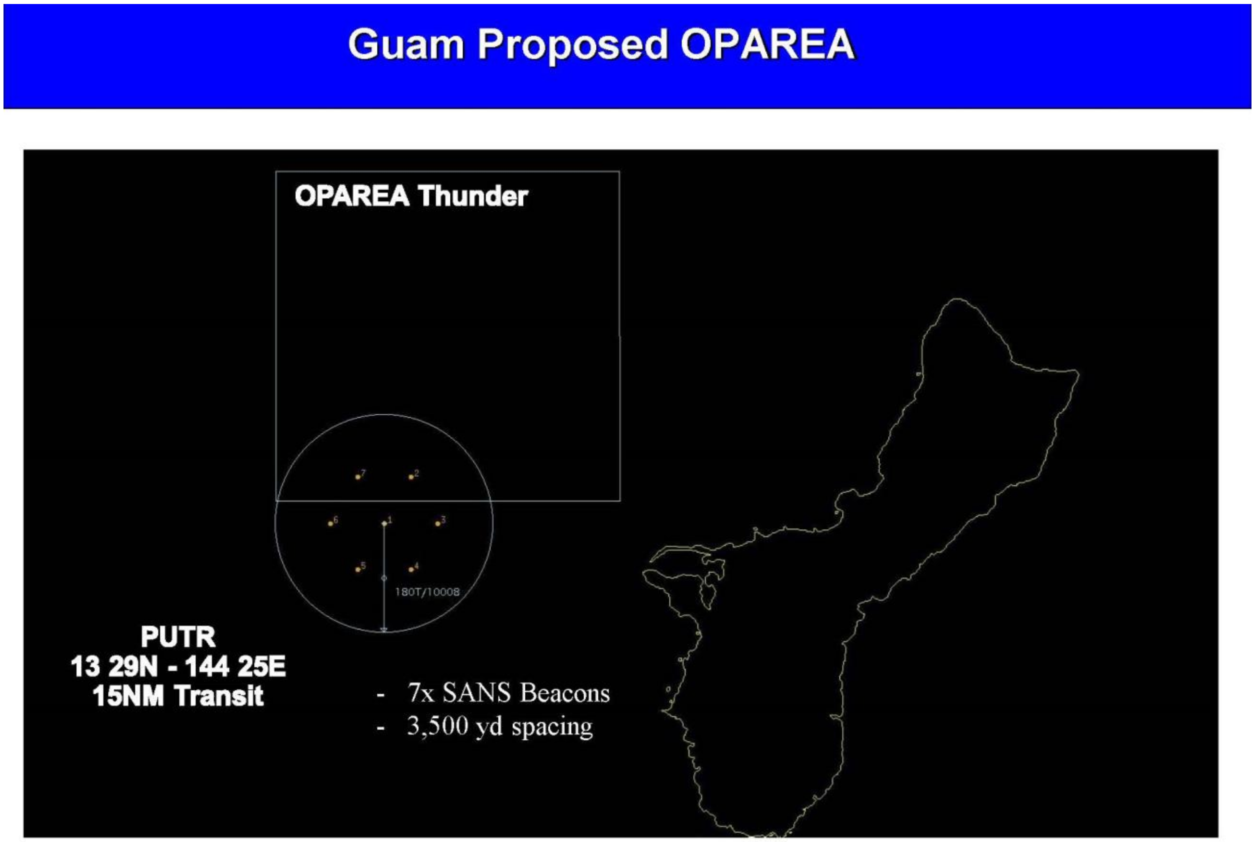

Figure 36. DOD Jurisdictions around Guam, proposed Portable USW Training Range (PUTR) Operation Area (OPAREA) Thunder. Source: U.S. Navy 2022.

3.4 Hawaii

The Hawaii Archipelago is comprised of 137 islands, islets, and coral atolls that are part of a great undersea mountain range known as the Hawaiian-Emperor Seamount Chain. The Hawaiian Islands extend for nearly 1,500 mi (2,414 km) from Kure Atoll in the northwest to Hawaii Island in the southeast. The islands are often grouped into the Northwestern Hawaiian Islands (NWHI; Nihoa to Kure) and the MHI (MHI; Hawaii to Niihau). The total land area of the 19 primary islands and atolls is approximately 6,423 mi^2 (16,600 km^2) and over 75% of the 1.42 million population resides on the island of Oahu.

3.4.1 Physical Environment

Geological Features

Coastline

Most coastline areas in the state are exposed to the open ocean, and wave-induced mortality frequently affects the reefs in these areas. The only significant buildup of reefs in the MHI is in areas that are reasonably sheltered from open-ocean swells and at depths that are not constrained by sea level. Examples include the Kona Coast of Hawaii Island, Kaneohe Bay and Barbers

Point on Oahu, the south shore of Molokai, and the north shores of Kauai and Lanai (Friedlander 1996).

Open Ocean

Within the Hawaii Archipelago, there are numerous banks and seamounts, with more observed in the NWHI rather than in the MHI. In the MHI, the largest bank is Penguin Bank, which is located southeast of Oahu.

Oceanographic Features

Large-scale ocean currents generally run east to west near the Hawaii Archipelago, as it sits toward the southern edge of the north Pacific Subtropical Gyre (WPFMC 2009c). Overall, the ocean currents and wind run from east to west. However, the islands act as barriers disrupting those currents and winds. These disruptions create chaotic mesoscale oceanic and atmospheric eddies. These eddies have relatively high velocities in the lee of the islands (WPFMC 2009c, Jia et al. 2011, and Woodworth et al. 2011). Eddies vertically displace underlying nutrient rich waters, causing mixing with nutrient poor waters, thus creating localized favorable biological conditions. Once established, these areas of increased productivity allow zooplankton to flourish, which then attract mid-trophic level species, which then become prey for top-level predators (Seki et al. 2002, Woodworth et al. 2011). The area in the lee of Hawaii Island is marked by an abundance of eddies (Jia et al. 2011).

Due to the geography of the islands, several channels experience strong winds, strong currents, and rough seas. The Alenuihaha Channel, between Hawaii Island and Maui has a significant funnel effect with incredibly strong winds. The Kalohi Channel, which separates Lanai and Molokai, typically experiences strong winds and choppy seas. The Pailolo Channel, which separates Molokai and Maui, is one of the windiest and roughest channels in the Hawaiian Islands (Mehaffy and Mehaffy 2006).

Extreme Weather

Hawaii’s climate consists of mild temperatures throughout the year and moderate humidity. Across the islands, trade winds averaging 8 to 12 kts (15 to 22 km/hr) blow from the northeast about 80% of the time. For the other 20% of the time, the islands experience Kona wind conditions, in which the wind blows from the southeast or southwest (Juvik and Juvik 1998).

The Hawaii Archipelago is subject to high wave energy produced from weather systems generated off the Aleutian Islands and other areas of the North Pacific. Such waves can have major effects on the nearshore environment. For example, high wave energies can break off pieces of coral, move underwater boulders, shift large volumes of sand, and erode islands (Grigg 2002).

The NWHI are only rarely in the path of tropical storms and hurricanes, but the impacts of large wave events from extra-tropical storms each winter are thought to be significant.

3.4.2 Biological Environment

The biological environment of Hawaii, including the species addressed in this PEIS, are described in detail in the Hawaii Archipelago FEP, which we incorporate here by reference (WPFMC 2009c). This document describes specific resources of concern, identified during scoping and interagency informal consultations to the level necessary for appropriate analysis.

Benthic and Sessile Organisms

See Section 3.1 for the general biology and threats to benthic and sessile organisms in the nearshore and offshore habitat. This section covers the only life history information specific to Hawaii.

Nearshore Reefs

The total potential coral reef area in Hawaii (MHI and NWHI) is estimated to be 1,100 mi^2 (2,826 km^2) within the 10-fathom (18-m) curve, and 20,437 mi^2 (5,300 km^2 within the 100-fathom (183 m) curve, respectively (Rohmann et al., 2005). The MHI represent the younger portion of the Hawaii Archipelago, with less well-developed fringing reefs that have not subsided as far below sea level as those in the NWHI (Smith 1993). The potential coral reef area surrounding the MHI is estimated at 475 mi^2 (1,231 km^2) within the 10-fathom contour (Rohmann et al. 2005).

The MHI have an estimated 475 mi^2 (1,231 km^2) of shallow reef habitat within the 10-fathom (18-m) contour (WPFMC 2009c). The condition of the coral reef system across the archipelago ranges from fair to good (NOAA 2018). Population growth, overfishing, and urbanization, runoff and development threaten many of these reefs. Research indicates that populations of reef-building corals around the archipelago evade epidemic disease outbreaks seen in other reefs around the world (WPFMC 2009c). The nearshore reefs did suffer during the 2014-2015 global coral bleaching event,[35] and there has been a less severe, but still notable, bleaching event in the archipelago from 2018-2019.[36]

Offshore Reefs

The Hawaii Archipelago FEP identifies eleven federally managed species including three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009c). These deep sea corals occur in suitable habitats across the archipelago and many are unstudied (Waddell and Clarke 2008). There are 6 formalized deep sea coral beds in the MHI: The Kauai Black Coral Bed, the Kaena Point Bed, the Makapuu Point Bed, the Auau Channel Bed, the Keahole Point Bed, and the Milolii-South Point Bed (WPFMC 2009c, WPFMC 2012). In the NWHI there are 3 beds: the180 Fathom Bank Bed, the Brooks Bank Bed and the Westpac Bed (WPFMC 2009c, WPFMC 2012).

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[35] https://www.noaa.gov/media-release/global-coral-bleaching-event-likely-ending
[36] https://www.fisheries.noaa.gov/feature-story/surveys-assess-2019-hawaii-coral-bleaching-event

In addition to threats discussed in Section 3.1.2, a specific threat to black coral in Hawaii is the invasive snowflake coral, first discovered in Pearl Harbor in 1972. It has rapidly spread to deep waters where it settles on and eventually smothers black coral colonies (Lumsden 2007).

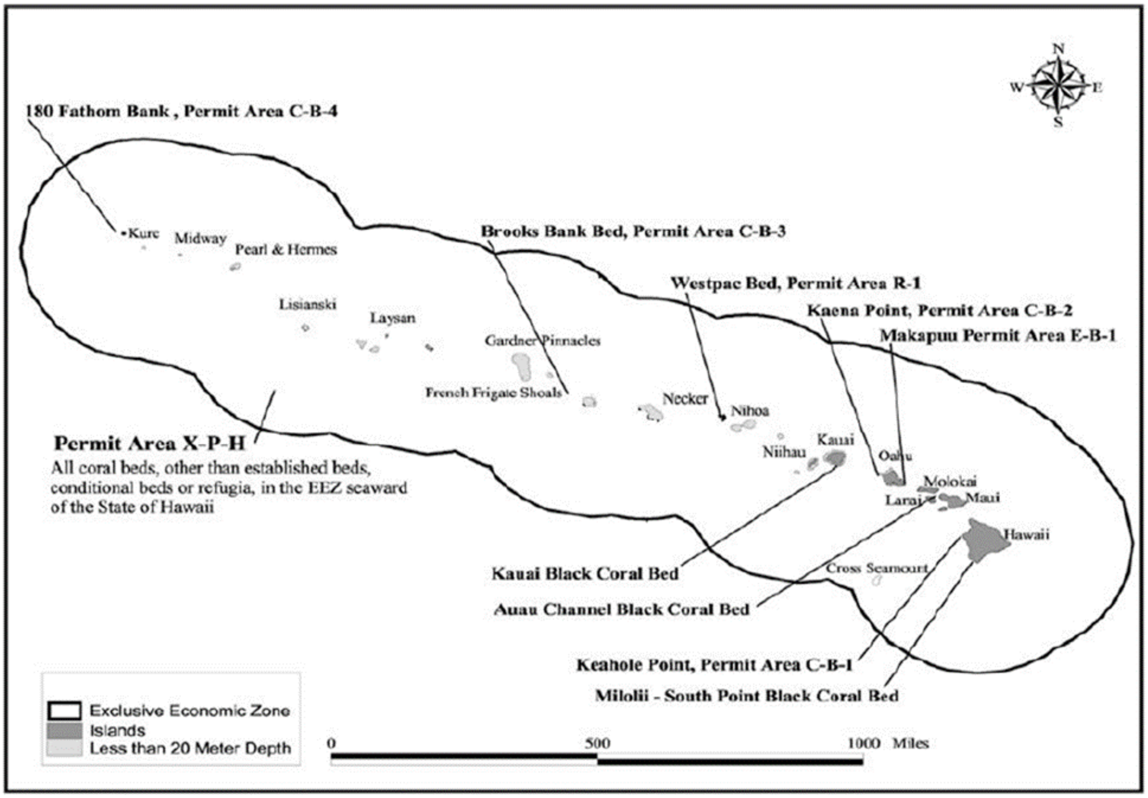

Figure 37. Deep Sea Coral Beds in the Hawaii Archipelago. Source WPFMC 2012.

Protected Species

Marine Mammals

Section 3.1.2 and Table 10 describe marine mammals that occur within the Hawaii Archipelago.

Of these, the MHI IFKW and the Hawaiian monk seal only occur within the Hawaii Archipelago. This section discusses these species in depth.

Humpback whales migrate through waters around the NWHI and occur off all eight MHI during the winter breeding season, particularly within the shallow waters of the main islands (WPFMC 2009c). Breeding season occurs from the first arrivals in September and ends with the last departures in May or June. The greatest numbers of humpback whales around the MHI occur in February and March. In 2015, the total population estimate in Hawaii was 10,103 individuals with the total Central North Pacific Population estimated at 21,808 individuals (Muto et al. 2015).

Hawaiian Insular False Killer Whale (Pseudorca crassidens)

There are three separate stocks of false killer whales located in Hawaii's waters. One of those stocks, the Hawaiian insular false killer whale (MHI IFKW), is genetically different from the pelagic false killer whale population observed elsewhere within the PIR and is currently listed as endangered under the ESA. The MHI IFKW has significant differences in both mitochondrial and nuclear DNA, which justifies separate management under the ESA (Carretta et al. 2014). The population estimate is between 144-187 individuals (Bradford et al. 2018). This is the only endangered stock. This species travels up to 78 mi (125 km) offshore to feed, and can move between islands and back within a day. The population utilizes the waters surrounding the Hawaiian Islands, but remains close within the islands boundaries and does not migrate to other areas in the Pacific (Figure 38) (Carretta et al. 2014).

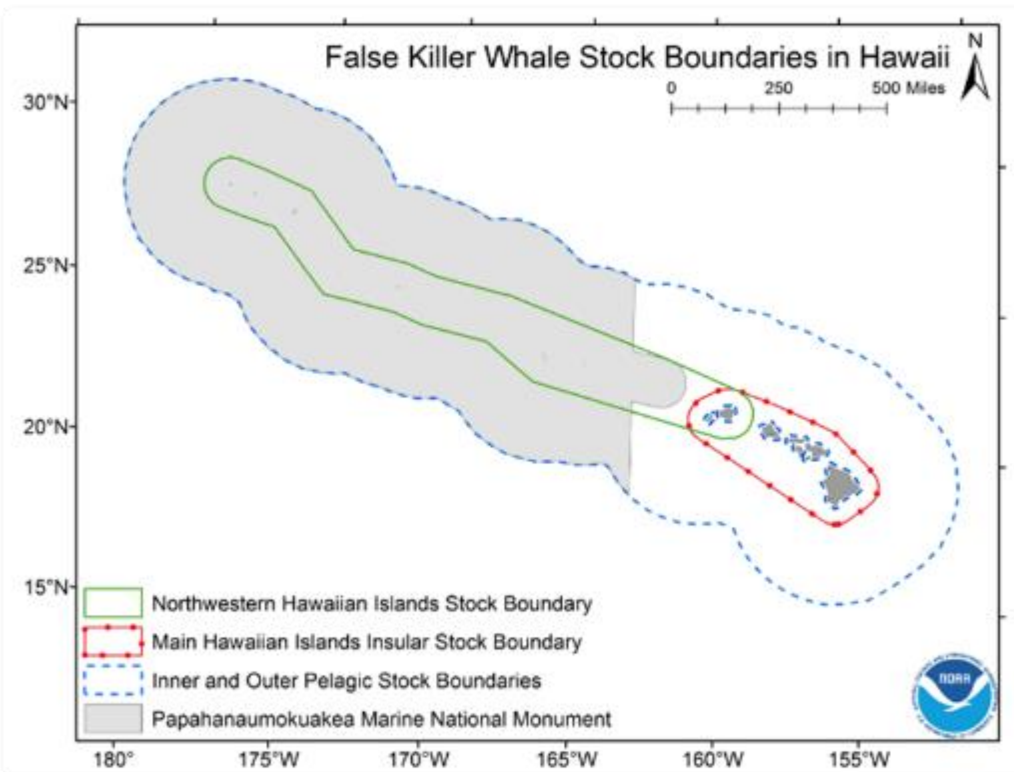

Figure 38. Range of the Main Hawaiian Islands Insular False Killer Whale in Hawaii. Source: NMFS 2017c.

On July 24, 2018, NMFS published a final rule (83 FR 35062) designating ESA critical habitat for MHI IFKW in waters from 147 ft to 10,500 ft (45 meters to 3,200 meters) in depth surrounding the MHI, encompassing approximately 19,280 mi² (49,948 km²) of marine habitat. This designation does not include most bays, harbors, or coastal in-water structures, and NMFS excluded 10 areas from the designation due to economic and national security impacts. In addition, two areas are precluded from designation because the Joint Base Pearl Harbor-Hickam Integrated Natural Resources Management Plan (JBPHH INRMP) provides a net conservation benefit to the species.

Hawaiian Monk Seal (Neomonachus schauinslandi)

The Hawaiian monk seal is one of the most endangered marine mammals in the world, and is classified as depleted under the MMPA. This species is endemic to Hawaii, meaning it is not found anywhere else in the world. The population distribution is throughout the MHI and the NWHI. These seals inhabit 113,100 mi^2 (293,000 km^2) throughout the islands (Figure 39). The population summary for Hawaiian monk seals in 2019 provides the best estimate for the species as 1,428 (95% confidence interval 1361-1520; NMFS 2020e). There is compelling evidence that the abundance of seals on the MHI has been growing since 2013 with a record high number of births (48) in 2019 (NMFS 2020e). The estimated abundance of Hawaiian monk seals in the MHI (including Niihau/Lehua) is 268 pups and non-pups (Caretta et al. 2019).

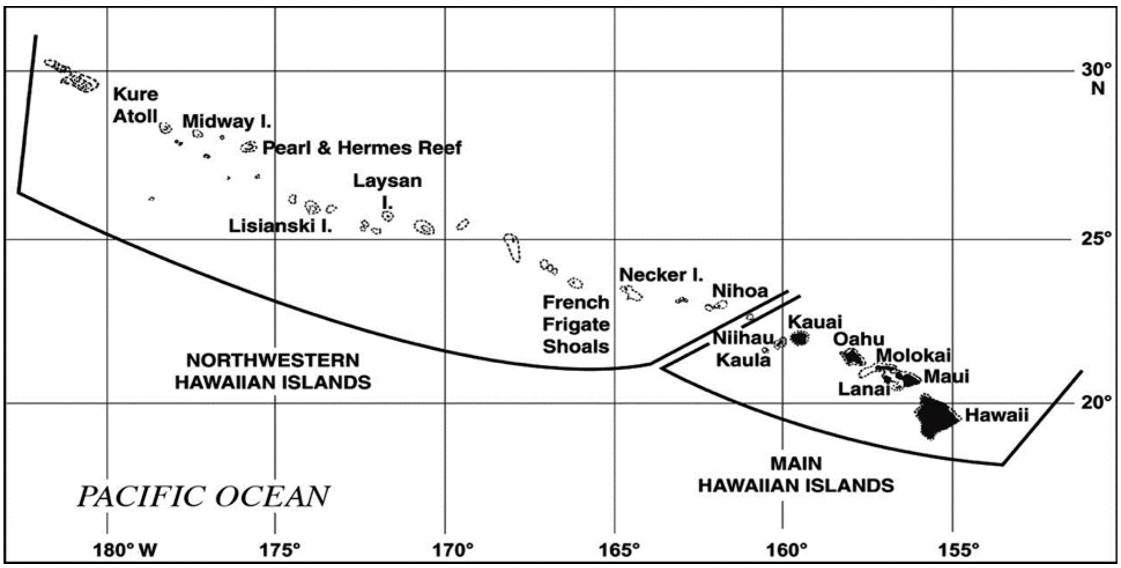

Figure 39. Hawaiian Archipelago and Range of the Hawaiian Monk Seal. Source: Baker et al. 2016.

In September 2015, NMFS issued a final rule to revise the critical habitat for the Hawaiian monk seal. Specific areas for designation include ten areas in the NWHI and six in the MHI. These areas contain one or a combination of habitat types including preferred pupping and nursing areas, significant haul-out areas, and marine foraging areas that will support conservation for the species.

Areas in the NWHI include all beach areas, sand spits and islets, lagoon waters, inner reef waters, the seafloor, and all subsurface waters and marine habitat within 10 m of the seafloor, out to the 200-m depth contour line around Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island.

Areas in the MHI include marine seafloor and subsurface waters from the 200-m depth contour line, through the water's edge 5 m into the terrestrial environment from the shoreline between identified boundary points on all eight MHI. In areas where critical habitat does not extend inland, the designation ends at the mean low water line.

Some terrestrial locations within the designation lack the essential features of Hawaiian monk seal critical habitat because they are inaccessible to seals for hauling out (such as cliffs) or lack the natural features necessary to support monk seal conservation (such as hardened harbors, shorelines or buildings) and are not included in the designation. The designation also excluded four areas because the national security benefits of exclusion outweigh the benefits of inclusion, and exclusion will not result in extinction of the species. Additionally several areas are precluded from designation under section 4(a)(3) of the ESA because they are managed under the JBPHH INRMP that provide a benefit to Hawaiian monk seals.

Sea Turtles

All five Pacific sea turtle species can occur throughout the Pacific. Section 3.1 contains a full description of each sea turtle species. The following provides Hawaii-specific information on these species.

The green sea turtle accounts for more than 98% of all sea turtles in Hawaii and the Hawaiian population is threatened under the ESA (Chaloupka et al. 2008). This population is composed of a single genetic stock (Dutton et al. 2008), with individuals spending most of their lives in the Hawaii ecoregion. This population appears to have increased gradually over the past 30 years, with near capacity nesting at French Frigate Shoals in the NWHI (Balazs and Chaloupka 2006; Chaloupka et al. 2008). On April 6, 2016, NOAA issued a final rule separating the global population into eight distinct population segments (DPSs). The Hawaiian stock, referred to as the Central North Pacific population, maintained its threatened status under the ESA (81 FR 20058) and only comprises 1% of the interactions with longline vessels. There is no critical habitat designation for the green sea turtle in Hawaii.

Hawksbill sea turtles are the second most common species in the waters of the Hawaiian Islands, as reflected by the stranding records, yet they are far less abundant than green sea turtles (Chaloupka et al. 2008; Seitz et al. 2012). The relatively small hawksbill population appears to be concentrated around Hawaii Island and Maui. The lack of hawksbill sightings during aerial and shipboard surveys and no recorded interaction with the Hawaii longline fishing fleet likely reflects the species' small size and difficulty in identification from a distance.

The other three species of turtle that can occur in Hawaii waters (loggerhead, olive ridley, and leatherback) are all primarily pelagic species. Satellite tracking data of both loggerhead and leatherback sea turtles indicate that they migrate across the Pacific Ocean primarily north of the EEZ around Hawaii (Benson et al. 2011; Kobayashi et al. 2008), but may transit through occasionally. Olive ridley sea turtles generally occur south of the Hawaiian Islands, preferring warmer tropical waters, although there have been at least three documented nestings of olive ridleys in Hawaii (Kelly 2010).

Seabirds

Seabirds listed as endangered or threatened that are present within the Hawaii Archipelago are band-rumped storm petrel, Hawaiian petrel, Newell's shearwater, and the short-tailed albatross. Of those, the Hawaiian petrel is only found in Hawaii and this section discusses the species in detail (WPFMC 2009c).

Other seabirds that occur within the Hawaii Archipelago are the black-footed albatross, Laysan albatross, masked booby, brown booby, red-footed booby, wedge-tailed shearwater, Christmas shearwater, petrels, tropicbirds, frigatebirds, and noddies (WPFMC 2009c).

Hawaiian Petrel (Pterodroma sandwichensis)

The endangered Hawaiian or dark-rumped petrel is a small pelagic seabird with a primary range around the Hawaiian Islands (Figure 40). Adults have a dark gray head, wings and tail, with a white forehead and belly, and measure 16-17 in. (40-43 cm) in length with a wingspan of 32 in. (81 cm). The population estimate is 19,000 individuals with 4,500-5,000 breeding pairs (BirdLife International, 2016c). A 2007 report indicated that populations have declined due to predation by introduced species at nesting colonies (i.e., mongoose, rats, feral cats), urbanization, and collisions with power lines. More recent reports state that conservation efforts have slowed the overall population decline (BirdLife International 2016c).

Nesting occurs in cavities up to 2 meters deep in the lava fields, burrowed beneath rocks, or at the base of cliffs. Hawaiian petrels reach reproductive maturity at about six years, and have a 13-18-year life span. Nesting pairs lay a single egg between May and June, with the chick leaving the nest around late December (BirdLife International 2016c). The Hawaiian petrel forages at night with flocks of other seabirds, preying on lanternfish, goatfish and squid. They capture prey by seizing it while sitting on the water or picking it off the surface with its feet. The Hawaiian petrel does not dive for food (BirdLife International 2016c).

Figure 40. Range of the Hawaiian Petrel. Source: BirdLife International, 2016c.

Sharks and Rays

All sharks and rays that occur in Hawaii occur elsewhere in the PIR. Section 3.1.2 contains thorough descriptions of each species.

3.4.3 Social and Economic Environment

State of aquaculture industry

Within the PIR, Hawaii has the longest history, largest industry, and most extensive technical capacity for both marine and freshwater aquaculture ventures. The value of Hawaii's aquaculture industry has held steady since a peak of roughly $78 million in 2014. In 2017, aquaculture sales reached $76.4 million, of which algae contributed $35.2 million (46%). Currently, the aquaculture industry in Hawaii produces a wide variety of crustaceans, finfish, mollusks, and algae for food (USDA 2018).

In 1999, with assistance from NOAA's National Marine Aquaculture Initiative (NMAI), Hawaii became the first place in the world with a commercially operating ocean-lease and offshore cage system. This began as a public-private partnership known as the Hawaii Offshore Aquaculture Research Project, which conducted environmental research and commercial production of moi (Pacific threadfin, *Polydactylus sexfilis*) off Ewa Beach, Oahu. By 2006, the private venture partner, Cates International, Inc. (CII), produced as much as 8,000 lbs. (3,630 kg) of moi per week. After it sold to Grove Farm Fish & Poi, LLC, operating as Hukilau Foods, the company declared bankruptcy in 2010. CII's founder later began a new venture, Mamala Bay Seafood, and intended to produce moi in a 10-cage facility over 75 acres in the nearshore waters of south Oahu. The final Environmental Assessment for this proposed project was completed in 2014 and the construction permit was extended in 2018;[37] however, this facility was never constructed.

In addition to Mamala Bay Seafood, Kona Blue Water Farms began harvesting commercial quantities of the amberjack, also known as "kampachi" or "kanpachi," in September 2005 in state waters off the Kona coast of the island of Hawaii. A year later, the company produced up to 10,000 lbs. (4,536 kg) per week of hatchery-produced sashimi-grade fish (Toth 2014). In 2012, Blue Ocean Mariculture acquired the hatchery and offshore assets of Kona Blue Water Farms and is currently the only active commercial aquaculture venture utilizing submersible sea cages in Hawaii. Blue Ocean Mariculture continues to culture amberjack and in 2014 they applied to the State of Hawaii for permission to increase production capacity from 550 U.S. tons (tons) (500 metric tons [t]) to 1,212 tons (1,100 t) of fish annually (Blue Ocean Mariculture 2014). The approved permit allows Blue Ocean Mariculture to culture almaco jack/kahala, Pacific threadfin/moi, dolphinfish/mahi mahi, and giant trevally/giant ulua.

In 2011, the founders of Kona Blue Water Farms founded Kampachi Farms, LLC, primarily a research venture to investigate and address the challenges of open ocean aquaculture. That year, NMFS issued a permit to Kampachi Farms to test the potential for untethered cages drifting in large-scale eddies that persist in the lee of the island of Hawaii, known as the Velella Project. The goal was to raise fish as sustainably as possible by moving cages offshore to reduce many of the environmental impacts of aquaculture. As such, the system was the first project to raise fish in cages untethered from the ocean bottom in U.S. waters.

In July 2016, NMFS issued a SCREFP to Kampachi Farms, LLC for a net pen system to culture and harvest of *S. rivoliana*. The permit for this project describes a net pen tethered to an existing mooring located in Federal waters approximately 5.5 nm (9.3 km) west of Keauhou Bay Hawaii Island. NMFS transferred this initial two-year permit to Forever Oceans Corporation in March 2017. It authorized the culture and harvest of a maximum amount of 30,000 kampachi or approximately 120,000 lbs. (54,431 kg) during the permit's two-year duration (NOAA 2015). Because of the delay in beginning culture activities, NMFS extended the permit through the end of 2021 with the same operations and processes for the permitted activity (30,000 kampachi, same location, gear, etc.).

There are examples of at least three other offshore aquaculture ventures in Hawaii over the past decade, although none expanded beyond the proposal stage. One of these, Hawaii Oceanic Technology, under the name King Kona Ahi, received a 35-year lease in 2011 from the State of Hawaii, and a required Army Corps of Engineers permit in 2013, to develop and operate a geostatic, untethered offshore cage system to raise bigeye and yellowfin tuna. This venture intended to investigate technology that would allow open ocean aquaculture siting in waters of

[37] https://dlnr.hawaii.gov/wp-content/uploads/2018/01/K-2.pdf

limitless depth. This technology, in collaboration with technology for automated feeding systems and other remotely operated systems, could provide for expansion of the aquaculture. However, Hawaii Oceanic Technology has since withdrawn from this lease, citing difficulties in raising money for a prototype cage and delays in obtaining permits. The company dissolved in January 2017 (Gomes 2017).

The Oceanic Institute, a research facility of Hawaii Pacific University, provides research for aquaculture from their land-based aquaculture facility in Waimanalo, Oahu. Over the last 20 years, their facility has housed a stock enhancement program for Pacific threadfin, as well as developed breeding technologies for commercial shrimp. The researchers have provided technical support to numerous ventures in open ocean aquaculture technology, but currently focus on marine ornamentals, shrimp and feed technology.

Characteristics and Economic Feasibility of Aquaculture Operations

As noted previously, within the PIR, Hawaii has the longest history, largest industry, and most extensive technical capacity for both marine and freshwater aquaculture ventures. Additionally, with a long history of supporting aquaculture innovation, the state is poised to support and develop a growing aquaculture industry.

Currently the state-run Hawaii Ocean Science and Technology Park, administered by the Natural Energy Laboratory of Hawaii Authority, houses many aquaculture innovation projects (NELHA). This facility offers a pre-permitted demonstration site to support emerging science and technology in renewable and ocean-based technologies. The mission of the facility is "to develop and diversify the Hawaii economy by providing resources and facilities for energy and ocean-related research, education, and commercial activities in an environmentally sound and culturally sensitive manner."[38] This facility has a track record of supporting the development of technologies related to aquaculture and is planning to increase its capacity for offshore technologies.

As noted above, the Oceanic Institute, run by Hawaii Pacific University, also has a long history of supporting and developing research essential to the aquaculture industry. Additionally, it co-administers the Center for Tropical and Subtropical Aquaculture (CTSA), one of five regional USDA aquaculture centers, with the University of Hawaii.

The University of Hawaii at Manoa Sea Grant Program is currently developing an aquaculture hub, with the aid of a $1.2 million NOAA grant to "revitalize, solidify, and expand an aquaculture-focused, collaborative program that would be socially, geographically, and economically inclusive." [39] This hub would provide integration between research, extension and education services, all aimed at supporting the development of the aquaculture industry. The University of Hawaii at Hilo has offered an aquaculture specialty since 1988 and houses the Pacific Aquaculture and Coastal Resources Center (PACRC).[40] This facility encompasses a

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[38] http://nelha.hawaii.gov/about/
[39] https://www.hawaii.edu/news/2019/09/20/noaa-aquaculture-funding/
[40] https://hilo.hawaii.edu/pacrc/

variety of aquaculture research and supports a long-term goal of providing infrastructure aquaculture programs at both University of Hawaii campuses, as well as supporting commercial aquaculture, fisheries, and conservation.

In addition to larger universities, several community colleges offer aquaculture technical and training programs, often on cooperation with the other programs listed above.

Scope of Fishing Industry - Wild Stocks

Of the wild-caught species in Hawaii, yellowfin tuna, bigeye tuna, dolphinfish, almaco jack, giant trevally, bluefin trevally, and pacific threadfin are the most likely candidates for culture under this action. Section 3.1.2 describes the life history characteristics of these fish. Fisheries that catch these species, supporting industries and surrounding fishing communities, are the focus of the following subsections.

The Hawaii FEP characterizes each of the inhabited MHI (Kauai, Niihau, Oahu, Maui, Molokai, Lanai, Hawaii) as a separate fishing community (WPFMC 2009c). Shore-side activities associated with the large-vessel fisheries are mostly concentrated near Honolulu. Activities associated with the small vessel fisheries, in contrast, are widely dispersed within and among islands (WPFMC 2009c).

Hawaii Pelagic Fisheries

Compared to the other regions, Hawaii has a diverse fishery sector that includes shallow- and deep-set longline, Main Hawaiian Islands (MHI) troll and handline, offshore handline, and the aku boat (pole and line) fisheries. The Hawaii longline fishery is by far the most important economically, accounting for 90% of estimated ex-vessel value of the total commercial fish landings in the State. The MHI troll was the second largest fishery in Hawaii with 7% of the total value, followed by MHI handline, aku boat, offshore handline fisheries, and other gear types comprising the remainder (WPFMC 2020d).

Longline vessels are prohibited from fishing within 50 mi (80 km) of the islands of Hawaii, Maui, Kahoolawe, Lanai and Molokai, and within 75 mi (121 km) of the islands of Oahu, Kauai and Niihau (57 FR 7661).

Hawaii-based U.S. longline vessels operate under a limited entry program, with 164 total permits, 146 of which are active (https://www.fisheries.noaa.gov/pacific-islands/resources-fishing/pacific-islands-permit-holders#hawaii-longline-limited-entry, accessed October 14, 2020). Hawaii longline vessels set shallow longlines to target swordfish or deep to target bigeye tuna. See WPFMC (2019d) for more information.

The State of Hawaii licensed 3,124 fishermen in 2019, including 1,929 (62%) who listed pelagic fishing gear as their primary fishing method and gear. This is a 6% decrease in fishing licenses from the previous year. Most licenses that indicated pelagic fishing as their primary method were issued to longline fishermen (46%) and trollers (40%). Ika shibi and palu ahi (handline) make up the remaining licenses (14%) (WPFMC 2020d).

Table 20. Number of HDAR Commercial Marine Licenses, 2018-2019. Source WPFMC 2020d.

Primary Fishing Method	Number of Licenses 2018	Number of Licenses 2019
Trolling	826	775
Longline	887	894
Ika Shibi & Palu Ahi	267	258
Aku Boat (Pole and Line)	2	2
Total Pelagic	1,982	1,929
Total All Methods	3,308	3,124

Hawaii Bottomfish fisheries

Bottomfish fishing was a part of the culture of the indigenous people of Hawaii long before European explorers first visited the islands. Descriptions of traditional fishing practices indicate that Native Hawaiians harvested the same deep-sea bottomfish species as the modern fishery and used similar specialized gear and techniques to those employed today. The State of Hawaii, Department of Land and Natural Resources, Division of Aquatic Resources, manages the deep-sea bottomfish fishery in the MHI (MHI) under a joint management arrangement with NMFS and the WPFMC (WPFMC 2020c).

The bottomfish fishery contains two groups. First, we outline the Deep-7 species group below.

Table 21. Deep-7 Bottomfish.

Common name	Scientific name	Local name
silver jaw jobfish	*Aphareus rutilans*	lehi
squirrelfish snapper	*Etelis carbunculus*	ehu
longtail snapper	*Etelis coruscans*	onaga
sea bass	*Hyporthodus quernus*	hapuupuu
pink snapper	*Pristipomoides filamentosus*	opakapaka
pink snapper	*Pristipomoides sieboldii*	kalekale
snapper	*Pristipomoides zonatus*	gindai

Three jacks and two snappers characterize the non-Deep-7 species group. All three jack species appear in local catch records since 1981.

Table 22. Non-Deep 7 & Bottomfish Species.

Common name	Scientific name	Local name
giant trevally	*Caranx ignobilis*	white ulua
gunkan, black trevally	*Caranx lugubris*	black ulua
butaguchi	*Pseudocaranx dentex*	pig-lip ulua
gray snapper	*Aprion virescens*	uku
goldflag jobfish	*Pristipomoides auricilla*	yellowtail kalekale

Decreasing catch and effort trends relative to measured averages characterized the 2018 MHI Deep 7 bottomfish fishery. This decline is attributed to trends in the portion of the fishery that harvests using deep-sea handline, which is responsible for a majority of Deep 7 bottomfish catch in the main MHI. Though the effort, participation, and the pounds landed all decreased, effort and participation decreased to the extent that CPUE for the fishery increased relative to short- and long-term averages for the gear type. Uku (*Aprion virescens*) and white ulua (*Caranx ignobilis*) dominated the non-Deep 7 bottomfish fishery. The total number of non-Deep 7 fish caught was higher than the short- and long-term averages, though the pounds caught was lower than the decadal average. Each of the major gear types used in the fishery (i.e., deep-sea handling, inshore handline, and trolling) all showed notable decreases in effort and participation relative to their short-term averages. However, all gears had increasing trends for CPUE. Trolling with bait showed increases for participation, effort, number of fish caught, and pounds landed relative to both ten- and twenty-year trends (WPFMC 2020c).

Hawaii Crustacean fisheries

Ula (lobster) was a traditional food source for Native Hawaiians and they sometimes used it in early religious ceremonies (Titcomb 1978). After Europeans arrived in Hawaii, the lobster fishery became by far the most productive commercial shellfish fishery. Crustacean fisheries in the MHI are comprised of the Heterocarpus deep water shrimps (*H. laevigatus* and *H. ensifer*), spiny lobsters (*Panulirus marginatus* and *P. penicillatus*), slipper lobsters (*Scyllaridae haanii* and *S. squammosus*), kona crab (*Ranina ranina*), kuahonu crab (*Portunus sanguinolentus*), Hawaiian crab (*Podophthalmus vigil*), opaelolo prawn (*Penaeus marginatus*), and aama crab (*Grapsus tenuicrustatus*). The main gear types used are shrimp traps, loop nets, miscellaneous traps, and crab traps.

In 2019, the MHI crustacean fishery, now comprised of only deepwater shrimp and kona crab, had an overall decline in catch relative to available short- and long-term trends. In general, there was a greater number of fishing trips taken for these species than recorded in their historical trends, but total catch (18,296 lbs.) decreased by 17% from its 10-year trend and 30% from its 20-year trend. Effort, participation, and catch values for shrimp species harvested by shrimp trap were not disclosed due to data confidentiality (i.e., less than three licenses reporting). Kona crab harvested by loop net had increases in catch (5,650 lbs.) and CPUE (80.71 lbs./trip) compared to its 10-year average despite having fewer associated licenses (23) and fishing trips (70); catch increased over 7% from its 10-year average while CPUE increased over 39%. Data for other gear types were unavailable to report due to data confidentiality (WPFMC 2020c).

Table 23. Annual Fishing Parameters for the 2019 Fishing Year in the MHI Crustacean Fishery. Source: WPFMC 2020c.

Parameters	2019
No. License	25
Trips	280
No. Caught	23,048
Lbs. Caught	18,296

Table 24. Annual Fishing Parameters for the 2019 Fishing Year in the MHI Crustacean Fishery. Source: WPFMC 2020c.

Methods and Fishery Indicators	2019
Shrimp Trap (*H. laevigatus*)	
No. Lic.	Insufficient data to report trends
No. Trips	Insufficient data to report trends
Lbs. Caught	Insufficient data to report trends
CPUE	
Loop Net (Kona crab)	5,650 lbs.
No. Lic.	23
No. Trips	70
Lbs. Caught	5,650 lbs.
CPUE	80.71 lbs./trip
All other gears	
No. Lic.	Insufficient data to report trends
No. Trips	Insufficient data to report trends
Lbs. Caught	Insufficient data to report trends
CPUE	Insufficient data to report trends

Commercial Catch and Landings of Species with Aquaculture Potential

Hawaii commercial fisheries caught and landed 36.5 million pounds of pelagic species in 2019, a decrease of 3% from the previous year. Although each fishery targets or intends to catch a particular pelagic species, the fisheries capture a variety of other species. The deep-set longline fishery targeted bigeye and yellowfin tuna. This was the largest of all pelagic fisheries and its total catch comprised 8% (32.0 million pounds) of all pelagic fisheries. The shallow-set longline fishery targeted swordfish and its catch was 837,000 pounds, or 2% of the total catch. The Main Hawaiian Islands troll fishery targeted tunas, marlins and other PMUS, and caught 2.5 million pounds or 7% of the total. The MHI handline fishery targeted yellowfin tuna while the offshore handline fishery targeted bigeye tuna. The MHI handline fishery accounted for 675,000 pounds (2% of the total). The offshore handline fishery was responsible for 477,000 pounds or 1% of the total catch (WPFMC 2020d).

The following figures show historical catch data for species with the greatest aquaculture potential in Hawaii.

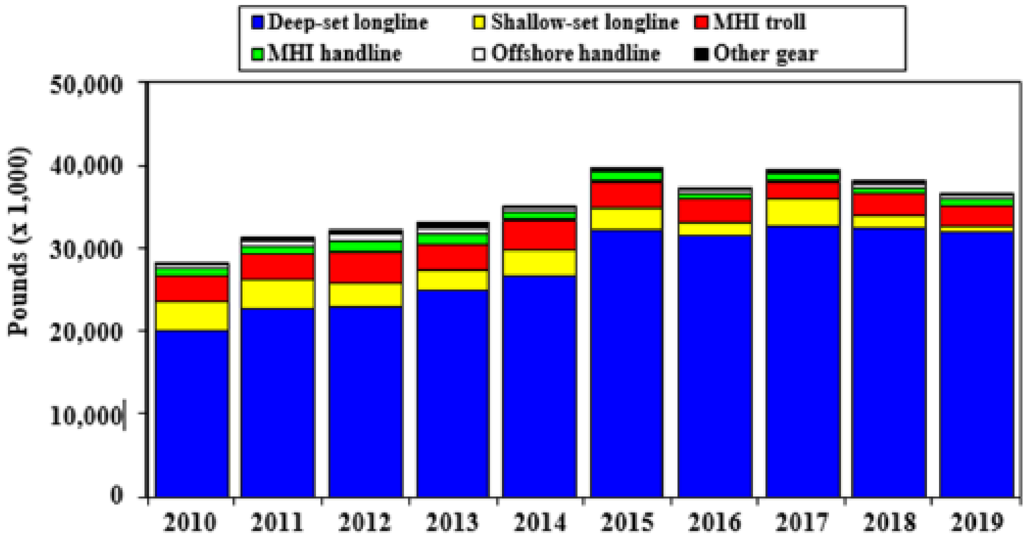

Figure 41. Total Commercial Pelagic Catch by Gear Type, 2010-2019. Source: WPFMC 2020d.

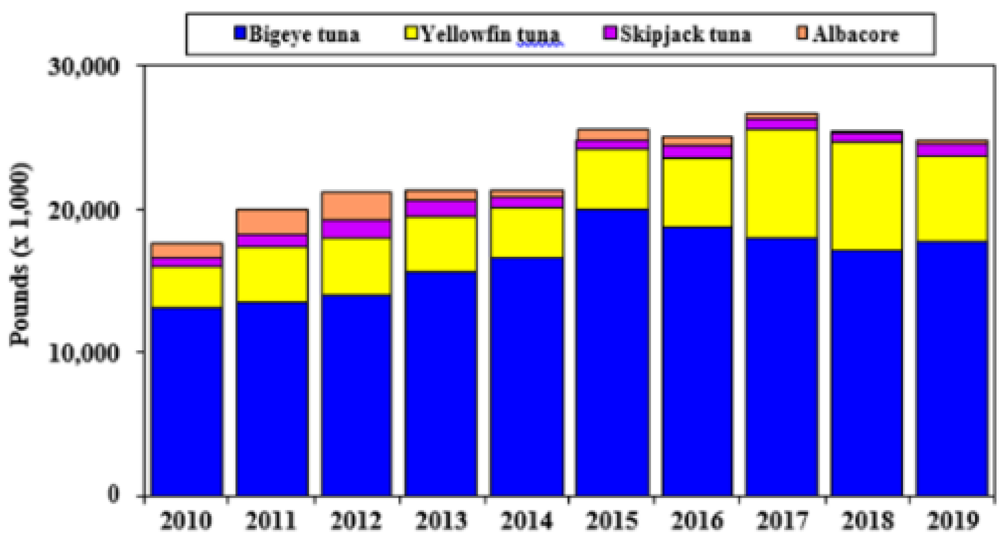

Figure 42. Hawaii Tuna Catch by all Gear Types (2010-2019). Source: WPFMC 2020d.

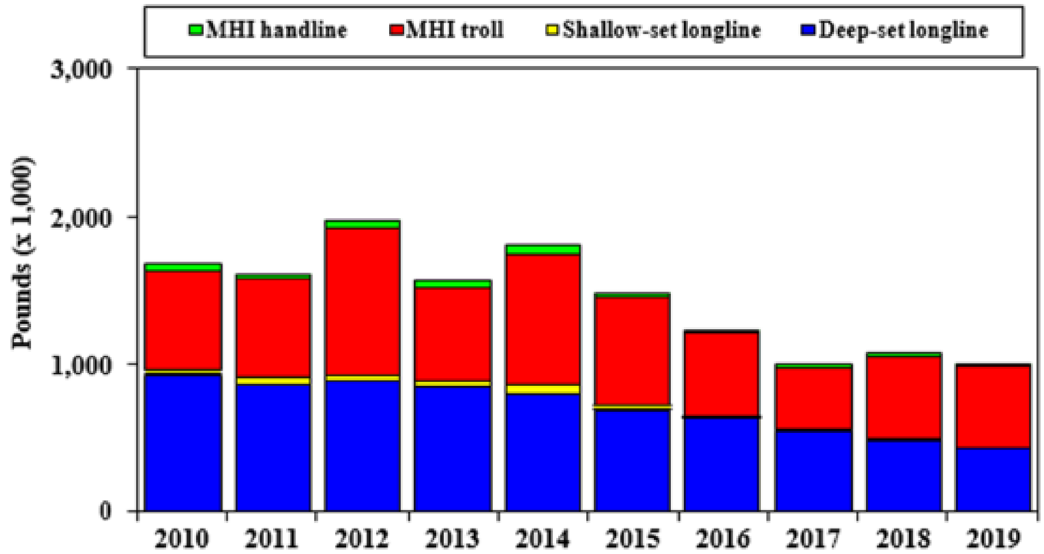

Figure 43. Hawaii Dolphinfish (Mahi Mahi) Catch by Gear Type (2010-2019). Source: WPFMC 2020d.

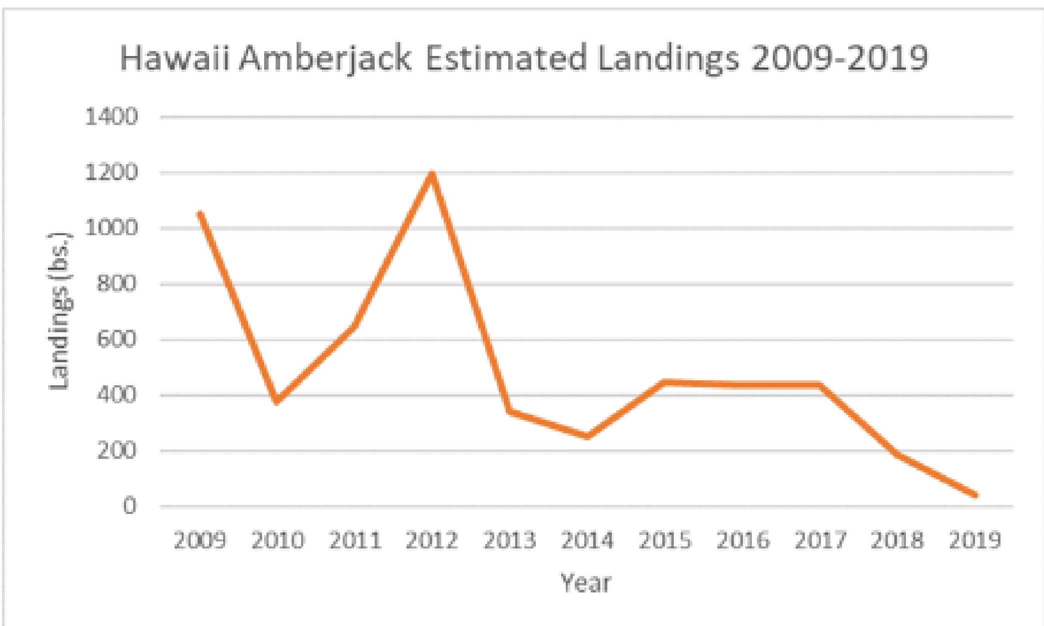

Figure 44. Hawaii Annual Amberjack Estimated Landings (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Amberjack species include *Seriola dumerili*, *S. lalandi*, and *S. rivoliana*

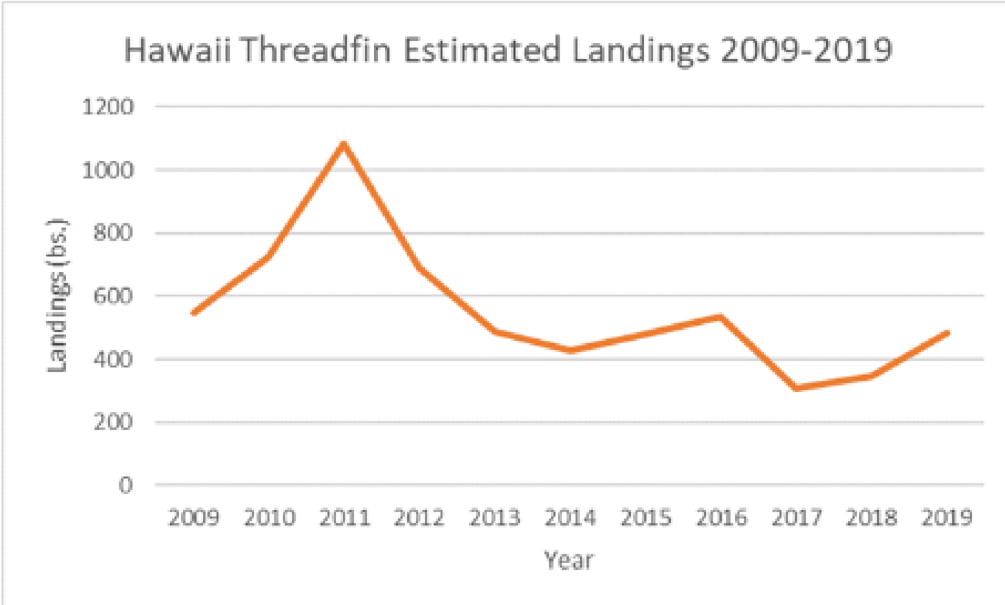

Figure 45. Hawaii Annual Pacific Threadfin Estimated Landings (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Pacific threadfin, *Polydactylus sexfilis* also includes unspecified threadfins (*Polydactylus* spp.)

Revenue from Commercial Fisheries

The total revenue from Hawaii's pelagic fisheries was $105.6 million in 2019, a decrease of 11% from the previous year. Bigeye tuna and yellowfin tuna represented 60% and 20% of the total pelagic revenue, respectively in 2019. The deep-set longline revenue was $92.9 million in 2019. This fishery represented 88% of the total revenue for pelagic fish in Hawaii. The shallow-set longline fishery decreased to $2.0 million and accounted for 2% of the revenue (WPFMC 2020d).

The MHI troll revenue was $7.2 million or 7% of the total in 2019, followed by the MHI handline fishery at $2.2 million (2%). The offshore handline fishery was worth $1.0 million in 2019. The trend for revenue from the deep-set longline was increasing, although it dropped 11% in 2019. Revenue for the shallow-set longline fishery was decreasing. The revenue from the MHI troll, MHI handline, and offshore handline fishery showed some variability and had no clear trend over the past ten years (WPFMC 2020d).

The total revenue from all fish in the bottomfish fishery (Deep-7 and non-Deep-7) in 2019 was $1.79 million, which is steady with the previous four years. There is currently no socioeconomic information for the crustacean fishery (WPFMC 2020c).

The following figures below provide additional data and trends for revenue, number of fishermen, and days fished for Hawaii's pelagic and bottomfish fisheries. Additionally, the annual catch and revenue data for amberjack and threadfin are included.

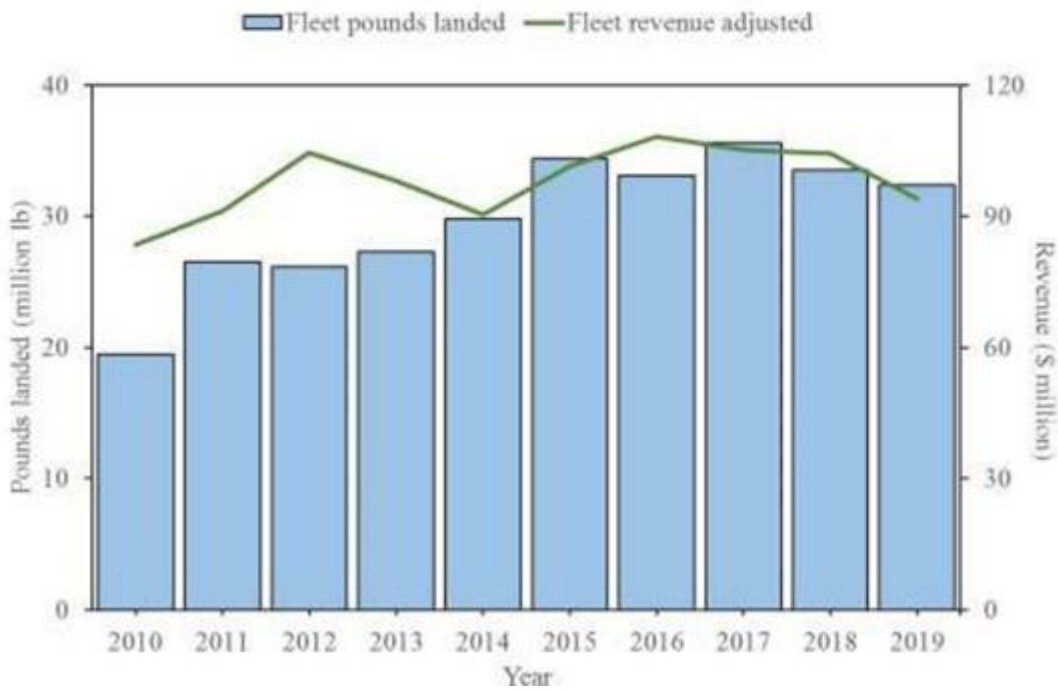

Figure 46. Commercial Landings and Revenue of Hawaii-Permitted Longline Fleet from Hawaii 2010-2019 Adjusted to 2019 U.S. Dollars. Source: WPFMC 2020d.

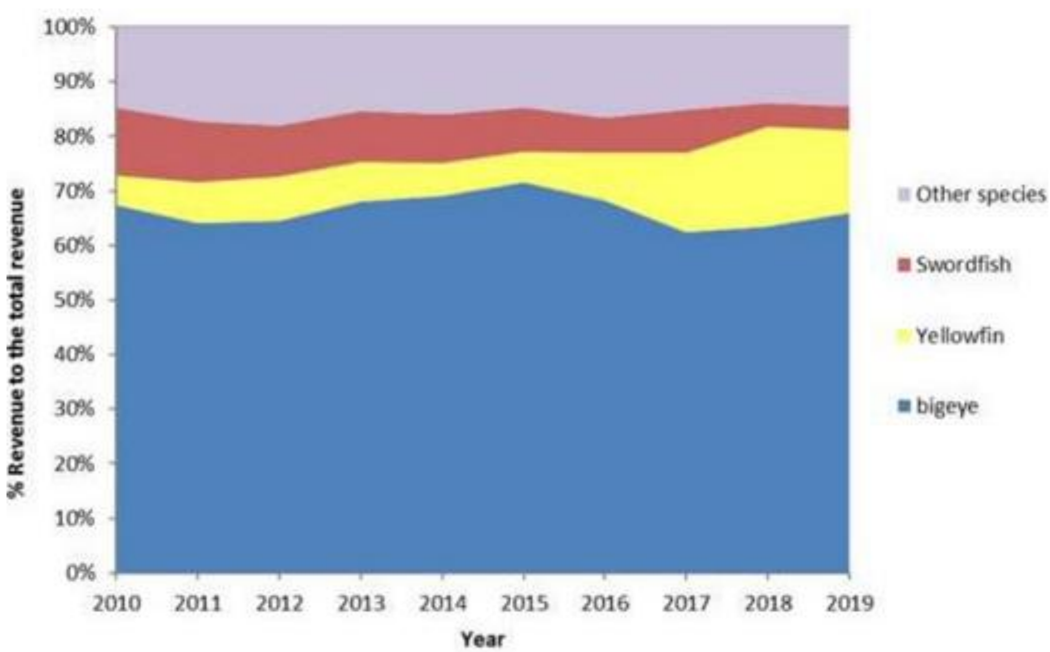

Figure 47. Trends in Hawaii Longline Revenue Species Composition from 2010-2019. Source: WPFMC 2020d.

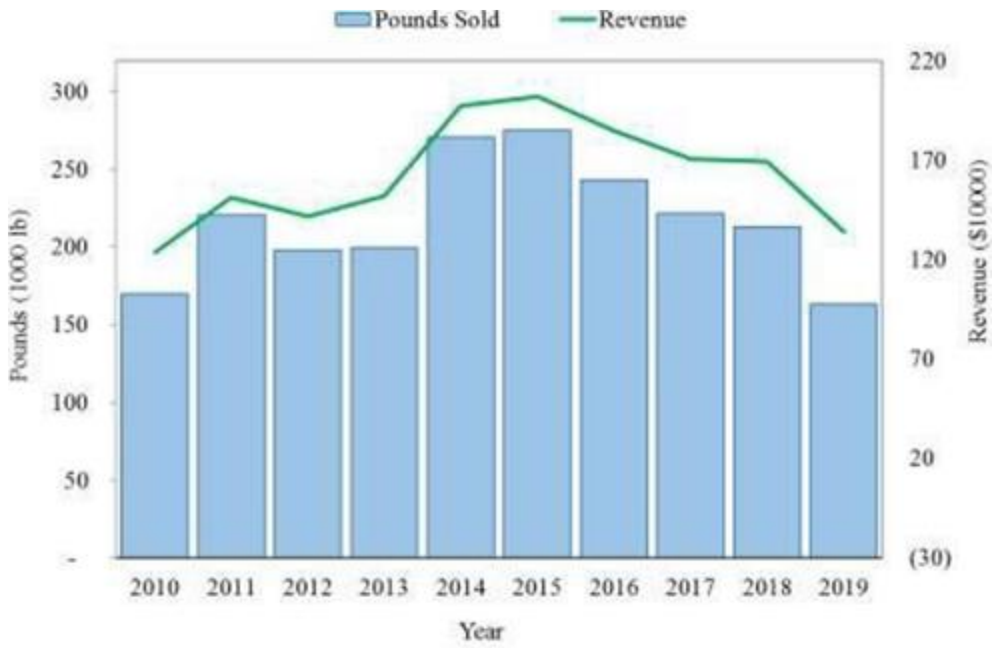

Figure 48. Pounds Sold and Revenue of BMUS of Hawaii Bottomfish Fishery, 2010-2019, Adjusted to 2019 U.S. Dollars. Source: WPFMC 2020c.

The following figures provide annual estimated revenue information for amberjack and threadfin sold to commercial marine vendors in Hawaii.

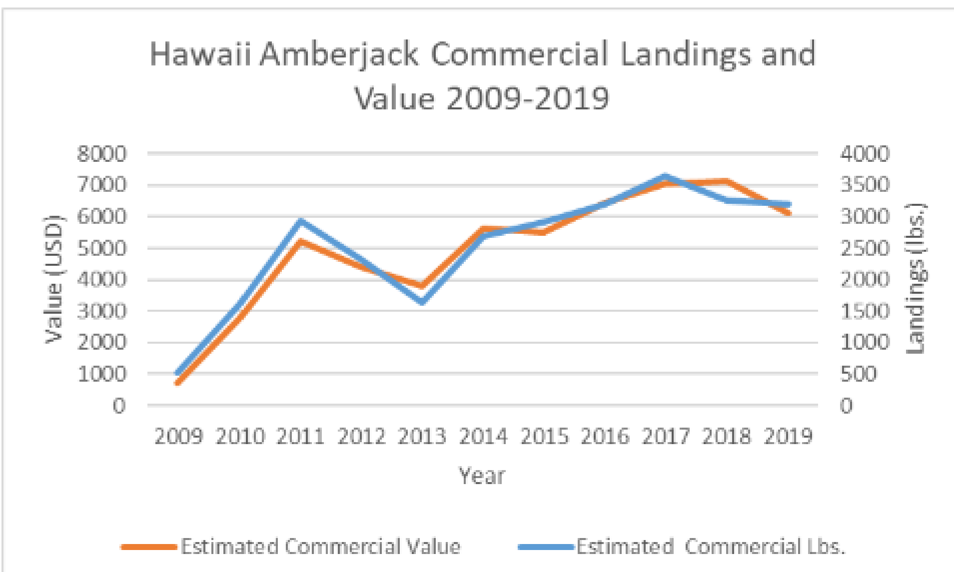

Figure 49. Hawaii Estimated Annual Amberjack Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Amberjack species include *Seriola dumerili*, *S. lalandi*, and *S. rivoliana*

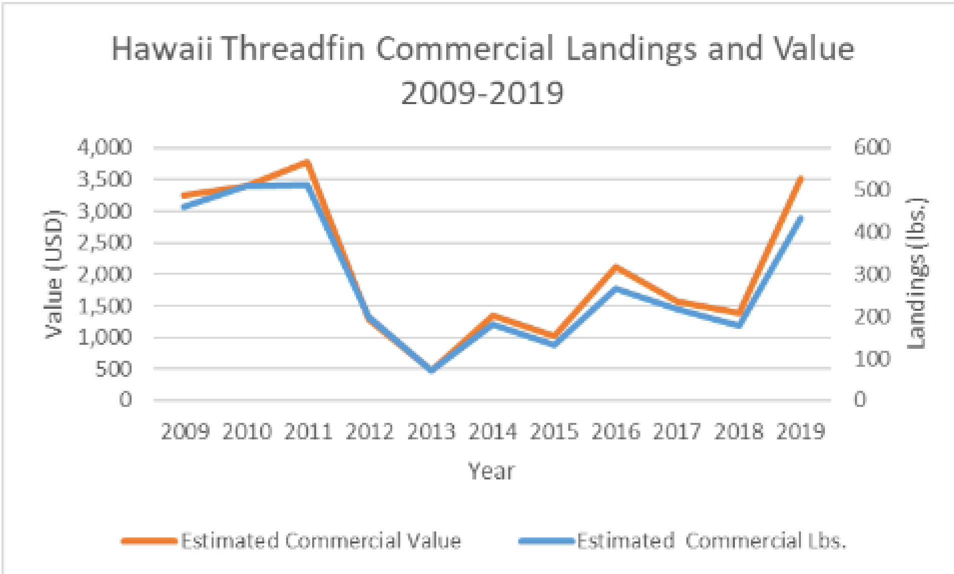

Figure 50. Hawaii Estimated Annual Pacific Threadfin Commercial Landings and Value (2009-2019) Source: WPacFIN's Best Estimated Total Commercial Landings.

Note: Pacific threadfin, *Polydactylus sexfilis* also includes unspecified threadfins (*Polydactylus* spp.)

Commercial Fishery Suppliers and Markets

The United Fishing Agency auction in Honolulu sells most of the pelagic longline catch, which represents more than 86% of annual commercial landings and revenue. Other commercial fishermen have multiple options for selling their catch including the Honolulu auction, directly to dealers/wholesalers, markets/stores, restaurants, roadside, or even selling or giving fish to friends and others. Much like other Pacific Island communities, a majority of this latter group of fishermen report selling their fish simply to recover costs, rather than as a primary source of income. Many also place importance on sharing fish as a part of maintaining relationships within their network of friends and family.

Hawaii residents' average seafood consumption is about two to three times more than other U.S. residents (WPFMC 2020c). In 2010, Hawaii imported 75% of all seafood consumed in the State from either the U.S. mainland or foreign markets, as local supply is not sufficient to meet the high seafood demand in the state.

Non-commercial Fishing Considerations

Non-commercial fishing for recreational, subsistence and cultural purpose are an important part of life and lifestyle in Hawaii. There are roughly 30 fishing clubs in Hawaii and the state hosts between 150 and 200 boat-based fishing tournaments. In 2018, the recreational catch was an estimated 43.7 million lbs. (19.8 million kg), which accounts for approximately 15% of the total catch (WPFMC 2019c).

Non-commercial fisheries are also extremely important in Hawaii economically, socially, and culturally. The total estimated pelagic recreational fisheries production in 2019 was nearly 12.8 million lbs. The number of small vessels in Hawaii declined to approximately 11,000 in 2018 since a peak of over 16,000 vessels in 2008. Boat-based anglers took 632,088 fishing trips in 2019, with only 7,744 designated charter vessel trips. Although unsold or not entering the typical commercial channels for fish sales, the total estimated value of the recreational catch was approximately $20 million in 2018 based on an average of $3.00/lb (WPFMC 2020d).

Relevant Socio-Economic Profile

As of July 2019, the estimated population of the state of Hawaii was 1,415,872, composed of about 37.6% Asian alone, 25.6% Caucasian alone, 24% mixed, 10.2% Native Hawaiian and other Pacific Islanders. While the primary language spoken is English, roughly 25% of residents speak another language at home.[41] The median age of Hawaii residents is 39.3 years old.[42]

In 2018, nominal GDP for the state of Hawaii was an estimated $97,282,000.[43] The top five sectors in the 2018 GDP accounted for 62% of the GDP and were real estate/rental/leasing (20.9%), government (19.5%), accommodation and food services (8.7%), health care and social assistance (6.8%) and retail trade (6.6%). The agriculture, forestry, fishing and hunting category by comparison directly contributed $406 million (0.4%) to the GDP.

With regard to the role of fishing in Hawaii, historically, Native Hawaiian subsistence relied heavily on fishing, trapping crustaceans, and collecting seaweed to supplement land-based diets. Native Hawaiians also maintained fishponds, some of which date back thousands of years and are still in use today. Fishing continues to play a central role in local Hawaii culture, diet, and economy. In 2015, with total revenue from commercial fishing of $110.9 million, the commercial fishing and seafood industry in Hawaii generated additional impacts to seafood processors and dealers, seafood wholesalers, seafood distributors, and retail. These total impacts, which exclude impacts from imports, were estimated to be $411.13 million in sales impacts, $162.7 million in income impacts, and 6,802 full- and part-time jobs in 2015 (NMFS 2017b). In Hawaii, consumers prefer fresh seafood, and while most consumers purchase seafood at markets or restaurants, friends, neighbors, or extended family members catch much of the seafood consumed in Hawaii.

Hawaii residents consume fresh bigeye tuna and yellowfin tuna, often as sashimi or poke (cubed and seasoned raw tuna) daily, especially during celebrations. Tuna wholesale prices increase dramatically at the end of the year because of the concentrated demand for fresh fish for the holiday season.

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[41] https://www.census.gov/quickfacts/fact/table/HI/PST045216, accessed 06/24/2020
[42] https://data.census.gov/, accessed 06/24/2020
[43] http://files.hawaii.gov/dbedt/economic/reports/GDP_Report_Final.pdf

Additional information about the role of fishing and marine resources across Hawaii, as well as information about the people who engage in fishing or use fishing can be found through the Hawaii FEP 2019 SAFE Report (WPFMC 2020c) and Pelagic FEP 2019 SAFE Report (WPFMC 2020d). An interactive online tool created by NMFS- Pacific Islands Fisheries Science Center depicts snapshots of Hawaii communities with information on fisheries involvement and demographics.[44]

Hawaii Administrative Environment

The Hawaii Department of Land and Natural Resources (DLNR) is responsible for managing public lands, water resources, ocean waters, navigable streams, and coastal areas. The DLNR Division of Aquatic Resources manages the State's marine and freshwater resources including commercial and non-commercial fisheries and aquaculture, aquatic resources protection and enhancement, and related education and enforcement programs. The DLNR operates in conjunction with Federal fisheries management concerning dealer reporting, fishing permits required for individuals in federally managed fisheries that cross into state waters, size limits for landings, and enforcing federally banned practices such as shark finning.

In 1978, the State developed the first formal aquaculture development plan in the U.S. In 1999, the Hawaii legislature approved ocean leasing for aquaculture (Buttner and Karr 2009). These efforts have led to a growing aquaculture industry in state waters.

Federally Managed Sanctuaries, Monuments and Wildlife Refuges

The Hawaiian Islands Humpback Whale National Marine Sanctuary, authorized by Congress in 1992, is located from the shoreline to the 100-fathom isobath (600-ft depth [183 m]), as shown in Figure 51. The sanctuary encompasses approximately 1,218 nm^2 (4780 km^2) and is managed via a cooperative Federal-state partnership between NOAA's Office of National Marine Sanctuaries (ONMS) and the Department of Land and Natural Resources.

[44] https://www.pifsc.noaa.gov/socioeconomics/hawaii-community-snapshots.php

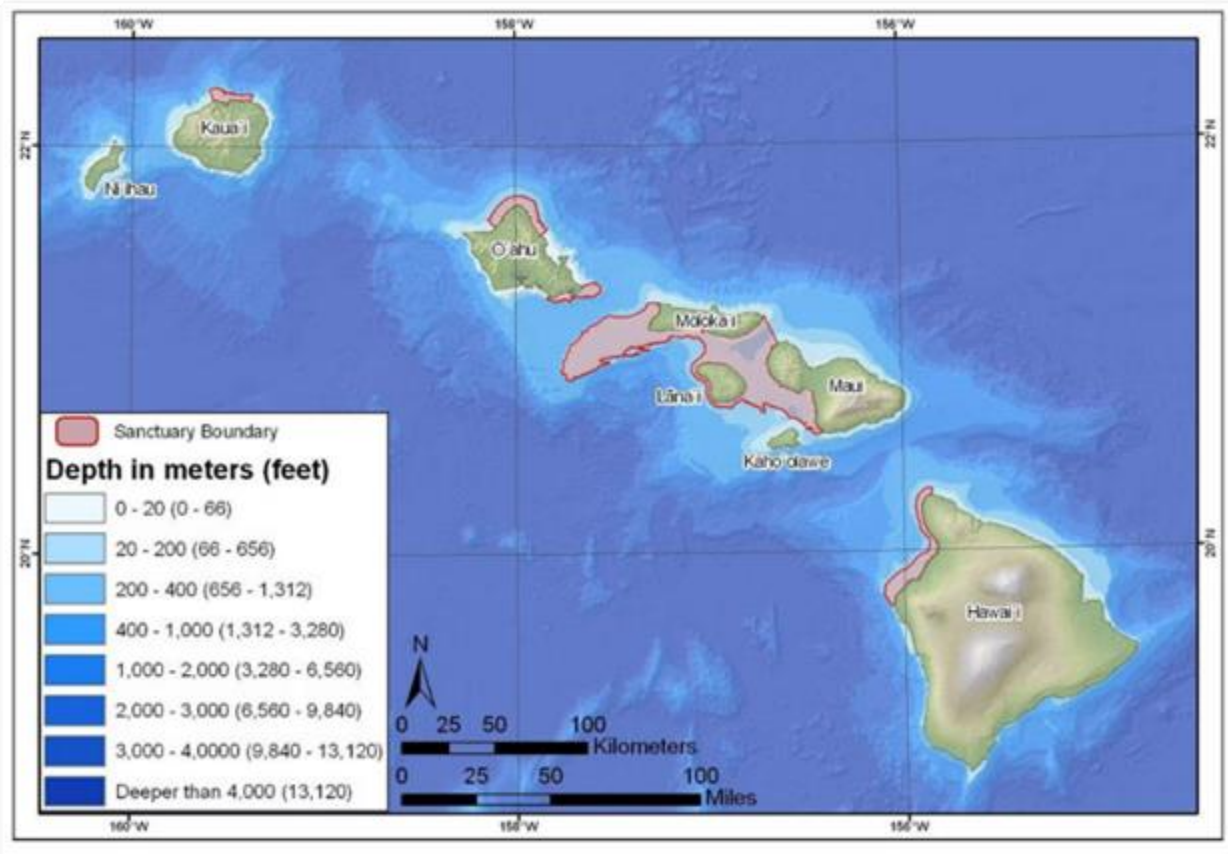

Figure 51. Hawaiian Islands Humpback Whale National Marine Sanctuary. Source: HIHWNMS Website.

The sanctuary's advisory council prepared an *Offshore Development and Aquaculture Report* (SAC 2012). In this report, the advisory council did not recommend banning aquaculture in the sanctuary, but if considered, the sanctuary must take an active role in its development. They also listed five concerns related to aquaculture development: aversion, attraction, entanglement, habitat degradation, and habitat loss, and measures to address and study these concerns.

The NWHI are subject to a series of management measures and jurisdictional authorities, including:

- A 1909 bird reserve, which converted into the Hawaiian Islands National Wildlife Refuge.
- A protected species zone (PSZ) that has prohibited longlining within 50 nm (93 km) of the islands since 1991.
- A coral reef ecosystem reserve in 2000 that mirrors the boundaries of the PSZ and prohibits all commercial fishing.
- A marine national monument that is the largest marine wildlife reserve in the world.

On June 15, 2006, President G.W. Bush created the Papahanaumokuakea Marine National Monument under the Antiquities Act of 1906. The Monument spans the entire NWHI, encompassing the islands and 139,797 mi^2 (362,073 km^2) of surrounding ocean waters. On August 26, 2016, President Obama expanded the Monument to 582,578 mi^2 (1,508,870 km^2), nearly the size of the Gulf of Mexico (Figure 52). The Monument prohibits all commercial fishing, including commercial aquaculture, within its boundaries. The Monument allows for certain armed forces' activities.

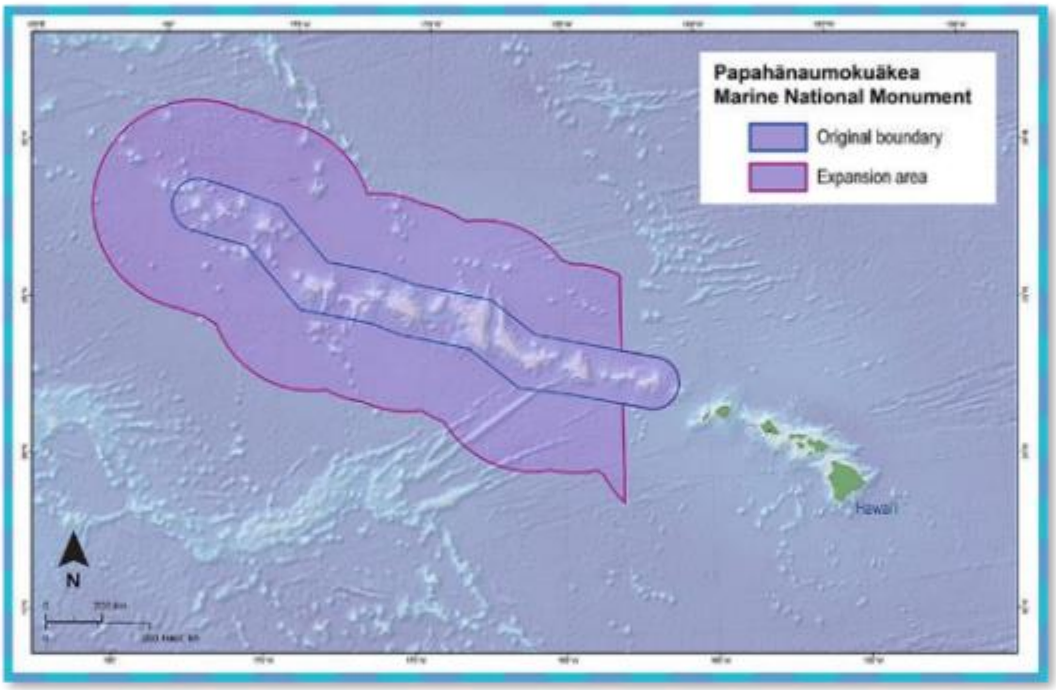

Figure 52. Papahanaumokuakea Marine National Monument. Source: ONMS Website.

Department of Defense Jurisdictions

With the large military presence in Hawaii, there are numerous restricted areas and other training zones, most of which would be incompatible with aquaculture. Hawaii waters are also part of a long term training and testing study area for the U.S. Navy (U.S. Navy 2018). The figures below provide the broader Hawaii-Southern California Training and Testing Study Area, as well as the detailed Hawaii Training and Testing map, showing restricted zones in State waters, and warning and operating areas across the EEZ and beyond into international waters (U.S. Navy 2018). DOD and Department of Homeland Security activities could occur throughout the broader study area.

All other areas in Figure 53 through Figure 57 are incompatible with aquaculture.

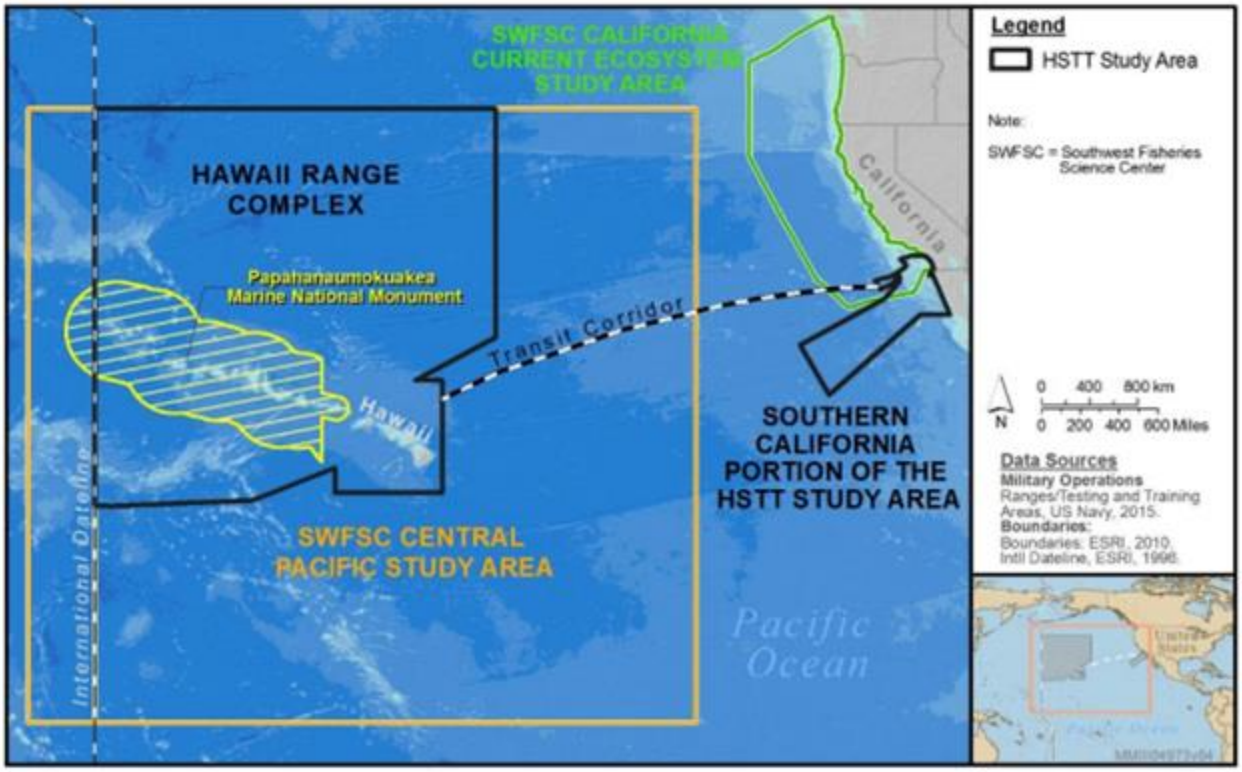

Figure 53. Hawaii-Southern California Training and Testing Study Area. Source U.S. Navy 2018.

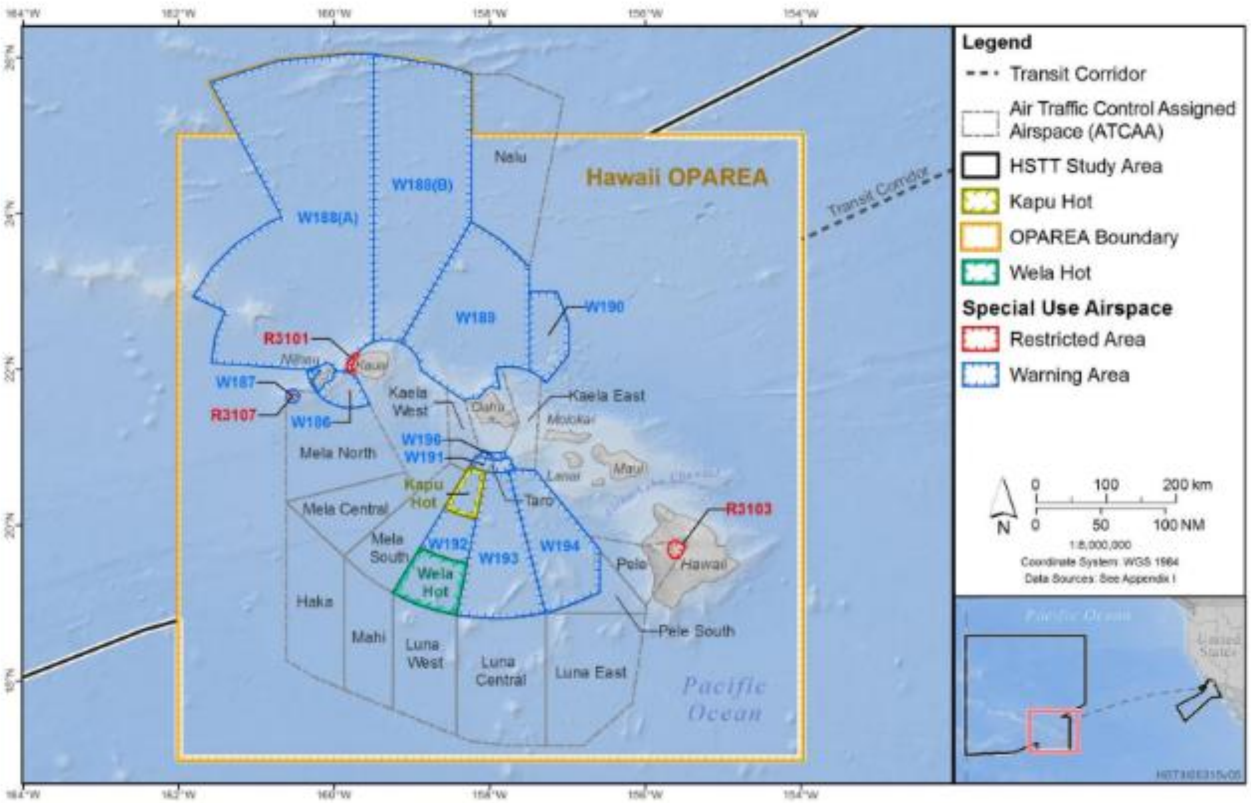

Figure 54. Hawaii Navy Testing and Training Zones (2018). Source: U.S. Navy 2018.

Notes: HSTT = Hawaii-Southern California Training and Testing, OPAREA = Operating Area.

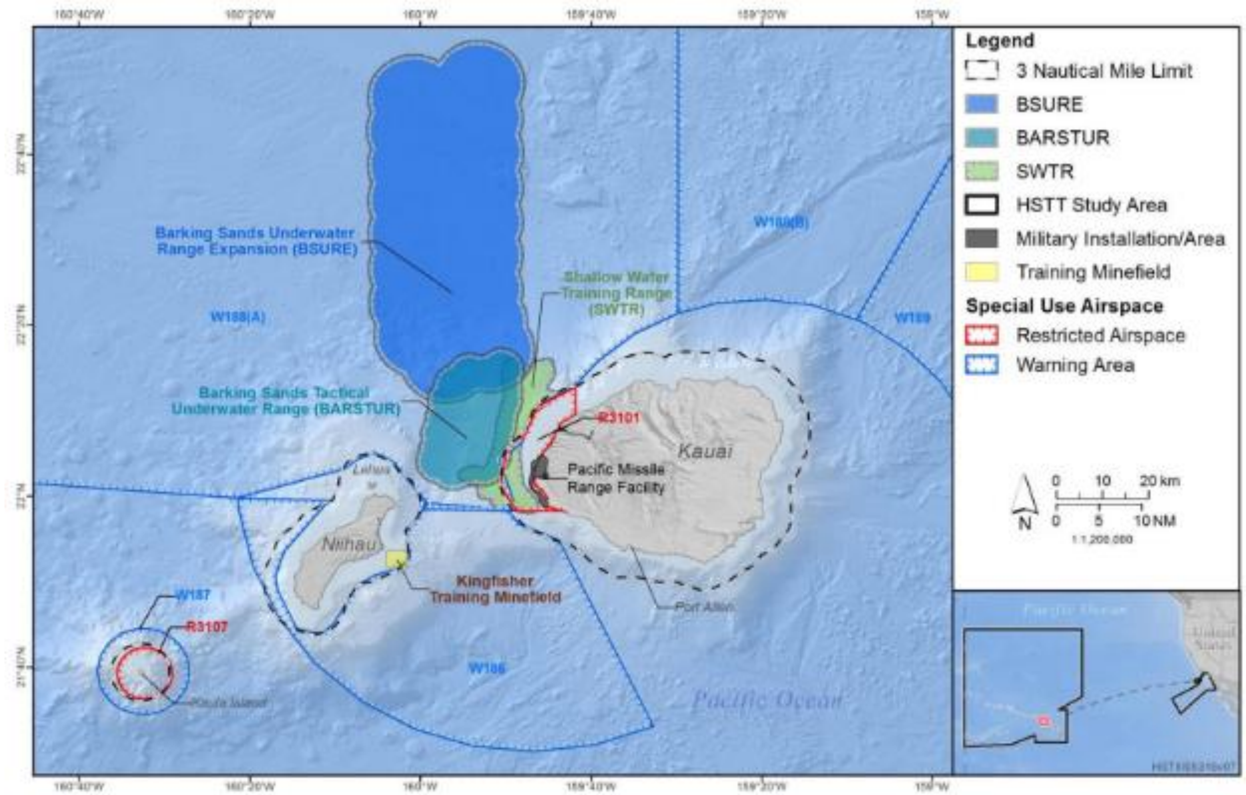

Figure 55. Navy Training and Testing Areas Around Kauai (2018). Source: U.S. Navy 2018.

Note: HSTT = Hawaii-Southern California Training and Testing

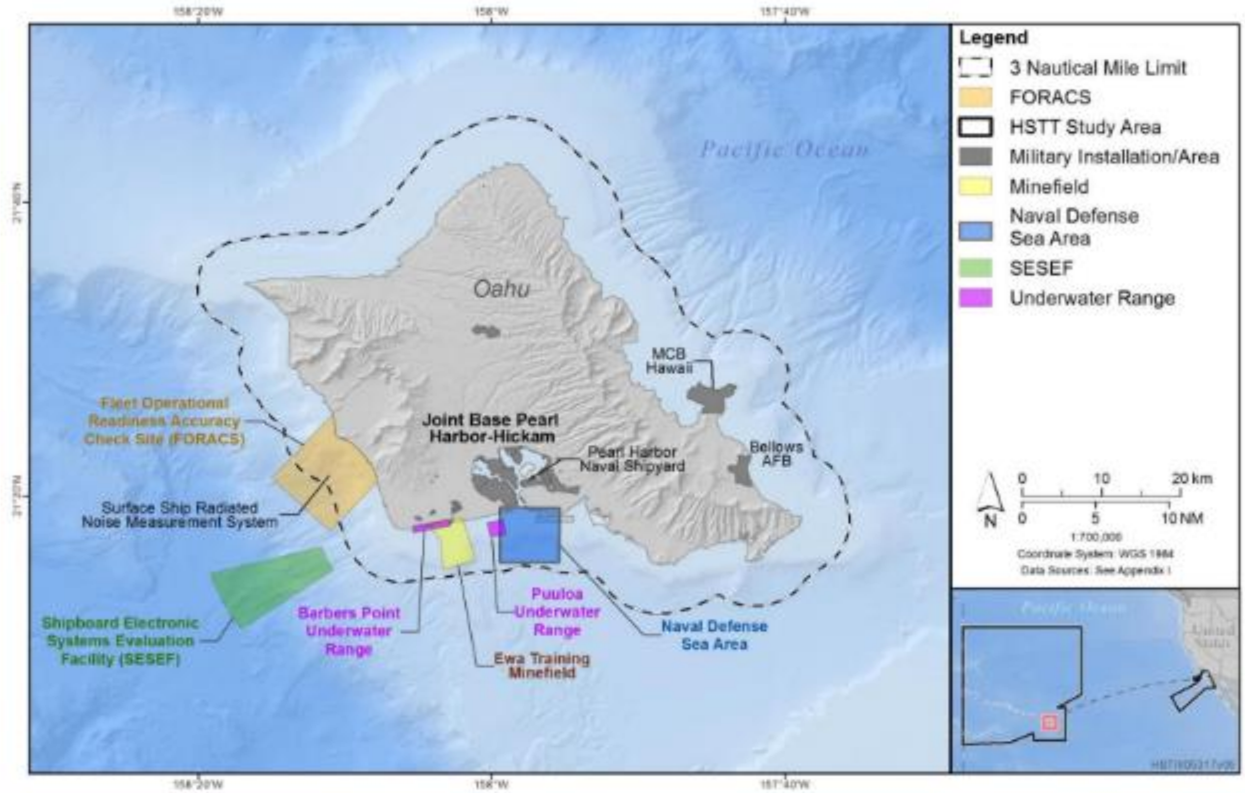

Figure 56. Navy Training and Testing Areas Around Oahu (2018). Source: U.S. Navy 2018.

Notes: HSTT = Hawaii-Southern California Training and Testing, MCB=Marine Corps Base, AFB=Air Force Base.

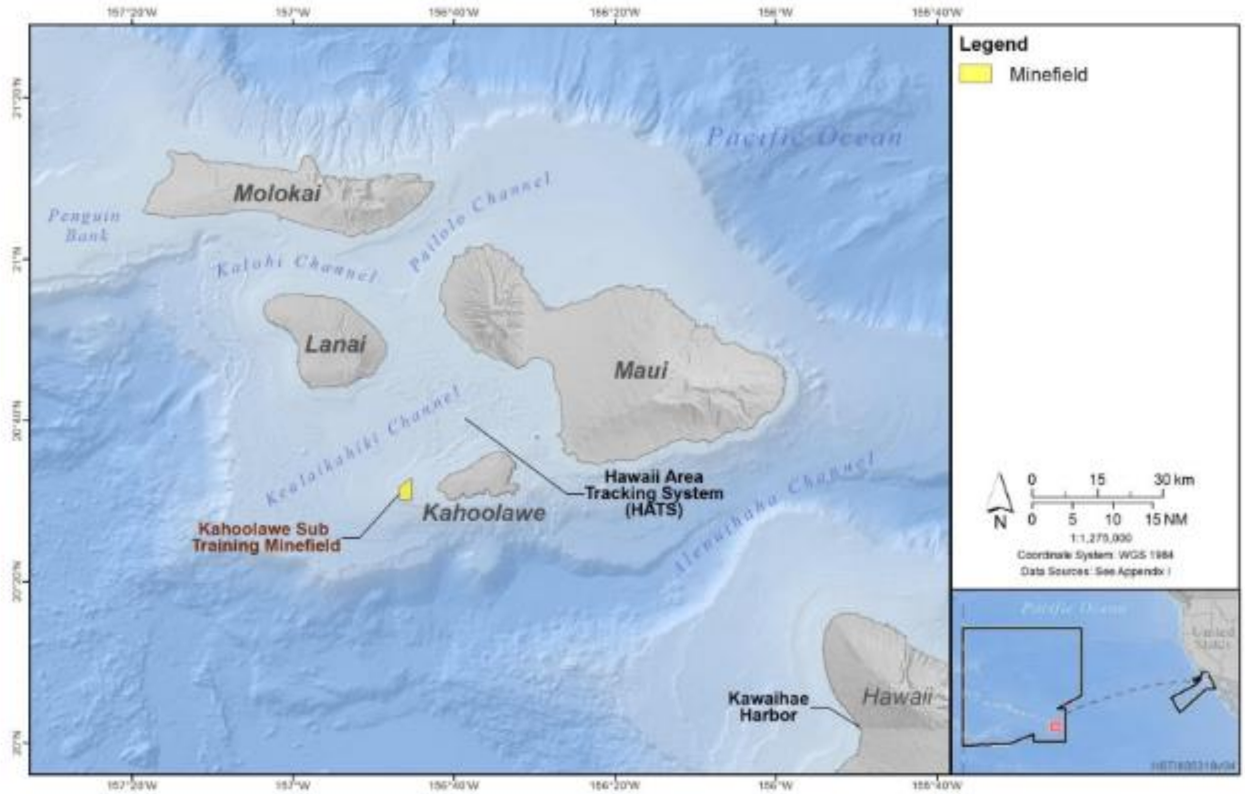

Figure 57. Navy Training and Testing Areas Around Maui Nui (2018). Source: U.S. Navy 2018.

3.5 Pacific Remote Island Areas (PRIA)

The PRIA is an unorganized group of seven islands and atolls throughout the Central Pacific that are under U.S. jurisdiction. Baker, Howland, and Jarvis Islands, Johnston Atoll, Palmyra Atoll and Kingman Reef lie between Hawaii and American Samoa. Wake Island is located between the NWHI and Guam. The Pacific Remote Islands Marine National Monument (PRIMNM) includes much of the PRIA and prohibits commercial fishing, including commercial aquaculture, within its limits. Commercial fishing and aquaculture are also prohibited within the EEZ surrounding Jarvis Island, Johnston Atoll and Wake Island, but are allowed outside the seaward boundary of the Monument at Baker Island, Howland Island, Palmyra Atoll and Kingman Reef.

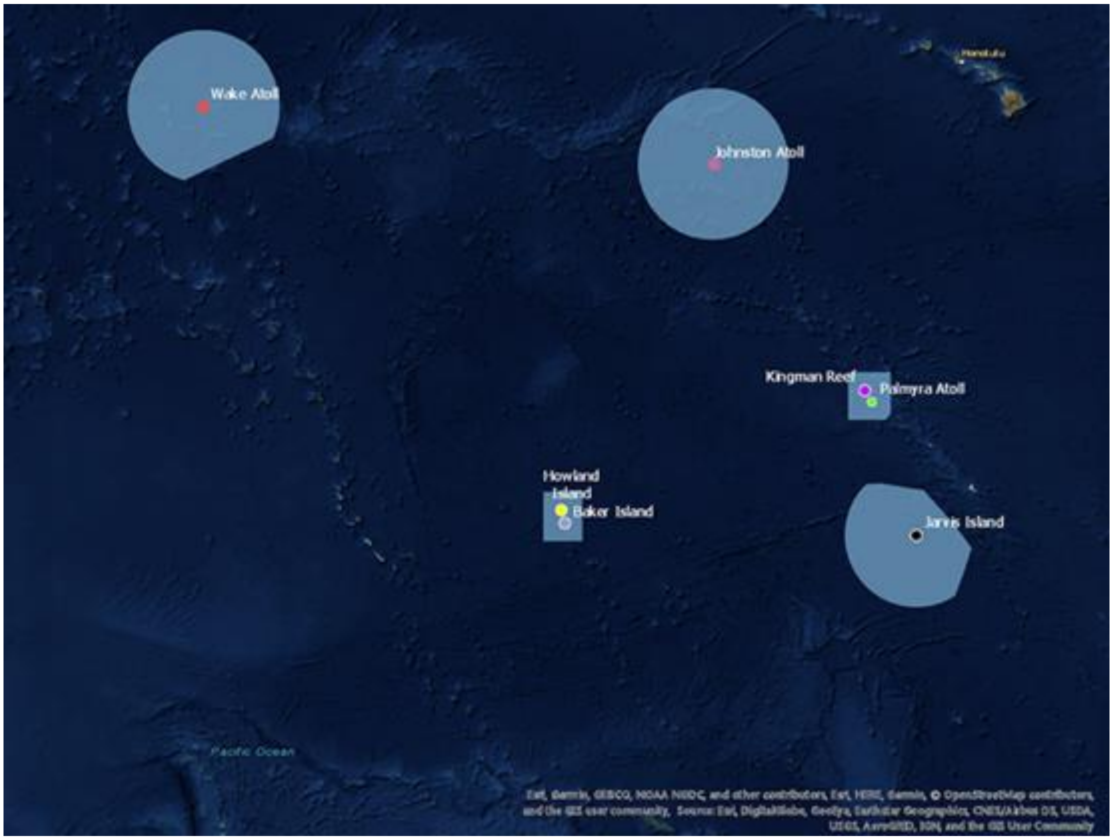

Figure 58. Map of the Islands Included in the PRIA.

The PRIA FEP (WPFMC 2009e) contains a detailed description of the physical and biological habitat. This section summarizes important information relevant to the analysis of the alternatives for Baker, Howland, Palmyra, and Kingman. Because commercial aquaculture has been prohibited throughout the EEZ around Jarvis, Johnston and Wake, this section does not describe these areas.

3.5.1 Physical Environment

Coastline

Howland and Baker Islands are both emergent, coral-topped seamounts, fringed by narrow, relatively flat coral reefs that drop off sharply very close to shore (CIA 2017). Palmyra Atoll comprises approximately 52 islets surrounding three central lagoons surrounded on all sides by extensive reef flats. The atoll is 753 mi^2 (1,949 km^2), of which 1.5 mi^2 (3.9 km^2) are emergent land (CIA 2005). Kingman Reef is located 33 nm northwest of Palmyra Atoll, consisting of 756 mi^2 (1,958 km^2) of fringing reefs around a central lagoon, with only 0.004 mi^2 (0.01 km^2) of permanent land (CIA 2005).

Open Ocean

Howland and Baker Islands are located within the Phoenix archipelago, approximately 1,830 nm (3390 km) southwest of Honolulu, about halfway between Hawaii and Australia. Palmyra Atoll and Kingman Reef are located at the northern end of the Line Island Archipelago, approximately 1,050 nm (1,945 km) south of Honolulu.

Oceanographic Features

Howland Island lies within the margins of the eastward flowing North Equatorial Counter Current and the westward flowing South Equatorial Current. Sea-surface temperatures of pelagic EEZ waters around Howland Island are often near 86°F (30°C). The depth of the mixed layer in the pelagic waters around Howland Island is seasonally variable, average mixed layer depth is around to 230 to 295 ft (70 to 90 m) (WPFMC 2009e).

Baker Island lies within the westward flowing South Equatorial Current. Baker Island also experiences an eastward flowing equatorial undercurrent that causes upwelling of nutrient rich and plankton rich waters on the west side of the island (Brainard et al. 2005). Sea surface temperatures of pelagic EEZ waters around Baker Island are often near 86°F. Although the depth of the mixed layer in the pelagic waters around Baker Island is seasonally variable, average mixed layer depth is around 330 ft (100 m) (WPFMC 2009e).

Palmyra Atoll lies in the North Equatorial Countercurrent, which flows in eastward direction. Sea-surface temperatures of pelagic EEZ waters are often 80-86°F (27°-30°C). Although the depth of the mixed layer is seasonally variable, the average mixed layer depth is around 295 ft (90 m) (WPFMC 2009e).

Kingman Reef lies in the North Equatorial Countercurrent, which flows in a west to east direction. Sea-surface temperatures of pelagic EEZ waters around Kingman Reef are often 80-86°F. The depth of the mixed layer in the pelagic waters around Kingman Reef is seasonally variable, average mixed layer depth is around 265 ft (80 m) (WPFMC 2009e).

Extreme Weather

Each of the PRIAs are low-lying and partially submerged islands, leaving them particularly vulnerable to extreme weather events, even those that are distant (Gardner et al. 2014). Cyclone activity throughout the North Pacific, Central Pacific, and South Pacific was average in 2019 (WPFMC 2020e).

Howland and Baker Islands are an equatorial climate, with little annual rainfall, constant wind and sun. There are no natural freshwater sources on the island.[45]

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[45] CIA https://www.cia.gov/library/publications/the-world-factbook/geos/hq.html, accessed April 10, 2020

Palmyra Atoll and Kingman Reef are also an equatorial climate, but are located within the Intertropical Convergence Zone, where the northeast and southeast trade winds meet. Each year Palmyra ad Kingman receive 400-500 cm of rainfall.[46]

3.5.2 Biological Environment

The PRIA FEP describes the biological environment of the PRIA in detail, including the species addressed in this PEIS, which we incorporate here by reference (WPFMC 2009e). This document describes specific resources of concern, identified during scoping and interagency informal consultations to the level necessary for appropriate analysis.

Benthic and Sessile Organisms

See Section 3.1.2 for the general biology of benthic and sessile organisms in the nearshore and offshore habitat. This section covers the only life history information specific to the PRIA.

Nearshore Reefs

The coral reef systems around the PRIA are generally healthy and productive. In 2015-2016 major heat stress events led to bleaching, as well as a minor event in 2018 (WPFMC 2020e). However, NOAA still considers the coral health in ‘good’ condition (NOAA 2018).

Offshore Reefs

Data on precious corals around PRIA are lacking, though they likely occur in suitable habitats across the archipelago. The PRIA FEP identifies eleven federally managed species: three pink coral, three gold coral, two bamboo coral, and three black coral species (WPFMC 2009e).

Protected Species

Marine Mammals

All marine mammals that occur in the PRIA occur elsewhere in the PIR. Section 3.1.2 contains thorough descriptions of all of these species and this section only contains details specific to the PRIA.

There is a resident population of bottlenose dolphins near Howland and Baker Islands (Brainard et al. 2005). Although other cetaceans found throughout the PIR are believed to occur around Baker Island, information on the types of species and their abundance in the PRIA is currently unknown (WPFMC 2009e).

Pacific bottlenose dolphins, spinner dolphins and melon-head whales frequent the waters of the Palmyra Atoll, while Kingman Reef supports a sizable population of bottlenose dolphins and melon-headed whales (WPFMC 2009e).

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[46] CIA https://www.cia.gov/library/publications/the-world-factbook/geos/lq.html, accessed April 10, 2020

Sea Turtles

There are no known reports of olive ridley, loggerhead, or leatherback sea turtles in any of the PRIA, although these waters are within the habitats of these species. The lack of observation may be due to their relatively rare occurrence and the largely uninhabited nature of the PRIA. Both green and hawksbill sea turtles are in the nearshore waters of most of the PRIA.

Green sea turtles and hawksbill turtles have been observed foraging offshore (WPFMC 2009e) and green sea turtles reportedly nest at Palmyra and Jarvis Islands. Resident turtles inhabit the lagoon waters at Wake and Palmyra. Green turtles are also reportedly in the marine environment around Howland, Baker, and Kingman, but nesting at these areas is unknown. Beach erosion at Palmyra Atoll negatively affects turtle movement and nesting

The hawksbill sea turtle is regularly in the waters of Palmyra Atoll and has been reported from Baker and Howland Islands. Waters around the PRIA may provide marine feeding grounds for this species (WPFMC 2009e).

Seabirds

Many of the islands in the PRIA host seabird colonies. Eleven seabird species occur on Howland Island: brown booby, masked booby, red-foot booby, great frigatebird, lesser frigatebird, blue noddy, brown noddy, gray-backed tern, sooty tern, white tern, red-tailed tropicbird. The most numerous breeding species are the lesser frigatebird, masked booby, and sooty tern (USFWS 2017a).

Ten seabird species nest on Baker Island: brown booby, masked booby, red-foot booby, great frigatebird, lesser frigatebird, blue noddy, gray-backed tern, sooty tern, white tern, red-tailed tropicbird (USFWS 2017a).

Palmyra Atoll hosts seven seabird species: brown booby, masked booby, red-footed booby, black noddy, brown noddy, great frigatebird, and sooty tern. The red-footed booby nesting colony on Palmyra Atoll is the second largest population in the world, with an estimated 6,250 pairs. (USFWS 2017a).

At Kingman reef, the brown booby is the only seabird recorded, using the emergent reef for roosting during the year (USFWS 2017a).

Sharks and Rays

All sharks and rays that occur in the PRIA occur elsewhere in the PIR. Section 3.1.2 contains thorough descriptions of each species.

3.5.3 Social and Economic Environment

Past and Present Commercial Offshore Aquaculture Operations

State of Aquaculture Industry

There have been no commercial aquaculture operations in the PRIA.

Characteristics and Economic Feasibility of Aquaculture Operations

The PRIA are unlikely locations for aquaculture operations. There are virtually no services at any of the locations, access to the islands and even within the monument waters is restricted, and grow-out facilities could not be sited inside of the Monument that surrounds all of the islands. In addition, these islands are among the most remote locations on the planet, 1,000 mi (1610 km) from the nearest commercial harbor or airport. Prior to and during WWII, the U.S. military constructed runways on Baker, Howland and Johnston Islands. These runways are no longer serviceable. Palmyra Atoll has one 6056 ft (1,846 m) unpaved runway that is privately owned.[47] Baker, Howland, and Kingman Reef do not have harbors, and vessels must anchor offshore. Palmyra Atoll does have an accessible sheltered lagoon for anchorage and a small wharf.[48] However, there is no admittance or access without a USFWS permit consistent with the conservation purposes of the Atoll.

Scope of Fishing Activity - Wild Stocks

Howland and Baker Islands and Kingman Reef are uninhabited. Since 2000, a group of four to twenty USFWS staff, Nature Conservancy staff, and researchers temporarily reside at Palmyra Atoll.[49] Fishing at Palmyra is for research and on-island consumption only.

Description of Commercial Fisheries

As many tropical pelagic species are highly migratory, the fishing fleets targeting them often travel great distances. Although the EEZ waters around Johnston Atoll and Palmyra Atoll are over 750 nm and 1000 nm (respectively) away from Honolulu, the Hawaii longline fleet does seasonally fish in those areas. For example, Hawaii-based longline vessels targeting yellowfin tuna visit the EEZ around Palmyra, whereas albacore is the main target species around Johnston Atoll. Similarly, the U.S. purse seine fleet also targets pelagic species (primarily skipjack tuna) in the EEZs around some PRIAs, specifically, the equatorial areas of Howland, Baker, and Jarvis Islands. The combined amount of fish harvested from these areas from the U.S. purse seine on average is less than 5% of their total annual harvest (WPFMC 2020d).

The record of fishing at the PRIA is somewhat limited. Hawaii-based vessels previously made sporadic commercial fishing trips to Palmyra Atoll and Kingman Reef. State of Hawaii commercial data between the years 1988-2007 indicates that landings of 51,740 lb (23,500 kg) non-longline caught pelagic fish, and 19,095 lbs. (8,660 kg) of bottomfish and reef fish at Palmyra Atoll, Kingman Reef and Johnston Island. This is equivalent to 1,293 lb/year (586

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[47] CIA https://www.cia.gov/library/publications/the-world-factbook/geos/lq.html, accessed April 10, 2020
[48] CIA https://www.cia.gov/library/publications/the-world-factbook/geos/hq.html, accessed April 10, 2020
[49] CIA https://www.cia.gov/library/publications/the-world-factbook/geos/lq.html, accessed April 10, 2020

kg/yr) non-longline pelagic fish and 477 lb/year (216 kg/yr) of bottomfish and reef fish. However, currently there are no bottomfish, crustacean, coral reef, or precious coral fisheries operating in the PRIA, and no historical observer data are available for fisheries under the PRIA FEP (WPFMC 2020e).[50]

Non-Commercial Fishing Consideration

There are no permanent residents on any of these islands and no recreational fishing. Fishing at Palmyra Atoll is strictly for research and on-island consumption.

Relevant Socio-Economic Profile

Additional information about the role of fishing and marine resources across PRIA can be found through the PRIA FEP 2019 SAFE Report (WPFMC 2020e) and Pelagic FEP 2019 SAFE Report (WPFMC 2020d).

Pacific Remote Islands Areas Administrative Environment

All of the PRIA are under Federal management, and are not associated with any state or territory. All of the areas have been designated National Wildlife Refuges, including all land, reef and waters out to 12 nm (3.7 km), administered either solely or jointly by the USFWS. In 2000, The Nature Conservancy (TNC) acquired Palmyra Atoll from its previous private owner and, in 2001, TNC conveyed 439 acres of the property to the USFWS. The entire atoll, including the main Cooper islet retained by TNC, is included within the Palmyra Atoll National Wildlife Refuge.

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[50] NMFS maintains a list of current permit holders, available at the following website: https://www.fisheries.noaa.gov/pacific-islands/resources-fishing/pacific-islands-permit-holders#pacific-remote-island-areas-bottomfish

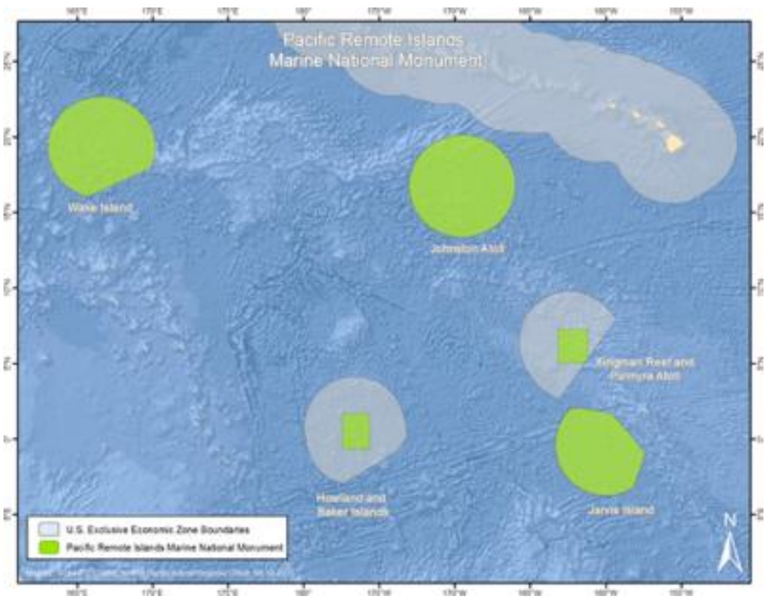

Figure 59. Map of the Pacific Remote Islands Marine National Monument.

Table 25. Marine Resource Management Boundaries within the PRIA. Source: WPFMC 2009e.

Island or Area	Dept. of Commerce	Dept. of the Interior and Dept. of Defense (as noted)
Howland I.	WPFMC/NMFS 0-200 nm	FWS: 0-3 nm
Baker I.	WPFMC/NMFS 0-200 nm	FWS: 0-3 nm
Jarvis I.	WPFMC/NMFS 0-200 nm	FWS: 0-3 nm
Johnston A.	WPFMC/NMFS 0-200 nm	FWS/U.S. Navy: 0-3 nm
Kingman R.	WPFMC/NMFS 0-200 nm	FWS: 0-12 nm[1]
Palmyra A.	WPFMC/NMFS 0-200 nm	FWS: 0-12 nm[2]
Wake I.[3]	WPFMC/NMFS 0-200 nm	DOI/U.S. Army: 0-3 nm

[1] Boundary formerly 0-3 miles under the jurisdiction of the U.S. Navy. Secretarial Order 3223 extended Department of the Interior's jurisdiction to 12 nm.
[2] Secretarial Order 3224 (Palmyra Atoll) extended the USFWS administrative authority from 3 to 12 nm.
[3]As of 1962, the jurisdiction over Wake Island is vested with the Department of the Interior. Since 1994, the Department of the Army has maintained administrative use of Wake Island.

Federally managed sanctuaries, monuments and wildlife refuges

The PRIA fishery management area is the EEZ seaward of Palmyra Atoll, Kingman Reef, Jarvis Island, Baker Island, Howland Island, Johnston Atoll, and Wake Island, PRIA. The inner boundary is a line coterminous with the seaward boundaries of the above atolls, reefs and islands PRIA and the outer boundary a line drawn in such a manner that each point on it is 200 nm from the baseline from which the territorial sea is measured, or is coterminous with adjacent international maritime boundaries. All of the islands and atolls are designated National Wildlife Refuges (NWRs), with primary management of the lands and waters to 12 nm by the USFWS. NMFS has primary responsibility for fishing related activities seaward of 12 nm from the islands and atolls.

On June 27, 1974, the Secretary of the Interior created Jarvis Island, Howland Island, and Baker Island National Wildlife Refuges (NWR). These refuges were expanded in 2009 to add submerged lands within 12 nm (22 km) of the island. The Jarvis refuge includes 1,273 acres (5.15 km^2) of land and 428,580 acres (1,734.4 km^2) of water. Howland Island includes 648 acres (2.62 km^2) of land and 410,351 acres (1,660.6 km^2) of water. The Baker refuge includes 531 acres (2.15 km^2) of land and 409,653 acres (1,654 km^2) of water (CIA 2017).

The Wake Island NWR includes 495,515 acres (2,005 km^2) of submerged lands and waters surrounding Wake Atoll out to 12 nm. The atoll was designated a National Historic Landmark in 1985 in recognition of its role in World War II. The Secretary of Defense continues to manage the emergent lands of Wake Atoll under an existing agreement between the Secretary of the Interior and the Secretary of the Air Force.

In 1926, President Calvin Coolidge established Johnston Atoll as a Federal bird refuge. In 1934, President Roosevelt placed the atoll under U.S. Navy control, but retained its status as a refuge. The Johnston Atoll NWR includes 660 acres (267 km^2) of land, of which 90% was artificially created by the military through coral dredging as well as the associated reef and nearshore waters.

In January 2001, the Secretary of the Interior designated the Palmyra Atoll and Kingman Reef NWR. The Palmyra Atoll NWR includes 4.6 mi^2 (12 km^2) of land and nearly 500,000 acres (2,000 km^2) of water of water out to 12 nm. The Kingman Reef NWR includes 3 acres (0.01 km^2) of emergent reef 483,754 acres (1,958 km^2) of submerged reefs and associated waters, out to 12 nm (USFWS).

In 2009, President George W. Bush created the Pacific Remote Island Marine National Monument (PRIMNM) incorporating 86,888 mi^2 (225,000 km^2) within its boundaries, which extended 50 nm (93 km) from the mean low water line (Proclamation 8336). In 2014 President Barack Obama extended the monument to the extent of the EEZ (200 nm) at Jarvis, Johnston and Wake, increasing the size of the monument by 408,299 mi^2 (1,057,000 km^2) to a total size of 495,187 mi^2 (1,283,000 km^2) (Proclamation 9173). The Department of the Interior and Department of Commerce, through USFWS and NOAA, respectively, jointly administer the PRIMNM. The PRIMNM includes 33 seamounts across the seven areas. There are approximately 132 additional seamounts within the EEZ and outside of the monument boundaries (Proclamation 9173).

The following EEZ waters are no-take MPAs: Landward of the 50-fathom (91-m) curve at Jarvis, Howland, and Baker Islands, and Kingman Reef, as depicted on National Ocean Survey Chart Numbers 83116 and 83153. In addition, regulations prohibit all fishing for CRECS within 12 nm of the islands in the PRIMNM, subject to USFWS authority to allow non-commercial fishing in consultation with NMFS and the WPFMC. The PRIMNM prohibits all commercial fishing within its boundaries.

Department of Defense Jurisdictions

The DOD has administrative authority in the PRIA for use as military airfields and for weapons testing through a number of historic Executive Orders. Executive Order 8682 of 1941 authorizes the Secretary of the Navy to control entry into Naval Defensive Seas Areas (NDSAs) around Johnston Atoll, Wake Island, and Kingman Reef, which include "territorial waters between the extreme high-water marks and the three-mile marine boundaries surrounding." In addition, the Navy has joint administrative authority with the USFWS of Johnston Atoll and has transferred administrative authority over Kingman Reef to the USFWS. DOD has suspended the Wake Island NDSA until further notice.

4 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

This chapter discusses the direct and indirect environmental impacts that would be expected to result from implementation of the No-Action Alternative (Alternative 1) and each of the action alternatives (Alternatives 2 and 3), which are described in Chapter 2.

Section 1.1.1 and Chapter 3 describe the action area in greater detail. This analysis does not consider secondary use areas, such as the coastal environment. Coastal areas include nearshore areas such as marinas or coastal storage facilities that may serve as holding, launch, or repair sites for aquaculture facilities. Because of the potential need for project-specific details to appropriately analyze project impacts, future assessments that would tier from this PEIS can cover specific area and facilities use.

4.1 Methods for analysis

This document assesses environmental impacts according to five impact criteria identified through scoping and common environmental concerns related to aquaculture. Section 4.1.1 describes these impact criteria.

Analysts utilize their professional judgment to determine where a particular effect falls in the following categories: minor, moderate, and major. Analysts also use the term "negligible" if there are no measureable effects on the resource expected or if there are no mechanisms by which the resource could be affected. Analysts also use professional judgment to assess whether the likelihood of an affect is plausible or merely speculative, using more qualitative terms for potential long-term effects.

This chapter uses the following terms throughout to discuss potential effects. In this analysis, the terms “effects” and “impacts” are interchangeable.

- Direct Effects - “Caused by the action and occurring at the same time and place” (40 CFR 1508.8).
- Indirect Effects - “Caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable.” (40 CFR 1508.8).

These terms describe the criteria in comparison to potential effects of the alternatives. The analyses for each impact area describes other resource-specific characteristics used for analyzing potential effects. The site permit duration (or lack thereof) limits the duration for most effects, depending on the management alternative in question.

4.1.1 Impact Criteria

The five impact criteria provide guidelines for the analysts to assess the context of a potential effect and serve as tools for comparing the alternatives based on the conclusions drawn from the analysis. Assessment against the impact criteria involves terms and thresholds that are both quantitative and qualitative. We use qualitative thresholds where resource-specific baseline data may be lacking or potential effects are difficult to predict quantitatively (e.g., cultural importance is difficult to measure in quantitative terms).

This programmatic assessment evaluates the impacts of any aquaculture management program within the action area that consists of large expanses of open ocean where there may not be environmental baseline data collection. Therefore, the analyses presented herein derive from readily available scientific literature, and reports and data that may or may not cover the entire action area. The body of research supporting the environmental effects of offshore aquaculture is currently minimal. Thus, the effects considered below derive from current knowledge of offshore aquaculture, as well as similar types of aquaculture with much more established bodies of research (e.g., cage and netpen culture in nearshore waters). To the extent practicable, analysts have identified instances where a lack of information may have implications for the conclusions about alternatives evaluated. The impacts would inevitably vary between facilities, depending on various siting parameters and the nature of the operations themselves and would be addressed in greater detail in the activity-specific NEPA assessments. Future data collection, if required by the chosen preferred alternative, would aim to address critical gaps regarding the affected environment and aid NMFS in future decision-making.

Impact Criterion 1: Effluents and Emissions from Marine Aquaculture Facilities

Key indicator topics
• Changes in physical parameters (turbidity, dissolved oxygen).
• Changes in nutrients (nitrogen, phosphorous).
• Changes in concentration of chlorophyll a.
• Changes in levels of pollutants (e.g., metals, polycyclic aromatic hydrocarbons (PAHs), oils, hydrocarbons, polychlorinated biphenyls (PCBs), antimicrobials, chemicals, etc.).

Brief description of potential effects

Aquaculture facilities could affect water quality both within and beyond the facility footprint. These effects reflect the total amount of a given substance added to the receiving waters over time compared with the normal background levels and carrying capacity of the area, rather than concentrations at the individual sources. These effects could stem from, but are not limited to, fish excretions, excess feed, release of veterinary drugs used to treat fish, or release of chemicals used during normal site operation and maintenance.

Impact Criterion 2: Habitat and Ecosystem Function

Key indicator topics
• Effects on geologic features and physical habitat.
• Effects on benthic habitat and organisms.
• Effects on aquatic vegetation.
• Invasive species.
• Habitat creation or loss.
• Changes in viewsheds and lightscapes.

Brief description of potential effects

Offshore aquaculture could affect geologic features and physical habitat through installation of mooring structures that secure the culture system to the ocean floor. These systems could also affect benthic habitat by nutrient enhancement (e.g., fish excretions or uneaten feed that settles to the bottom) and these effects could also extend to organisms residing in, or anchored to, the benthos.

Observed changes in benthic and aquatic vegetation communities could be characterized as changes in growth rate for the species, or changes in the diversity of species.

The presence of aquaculture structures could disrupt continuous habitats, or could create novel habitat in the pelagic environment. Aquaculture facilities could also act as a FAD, which may affect predator-prey relationships, species diversity and distribution.

Impact Criterion 3: Local Wild Fish Stocks

Key indicator topics
• Competition for resources and habitat.
• Predation.
• Changes in genetics of wild populations.
• Disease interactions between wild and cultured species.
• Feed formulation effects on source fisheries.

Brief description of potential effects

Effects on local wild fish stocks could be due to escapement of the cultured fish, which could interact with local stocks either through predation, by competition for resources and habitat, or by interbreeding with wild populations of the same fish.

Aquaculture operations could contribute to the transmission and amplification of naturally occurring pathogens and parasites. Culturing fish could also introduce pathogens or parasites to an area, though measures to treat and prevent this spread may mitigate the risks.

Using whole fish for feeding cultured fish could contribute to impacts on wild stocks. Using formulated feeds typically reduces the reliance on wild fish stocks for feed. In both cases, analysts should consider the sustainability of the source.

Impact Criterion 4: Other Marine Wildlife and Protected Species

Key indicator topics
• Injury or mortality.
• Changes in behavior.
• Disturbance from human activity or equipment operation.

Brief description of potential effects

Marine wildlife other than local wild fish stocks could include marine mammals, sea turtles, seabirds, sharks and rays.

Aquaculture operations may pose a risk of injury or mortality for wildlife due to entanglement, direct physical impact, entrapment, attraction of predators to the area, collision with passing vessels, or exposure to discharges. Impacts could also include changes in behavior (e.g., attraction to the culture facility) and disturbances from human activity or equipment operation (e.g., noise).

Impact Criterion 5: Socioeconomic Impacts

Key indicator topics
• Effects on current aquaculture industry.
• Changes in market value and revenue.
• Changes in employment.
• Competing uses for ocean area/access.
• Cultural heritage.
• Environmental justice.

Brief description of potential effects

The presence of an aquaculture industry could affect the availability, market value, and revenue for species associated with the operations. This could also affect employment for on-site and support operations. Aquaculture activities and siting must consider other uses for the area and resources, as well as access for those other users, including an understanding of the culturally important areas and activities. Federal agencies are required to conduct their programs, policies, and activities in a manner to ensure individuals or populations are not excluded from participation in, or denied the benefits of these activities. Additionally, Federal agencies shall ensure individuals or populations are not subjected to discrimination based on race, color, national origin, or income level.

4.2 Comparison of Alternatives

This section is a comparative discussion of the impacts of the alternatives. Table 26 is a side-by-side summary of those impacts, followed by a more detailed analysis.

Table 26. Comparison of Direct and Indirect Impacts for All Alternatives Based on Permit Duration. Note: This table describes net effect intensity from negligible to major in the context of adverse or beneficial impacts. The context factor abbreviations are Direct and/or Indirect (D, I), Local to Large Scale (L, LS). The relevant alternative describes duration for each impact.

Description of potential effects and factors affecting their severity	**Alternative 1.** **No Action** **No permits except CRECS permits 1-2 years**	**Alternative 2.** **Limited Aquaculture Management Program** **Permits up to 10 years**	**Alternative 3 (Preferred).** **Expanded Aquaculture Management Program** **Permits up to 20 years**
1. Effluents and Emissions from Marine Aquaculture Facilities			
Subject to EPA permit for water quality and monitoring	Yes	Yes	Yes
Only FDA-approved antibiotics and associated chemicals allowed for use	Yes	Yes	Yes
Restrictions on industry size and concentration in a given area	No	Yes	Yes
Impacts from multiple facilities considered	No	Yes	Yes
Net effects	Minor to moderate adverse	Negligible to minor adverse	Negligible to minor adverse
Description of effects	Adverse (D, I, L, LS): • Possible increase in greenhouse gas (GHG) emissions from vessel traffic.	Adverse (D, I, L, LS): • Possible increase in GHG emissions from vessel traffic.	Adverse (D, I, L, LS): • Possible increase in GHG emissions from vessel traffic.

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
	• Unrestricted industry size and concentration could lead to larger impacts to water quality. Beneficial (D, L, LS): • Water quality monitoring requirements and chemical use limitations reduce water quality impacts. • Short permit duration limits the time needed to return to baseline conditions.	• Medium permit duration limits the time needed to return to baseline conditions. Beneficial (D, I, L, LS): • Water quality monitoring requirements and chemical use limitations reduce water quality impacts. • Area-based management further reduces direct and indirect impacts.	• Longer permit duration extends the time needed to return to baseline conditions. Beneficial (D, I, L, LS): • Same as Alt. 2.
2. Habitat and Ecosystem Function			
Subject to permitting through USACE	Yes	Yes	Yes
Consideration for permanent vs. reversible habitat creation from moorings	No	Yes	Yes
Consideration for potential impacts on EFH and HAPC required for operations raising ECS and MUS	Yes	Yes	Yes
Consideration for potential impacts on EFH and HAPC required for operations raising any species native to the PIR	No	Yes	Yes

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
Consideration for potential impacts on non-EFH and HAPC habitats required	No	Yes	Yes
Consideration for potential impacts from gear failure required	No	Yes	Yes
Net effects	Moderate to major adverse	Moderate adverse to minor beneficial	Negligible to moderate adverse
Description of effects	Adverse (D, I, L, LS): • Unrestricted industry size and concentration could lead to larger impacts. • Gear failure could be catastrophic without required mitigation and prevention plans. • Mooring impacts are permanent without required decommissioning plan. • Species-dependent consideration for EFH and HAPC. • Habitat creation is not considered. • Impacts on lightscapes may or may not be considered.	Adverse (D, I, L, LS): • Medium permit duration limits the time needed to return to baseline conditions. • Required prevention plans prevent gear failure. If it occurs, required mitigation plans ensure it is less likely to be catastrophic.	Adverse (D, I, L, LS): • Longer permit duration extends the time needed to return to baseline conditions. • Required prevention plans prevent gear failure. If it occurs, required mitigation plans ensure it is less likely to be catastrophic.

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
	Beneficial (D, L, LS): • Permitting through USACE and EPA limits potential impacts. • Unlikely to impact viewsheds. • Short permit duration limits the time needed to return to baseline conditions.	Beneficial (D, I, L, LS): • Permitting through NMFS, USACE and EPA further limits potential impacts. • Unlikely to impact viewsheds. • Short permit duration limits the time needed to return to baseline conditions. • Area-based management further reduces impacts. • Mooring impacts could be reversible with required decommissioning plan. • Universal consideration for EFH and HAPC. • Habitat creation is considered. • Impacts on lightscapes are considered.	Beneficial (D, I, L, LS): • Same as Alt. 2.
3. Local Wild Fish Stocks			
Potential genetic, predation or competitive impacts considered solely on a case-by-case basis	Yes	No	No
Impacts of pathogen and parasite transfer may be considered solely on a case-by-case basis	Yes	No	No
Comprehensive siting analysis considers genetic, predation,	No	Yes	Yes

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
competition, and disease transfer impacts			
Impacts on source fisheries for feed could be considered	No	Yes	Yes
Net effects	Moderate to major adverse	Moderate Adverse to minor beneficial	Moderate Adverse to minor beneficial
Description of effects	Adverse (D, I, LS): • Unrestricted industry size and concentration could lead to larger impacts. • Impacts on broodstock source fisheries not considered. • Pathogen transfer and escape impacts not considered for non-CRECS. • Non-native and GE species could be cultured and possibly escape. Beneficial(D-I, L): • Pathogen transfer and escape impacts only considered for CRECS.	Adverse (D, I, L): • Pathogen transfer and escapes could happen, but management measures would reduce the impact. Beneficial (D-I, L-LS): • Pathogen transfer and escape impacts considered for every operation. • Non-native and genetically engineered species are not cultured.	Adverse (D, I, L): • Same as Alt. 2. Beneficial (D-I, L-LS): • Same as Alt. 2.

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
		• Area-based management further reduces impacts.	
4. Other Marine Wildlife and Protected Species			
Potential impacts on protected species considered for operations raising CRECS and MUS	Yes	Yes	Yes
Potential impacts on protected species considered solely on a case-by-case basis for operations raising non-CRECS and MUS	Yes	No	No
Consideration for potential impacts on protected species required for operations raising non-CRECS and MUS	No	Yes	Yes
Restrictions on industry size and concentration in a given area	No	Yes	Yes
Impacts from multiple facilities considered	No	Yes	Yes
Net effects	Moderate to major adverse	Negligible to minor adverse	Negligible to minor adverse
Description of effects	Adverse (D, I, L): • Unrestricted industry size and concentration could lead to larger impacts.	Adverse (D, I, L): • FAD effect could result in more frequent wildlife encounters.	Adverse (D, I, L): • Same as Alt. 2.

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
	• FAD effect could result in more frequent wildlife encounters. Beneficial (D, L): • Predation, noise impacts unlikely for sea turtles, sea birds, sharks and rays. • MMPA protections reduce risk for noise impacts on marine mammals. • Aquaculture operations are subject to listing on the MMPA List of Fisheries for risks to marine mammals.	Beneficial (D, L): • Rigid line use reduces entanglement risk. • Predation, noise impacts unlikely for sea turtles, sea birds, sharks and rays. • MMPA protections reduce risk for noise impacts on marine mammals. • Aquaculture operations are subject to listing on the MMPA List of Fisheries for risks to marine mammals. • BMPs, mitigation measures, and area-based management further reduces impacts.	Beneficial (D, L): • Same as Alt. 2.
5. Socioeconomic Impacts			
Permitting structure is designed for offshore aquaculture	No	Yes	Yes
Permit transferability allows an economic benefit to permit holders	Yes	Yes	Yes

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
Permit duration allows for development of a viable commercial operation	No	Yes	Yes
Permitting structure reduces financial burden of remaining in compliance	No	Yes	Yes
Net effects	Moderate adverse	Minor adverse to minor beneficial	Minor beneficial
Description of effects	Adverse (D, I, L, LS): • Possible competition with wild seafood sector. • Disjointed permitting structure is costly and hinders operation development. • Shorter permit duration is challenging and costly for long term operation. Beneficial (D, I, L, LS): • Transferable permit can be an economic benefit to the permit holder. • Possible supplement to wild seafood sector. • Ocean access is not restricted exclusively to the permit holder.	Adverse (D, I, L, LS): • Possible competition with wild seafood sector. • Culturing non-CRECS would require a permit. Beneficial (D, I, L, LS): • Transferable permit can be an economic benefit to the permit holder. • Possible supplement to wild seafood sector. • Ocean access is not restricted exclusively to the permit holder.	Adverse (D, I, L, LS): • Same as Alt. 2. Beneficial (D, I, L, LS): • Same as Alt. 2.

Description of potential effects and factors affecting their severity	Alternative 1. No Action No permits except CRECS permits 1-2 years	Alternative 2. Limited Aquaculture Management Program Permits up to 10 years	Alternative 3 (Preferred). Expanded Aquaculture Management Program Permits up to 20 years
	• NHPA considered for siting operations raising CRECS. • Unlikely to affect subsistence fishing.	• NHPA considered for siting operations. • Unlikely to affect subsistence fishing. • Comprehensive siting analysis can prevent impacts on significant cultural, historic, or archaeological resources. • Comprehensive siting analysis can reduce costs for operator. • Streamlined permitting and medium permit duration can attract greater investment for operations.	

4.3 Analysis of the Alternatives

The following analysis lays out potential effects of each alternative described in Chapter 2. The duration of these effects is dependent upon the current or proposed permitting structure as outlined below:

Alternative 1:

- All non-CRECS: No permit required, so unlimited duration.
- CRECS: 1-2 years.

Alternative 2:

- Up to 10 years.

Preferred Alternative 3:

- Commercial permits: up to 20 years.
- Research and innovation permits: up to 3 years.

Given the offshore conditions being considered, and the variation of potential scale of an individual facility or industry, the difference in impacts between a 10-year versus a 20-year aquaculture permit based solely on the permit length is not likely to be significant, especially given opportunity for permit renewal under both Alternatives 2 and 3. There may be notable temporal differences and this section outlines specific instances where relevant.

4.3.1 Effluents and Emissions from Marine Aquaculture Facilities

Water quality in the EEZ in the PIR is predominantly uniform in the upper mixed layer (approximately 0-650 ft [200 m] depth). Turbidity, and the concentration of nutrients, dissolved organic matter, and most pollutants in the open ocean are very low, typical of tropical oligotrophic waters. The principle sources of pollution in the marine environment are land-based, including excessive nutrients, heavy metals, persistent organic pollutants (e.g., pesticides, PCBs). While these are present, they generally occur in very low concentrations in the open ocean (Holmer 2011). In contrast, plastic pollution is prevalent in the action area (Ericksen et al. 2013).

The principle concern for aquaculture's effects on water quality is nutrients from feed inputs and the associated waste products. The analysis assumes that prospective permittees would desire to site their facility where water quality factors - including temperature, dissolved oxygen, and water chemistry - are optimal for the species intended. This analysis also assumes that deep water sites have currents adequate to dilute the effects of excess nutrients or pollutants, which would minimize potential impacts.

Changes in physical parameters (turbidity, dissolved oxygen)

Turbidity is generally not a concern for offshore facilities of any size, given the low turbidity in the open ocean (Price and Morris 2013, Gentry et al. 2017). NMFS does not expect turbidity to be a concern for offshore facilities in the PIR given the characteristics of an oligotrophic pelagic environment. There is also evidence from long term monitoring at offshore facilities in both Hawaii and Puerto Rico that there is no difference in turbidity between facility and control sampling sites (Alston et al. 2005, PlanB Consultancy 2015, Seafood Watch Consulting Researchers 2020).

Similarly, open ocean cage culture will likely have a negligible effect on the dissolved oxygen levels in the surrounding environment, for both large and small facilities, based on carrying capacity models and long-term measurements at active facility sites (Braaten 2007; Helsley 2007, Benetti 2007, Gentry et al. 2017, Seafood Watch Consulting Researchers 2020). Low dissolved oxygen levels within the facility footprint, however, could affect the health and growth rates of cultured fish but has been an issue exclusively in facilities sited in nearshore shallow habitat (< 80 ft [25 m]). Mitigation measures include oxygen bubblers, mechanical aeration, and submerging the cage structures to access better-oxygenated waters (Price and Morris 2013).

Changes in Nutrients (nitrogen, phosphorous)

Excess feed and fish wastes are the primary drivers for nutrient enrichment due to aquaculture operations. Effective feed management could mitigate excess feed and managing the stocking density of fish in the aquaculture system could mitigate impacts from fish wastes. Based on a long-term dataset from the only commercial offshore finfish culture facility in Hawaii state waters, the facility’s activities did not impact nitrogen and phosphorus levels in the surrounding waters (Seafood Watch Consulting Researchers 2020).

Feed is often the largest variable cost of aquaculture operations and aquaculture managers strive to minimize waste (i.e., uneaten food falling through the cages). Recent advances in both feed formulation and feeding practices have minimized food waste, while concurrently reducing the nitrogen load in the surrounding environment (Rust et al. 2014; Stickney 2002; Braaten 2007; Marine Aquaculture Task Force 2007; Belle and Nash 2008; Olsen et al. 2008).

Changes in Concentration of Chlorophyll a

Nutrient enrichment could increase growth of plants and algae in a given area, typically quantified with chlorophyll a concentrations as it is the most common photosynthetic pigment in green plants and algae. Increases in chlorophyll a concentrations in receiving waters could indicate a shift towards eutrophication. The most relevant symptom of eutrophication, harmful algal blooms (HAB), have been triggered by eutrophication in nearshore waters, causing the accumulation of toxins in fish and shellfish and potentially altering food-web dynamics (Kapetsky and Aguilar-Manjarrez 2007). However, excess nutrients localize to the area immediately surrounding and underneath the cage, and there is no measurable effect beyond 30 m from a cage in well-flushed waters (Helsley 2000, 2003, 2007; Benetti et al. 2007; Price and Morris 2013). As with other water quality parameters, a long term dataset from Blue Ocean Mariculture indicates that the facility’s presence and activity have had no impact on chlorophyll a levels in the surrounding offshore environment (Seafood Watch Consulting Researchers 2020).

HAB are rare to absent in offshore waters of the PIR (Holmer 2011). However, in other regions, HAB have been historically present, and are becoming increasingly frequent with climate change. While aquaculture's contribution to HAB triggering factors is debatable, HAB typically result from a myriad of factors relating to nutrient enhancement and aquaculture could play a role, even while suffering large losses from HAB (Diaz et al. 2019, Quiñones et al. 2019). Due to the very rare occurrence and surrounding oligotrophic waters of the PIR, as well as the rapid dilution of excess nutrients, aquaculture systems are unlikely to cause algal blooms within the action area (Helsley 2007).

Changes in Levels of Pollutants

Aquaculture facilities pose a potential risk of introducing chemicals and greenhouse gases to the environment. Potential chemical introductions could be through drug administration or leaching from embedded protective paint or other coatings on operation equipment, and greenhouse gas emissions could come from vessel traffic associated with the operation (Gipperth 2009). While there are potential impacts related to chemical leaching or therapeutant inputs, improvements in maintenance and husbandry over the past 20 years has shown a marked decrease in the use of these products and a subsequent reduction in environmental concern (Rust et al. 2014; Price and Morris 2013, Harper 2011). This decrease in use of coating chemicals is primarily due to cost and marginal effectiveness, which has led to substantial research on non-chemical strategies, including air drying (Braaten 2007; Holmer et al. 2008), acetic acid immersion (Forrest et al. 2007), high pressure water sprayers (Belle and Nash 2008), and non-toxic biofilms (Bazes et al. 2006) that have shown promising results.

The FDA issues the approval of disinfectants, antibiotics, and vaccines in aquaculture (NMFS and USFWS 2008). The FDA website maintains the current list of approvals.[51] The current U.S. aquaculture industry uses relatively little antimicrobials in comparison to other domestic farmed industries. However, there are international examples of concentrated and frequent antimicrobial use leading to resistance in the environment (Love et al. 2020). Thus, minimizing the use of antimicrobials (e.g., utilizing vaccines and controlling the antimicrobials approved for use) is paramount to reducing the discharge, which would either dissolve into the water column or settle into the sediment (Rigos and Troisi 2005). Studies of the effects of antibiotics in the environment near aquaculture cages occasionally observe antibiotic resistant bacteria but it could be difficult to align specifically with on-site practices, alone, given that most waterways are multi-use and receive outfall from land-based facilities (Chiasson et al. 2018; Lafaille et al. 2018; Tamminen et al. 2010).

Offshore aquaculture operations will likely rely on support vessels that transport personnel, supplies, equipment, feed and fish between the operation and a port or land-based facility. These vessels are likely to be similar to, if not the same, vessels operated by current fishing fleets in the PIR and would use fossil fuels that emit greenhouse gases.

[51] https://www.fda.gov/animal-veterinary/aquaculture/approved-aquaculture-drugs

Summary of Effluents from Marine Aquaculture Facilities

Impacts applicable to all alternatives:

Water quality impacts from concentrated aquatic animal production are a regulated point source of pollution under 40 CFR 122.24. Moreover, projects under all alternatives would be subject to the EPA National Pollutant Discharge Elimination System (NPDES) permit program, which sets water quality standards and monitoring requirements for aquaculture grow-out facilities.

In addition to the required NPDES permit, all alternatives could only use FDA-approved antibiotics and associated chemicals. None of the alternatives has specific regulations for antifouling chemicals.

Potential changes in greenhouse gas emissions for a new or expanded aquaculture industry in relation to current emissions from vessel traffic in the PIR will depend on the distance to port, the number of trips required for farm operations, and the size of the support vessels. Some members of PIR fishing communities may participate in aquaculture support operations, either in addition to or in the place of their normal fishery participation. This could lead to increased traffic and greenhouse gas emissions (in the case of the former) or no difference in traffic and greenhouse gas emissions (in the case of the latter). Considerations for greenhouse gas emissions would be explored during any siting analysis.

Alternative 1:

Under Alternative 1, regulations do not restrict the number of facilities, regardless of whether the species falls within the CRECS. Without regulatory limitation on the number of facilities in an area, existing regulations require minimal consideration of the direct and indirect impacts. The net effects of Alternative 1 are likely minor to moderate adverse.

Alternatives 2 and 3:

Under Alternatives 2 and 3, the number of facilities would be restricted based on comprehensive siting analyses, thus preventing operation beyond the carrying capacity of a given area. These siting analyses would likely include the potential impacts from multiple facilities in a given area.

Under Alternatives 2 and 3, the limited entry system would likely limit the potential effluent impacts.

Under Alternative 2, the permit duration (10 years) could reduce long term impacts or offer a quicker return to baseline conditions if the permit is not renewed. The net effects of Alternative 2 are likely negligible to minor adverse.

Under Preferred Alternative 3, the permit duration (20 years) would increase the length of time needed for the area to return to baseline conditions if the permit is not renewed. The net effects of Preferred Alternative 3 are likely negligible to minor adverse.

4.3.2 Habitat and Ecosystem Function

Effects on Geologic Features and Physical Habitat;

As described in Chapter 3, geologic features in the action area primarily consist of undifferentiated deep ocean floor, with a relatively small percentage of banks, slopes, guyots, and seamounts, and a few known hydrothermal vents to the southeast of Guam. Some coralline structures may also be associated with some of the shallow banks, slopes and seamounts.

Habitat damage (i.e., breaking, scraping or crushing) associated with installation of anchors or the swing of the mooring line during operations is one type of potential impact to geologic features. The extent of the impact would depend on the number of moorings and the specific type of substrate to which it is permanently fixed. For instance, a single-point mooring swings in a radius around an anchor, which could potentially scour the seafloor within the mooring's footprint. This activity could flatten an area that previously contained elevated, breakable habitat (e.g., relic reef, rock pinnacles). Multiple-point moorings sway back and forth and have much less slack that could make contact with the seafloor, thus reducing the potential impacts to elevated benthic structures. Facilities located in soft sediment or sandy substrate would have little to no effect on physical benthos (Helsley 2000). Additionally, the number of moorings would depend on the number aquaculture facilities in a given area.

For facilities that may be decommissioned, moorings or anchors would likely remain intact on the seafloor when the facility cuts anchor lines while leaving the mooring/anchor in place permanently. Thus, while the effects of the lines would be temporary, the moorings/anchors could be considered a permanent effect.

A moored structure does have the potential to detach from the lines, where it could drift into shallow waters and damage coral reef habitat. The impact could be as significant as a ship grounding, or worse, if the structure continued to roll over the reef instead of embedding in a single location. While unlikely, this impact could be significant depending on the location, type of habitat, and potential size of the damaged area.

Effects on Benthic Habitat and Organisms

On an individual facility basis, habitat function as a result of single or multiple moorings would not likely change given the relatively small footprint on the ocean bottom, and would therefore be considered a minor effect. When multiple facilities are located in the same area, this could impact the broader benthic habitat.

Mooring placement and effects could impact bottomfishing grounds. Areas known to be high quality bottomfishing grounds are generally areas with benthic relief that allows refuge for these and other species. These areas tend to occur on slopes that would be poor choices for anchoring an aquaculture facility, thus this program is unlikely to impact these benthic habitats under all alternatives.

Additionally, aquaculture activities could impact areas designated as EFH and HAPC and critical habitat for protected species.

In addition to designated HAPCs, other areas may be sensitive to effects from facility anchors or moorings. Such effects could include scraping, scouring, entanglement or abrasion. For example, siting a facility within or near known locations of precious coral beds or at Penguin Bank within the Hawaiian Islands would substantially increase potential for permanent damage. While less studied, the offshore banks of the Marianas Archipelago may include benthic relief important to harboring higher levels of biomass and biological diversity than other areas. Considering these and other factors during permit review is the best means to determine whether alternate siting is appropriate to avoid impacts to important geological features.

The seafloor in deep waters has low biomass and low biodiversity, with most organisms slow growing and relatively long-lived (Glover and Smith 2003). While concern for and research into benthic community impacts from aquaculture has been a long-standing concern globally, the majority of information has resulted from studies in enclosed bays and facilities sited in waters less than 25 m, as reviewed in Price and Morris (2013). Most studies indicate that sedimentation of particulate organic material generated by an aquaculture facility would likely only affect benthic organisms at facilities sited in coastal waters shallower than 200 m (Price and Morris 2013). Although a high production facility sited in an area with minimal currents could impact deeper habitats, limited research on offshore aquaculture in several European aquaculture sites from the Mediterranean to the North Sea indicates that the impact would likely be negligible (Borja et al. 2009, Moraitis et al. 2013).

Though indirect effects (e.g., eutrophication, sedimentation and effects on the food web) are difficult to ascertain, studies have attributed measurable effects to aquaculture at an ecosystem level, with one study observing lower benthic infaunal biodiversity 500 m from the facility (Hargrave 2003). Observations of indirect effect appear to be more prevalent where currents are stronger, indicating a trade-off between lower impacts in the near-field and weaker indirect impacts due to dilution of waste and feed. Both deep- and shallow-water organisms could be affected by anchors and mooring lines.

Effects on Aquatic Vegetation

The action area primarily consists of deep ocean floor (> 650 ft [200 m]), with fewer areas shallower than 650 ft; thus there are very few places in the action area where the subsurface is shallow enough for benthic plants to grow. While benthic aquatic plants could occur within the shallow areas, any light penetration below 650 ft is too weak to drive plant growth. Facilities sited in waters shallow enough for plants to grow would be the only facilities that impact benthic aquatic plants. For these potential sites, effects on aquatic plants could include the shadow made by the facility structures, reduced light from localized turbidity, sedimentation of particulate organic matter, and physical disturbance of an anchor or anchor chain. In the case of finfish aquaculture, nutrient enrichment could be a potential effect for aquatic vegetation, but this would not be a likely potential effect from unfed (e.g., shellfish or seaweed) aquaculture (Clavelle et al.

2019). Aquatic vegetation, with the exception of invasive algae,[52] is typically considered EFH, particularly for bottomfish species in the PIR.

Habitat Creation or Loss

Aquaculture facilities could create habitat through mooring installation or the presence of the culture structures themselves. Anchors may create habitat by providing relief in areas where it may be lacking, thereby providing a hard surface that may attract benthic organisms (see Kogan et al. 2007). This same logic follows for the culture system structures, which would also present new hard surfaces that could attract certain organisms. When siting multiple facilities in a given area, more anchors and moorings would increase the possibility for habitat creation.

Offshore grow-out facilities act as FAD - structures floating at or near the surface, creating habitat in the pelagic environment and attracting a variety of organisms (FAO 2005, Callier et al. 2018). Aquaculture cages and net pens act in the same manner (Alston et al. 2005; Sanchez-Jerez et al. 2011) and cages that allow some level of biofouling tend to have larger and more diverse assemblages compared to cages that employ anti-fouling compounds (Nelson 2003). FAD-associated fish are likely to remain in the area for an extended period. Even with the presence of a predator, these fish congregate into a tight area underneath the FAD to avoid predation (Nelson 2003).

The impacts of aquaculture cages functioning as FAD are variable and would depend on the location, structure and culture species (Clavelle et al. 2019). Regardless, aquaculture sites would increase species diversity, as well as attract larger fish and predators (Dempster et al. 2005; Rensel and Forster 2007; McKinnon et al. 2008; Alston et al. 2005; Oakes and Pondella 2009, Callier et al. 2018). FAD and aquaculture facilities attract predators, such as tuna, sharks, and marine mammals, as prey species aggregate around these areas (Daghorn et al. 2007; Helsley 2007; Sanchez-Jerez et al. 2011; Papastamatiou et al. 2010). These larger fish and other predators are often primary targets for activities like fishing and recreational diving.

Fishing mortality of wild target species stocks may increase near the facilities since fishermen would likely target FAD and aquaculture facilities (Daghorn et al. 2007, Sanchez-Jerez et al. 2011; Marsac et al. 2000), although Price and Morris (2013) found no negative correlation between aquaculture activity and fishery landings.

While the action alternatives would prohibit culturing species that are not native to the region of the facility location, it is possible that the FAD nature of the structures could create habitat for other types of species that may arrive at the facility. These species may arrive naturally due to currents and/or wind or via vessel traffic that is either related or unrelated to the facility. Overall, there is a relatively minor potential for an aquaculture facility to become a vector that could introduce an invasive species in comparison to the existing potential from all other ship traffic throughout the PIR (Godwin et al., 2004). Due to the substantial mixing and large-scale movement of waters within the open ocean, the potential for invasive species to become

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[52] see https://www.invasivespeciesinfo.gov/executive-order-13112-section-2-federal-agency-duties

established in the pelagic habitat is generally considered low; however, based on studies of marine debris transiting the Pacific Ocean, it is possible for invasive coastal species to survive the journey (Carlton et al. 2017). If an invasive species transits a facility, whether it be from boat traffic, marine debris, or other avenues, it is possible, though unlikely, that the facility could allow an environment for the species to grow.

Changes in Viewsheds and Lightscapes

Offshore aquaculture may have varying visual impacts on the seascape. Visual impacts could be a contentious issue, with higher sensitivity in areas of high tourism and desirable locations compared to rural and remote areas. Currently, objective methods to assess visual impacts are not available (Falconer et al. 2013), however, distance and height play an important role. From a high viewpoint, the contrast of the ocean makes surface cages and net pens more obvious. Cage systems sited far enough offshore may hide the structure from view in the vastness of the ocean (Grant 2006). Low-level viewpoints would most likely have a hard time seeing structures far out and would be absorbed into the horizon (Grant 2006). Additionally, submersible cages would likely reduce impacts to viewsheds. In Hawaii, cage placement near Keahole point was determined to have no effect on the seascape of the area (Blue Ocean Mariculture 2014).

The USCG (14 U.S.C. 83 et seq.) requires that aquaculture structures located in navigable waters must be marked with lights and signals. Surface lights and beacons on aquaculture facilities may attract nocturnal birds to the facilities, subjecting them to potential injury or death due to collision or entanglement with the structure, including exposed wiring and cables (GMFMC and NOAA, 2009). Surface work lights are often down-shielded to prevent light pollution. Most beacon lights are red or green, which are visible for 12 nm (22 km). Without shielding, a strong white light is visible for 18 nm (33 km) (Cicin-Sain et al. 2000).

The State of Hawaii permit for the Blue Ocean Mariculture facility one mile offshore of the Kona coast of Hawaii Island explicitly prohibits artificial lighting if the light directly illuminates or the glow extends beyond the lease property boundaries toward the shoreline and ocean waters. The permit requires that all exterior lighting be down-shielded to protect the night sky (DLNR 2014). The Kampachi Velella Project description noted that lighting of the Velella Delta array is similar to a single fishing boat and concluded that the facility should have no perceptible impact on the viewshed or seascape. Lights used during night work would be down-shielded and would not likely result in light pollution on land (Blue Ocean Mariculture 2014).

Summary of Habitat and Ecosystem Functioning

Impacts common to all alternatives:

All alternatives allow moorings and these would be subject to USACE permitting.

Under all alternatives, water quality monitoring would be required under an EPA NPDES water quality permit, which would provide data on factors that could affect aquatic vegetation (e.g., turbidity, sedimentation, etc.).

Given that the action area does not include coastal waters (i.e., <3 nm from shore), this action is unlikely to impact viewsheds in the PIR. A project-specific EA or EIS could consider potential impacts on lightscapes where applicable.

Alternative 1:

Under Alternative 1, current regulations do not restrict the number of facilities. Without limitation, there would be minimal consideration of the direct and indirect impacts.

The potential effects of habitat creation from anchors or moorings is considered permanent for Alternative 1 particularly since it is assumed that they would be left in place permanently.

A project-specific EA or EIS could address the potential impacts of gear failure, but the regulations do not currently require an emergency action plan that incorporates gear failure. Without catastrophic mitigation plans, the potential impacts to the geophysical features and physical habitat could range from moderate to significant.

For non-CRECS, no NMFS permit would be required and, thus, EFH and HAPC would not be considered unless required by other agency permits for the operation. The impacts for this would depend upon the chosen location and cultured species. The permitting process for CRECS would consider the potential impacts to EFH and HAPC.

Permit applications would not require consideration for sensitive habitats that do not have EFH and HAPC designations. The effects of this would range from minor to major.

This alternative does not require consideration for habitat creation due to the presence of the culture system structures.

A project EA or EIS could consider the potential impact on lightscapes; however, this would not be required for non-CRECS. The net effects of Alternative 1 are likely moderate to major adverse.

Alternatives 2 and 3:

Alternatives 2 and 3 require a decommissioning plan. This would determine whether moorings are permanent structures or whether the operation must remove them. Thus, under these alternatives the potential effects of habitat creation from anchors or moorings is either permanent or reversible, depending upon the types of moorings used, the ease of removal, and the cost of removal.

The number of facilities would be restricted based on comprehensive siting analyses, thus preventing operation beyond the carrying capacity of a given area. These siting analyses would likely include the potential impacts from multiple facilities in a given area, potential for habitat creation or loss, impacts on lightscapes, as well as impacts to sensitive habitats beyond EFH and HAPC. This would reduce the potential impacts on near and far-field habitats, as it would be more inclusive.

Both alternatives would require systems that have demonstrated effectiveness, redundancies and regular inspections to prevent gear failure along with an emergency action plan that addresses the response to and mitigation for gear failure. Safeguards in place would likely prevent a catastrophic failure, resulting in impacts range from minor to moderate in the event of a gear failure.

Under Alternative 2 and 3, the limited entry system would likely limit the potential habitat impacts.

Under Alternative 2, the permit duration (10 years) could reduce long term impacts or offer a quicker return to baseline conditions if the permit is not renewed. The net effects of Alternative 2 are likely moderate adverse to minor beneficial.

Under Preferred Alternative 3, the permit duration (20 years) would increase the length of time needed for the area to return to baseline conditions if the permit is not renewed. The net effects of Preferred Alternative 3 are likely moderate adverse to neutral.

4.3.3 Local Wild Fish Stocks

The development of marine aquaculture has raised concerns regarding the possible genetic and ecological impact of escaped fish on wild, native populations. Aquaculture escapes could lead to interbreeding between cultured species and wild populations, or predation by or competition with cultured species.

Both intentional and accidental releases may have multiple effects on the environment over time. For example, several studies have investigated the effects of taape (blueline snapper *Lutjanus kasmira*) on Hawaii's native fish. Taape are an introduced species, with first introductions in the 1950s for sport fishing. Over the course of 40 years, its range expanded from the MHI to the NWHI. It shows little aggression toward native Hawaiian snappers and goatfish, does not share the same depth or feeding habitats with most native snappers or goatfish, and is not an aggressive predator of other native fishes. These studies concluded that the competition-related concerns for this species appears to have been unfounded (Parrish et al. 2000, Schumacher 2011). Conversely, the accidental introduction of gorilla ogo (*Gracilaria salicornia*) through aquaculture in Waikiki and Kaneohe Bay in 1974 has imparted a significant negative effect on the coral reef environment around Oahu, Molokai and Hawaii Island (Ongley, 2006).

While global accidental escapes (i.e., trickle losses) from net pens have decreased substantially over the past 20 years (Rust et al. 2014), these types of escapes do occur, even in waters of the PIR (Seafood Watch Consulting Researchers 2020). Catastrophic escapes (i.e., entire pens or cages) could release large amounts of fish into the surrounding environment and most of these have occurred in salmon aquaculture in other regions of the world. In particular, over 4 million fish escaped during an 8-year period in Norway, though there have also been domestic catastrophic failures as well (Glover et al. 2017). Recapture rates of escaped fish could vary wildly depending on the species and the culture location (Seafood Watch Consulting Researchers 2020, Niklitschek et al. 2017). While there are many examples of escapes (Atalah and Sanchez-Jerez 2020, Glover et al. 2017, Niklitschek et al. 2017) and successful recapture in nearshore environments, recapture could be more difficult in an offshore environment.

Changes in Genetics of Wild Populations, Competition

None of the action alternatives would permit the culture of non-native species, thereby eliminating the risk of introducing non-native species to the environment. Minor benefits to wild stocks include the availability of a new source of food, including algal growth on cages or pellets falling through the cage, and shelter and foraging habitat for fish in a pelagic ecosystem primarily devoid of both (Vita et al. 2004; Helsley 2007; Sudirman et al. 2009, Price and Morris 2013).

With relatively few exceptions, marine fish presently used for aquaculture in the U.S. are genetically and phenotypically similar to their wild conspecifics (i.e., the same species), having been collected directly from wild populations as eggs or juveniles, or derived from wild broodstock, which are spawned in captivity (Gulf of Mexico Fishery Management Council 2009, Seafood Watch Consulting Researchers, 2020). However, even escapes of hatchery-reared native fish could pose threats to the local wild stock (Besnier 2011; Holmer 2010; Waples et al. 2012). The longer a broodstock line is developed (i.e., bred to improve growth, quality, and disease resistance, etc.) the greater the chance that their genes would begin to drift from their wild counterparts.

Within the PIR, fish used for new aquaculture ventures come from broodstock collected from the wild, so their offspring would pose no immediate threat to the genetic integrity of the wild populations. While maintaining the wild genetic structure of cultured fish in the PIR could safeguard against escapes, the possibility of genetic separation would likely remain as the industry matures within the PIR.

In other regions, escaped cultured stocks are generally less fit to live in the wild, with 50 percent annual mortality rate, and no fish surviving past three years (Blanchfield et al. 2009). Escapes from facilities in Hawaii have generally shown similar behavior, as escapees stay near the cages for several days and facilities report a recapture rate of approximately 40% (Seafood Watch Consulting Researchers 2020).

Research into genetically engineered organisms for use in aquaculture is a growing field that aims to develop fish that exhibit enhanced growth efficiency, environmental tolerance, disease and parasite resistance, thus saving resources, time, and money (Upton and Cowan, 2014, Cleveland 2019). While the FDA has approved one strain of genetically engineered salmon for production,[53] this species is not suited for culture in the waters of the PIR.

Disease Interactions between Wild and Cultured Fish

As water moves freely between cultured fish in cages/pens and the pelagic environment, the potential for transfer of diseases and parasites between wild and cultured populations exists. Both wild and cultured fish risk exposure to pathogens naturally occurring in the ocean. While wild stocks are often carriers of these pathogens, disease occurs only when the pathogen overcomes

[53] https://aquabounty.com/our-salmon/

the host's immune system. Cultured fish may encounter pathogens at the hatchery or in a grow-out facility where pathogens naturally occur in the surrounding waters. Disease or parasite transmission is more likely to occur when wild conspecifics (members of the same species) frequent the aquaculture facility, and further when they frequently transit between facilities (Uglem et al. 2014, Holmer 2010). The risk of pathogen transmission to wild populations is higher in areas where cultured fish outnumber the wild population (Jensen et al. 2010). In addition, seals and other pinnipeds may carry nematodes and lice, which could pose some risk for transferring parasites between adjacent facilities (Roycroft et al. 2004).

While natural pathogen levels are generally not a concern for wild stocks, cultured species live at higher densities in confined cages, where diseases and parasites could rapidly transfer throughout the population, causing mass mortality. This is a significant economic concern for aquaculture facilities, but also has the potential to increase the prevalence of pathogens in the surrounding habitat, possibly affecting wild stocks (Frazer 2009, Marty et al. 2010). There is evidence in nearshore salmon net pen aquaculture that active cage sites can serve as reservoirs for pathogens (Frazer 2009, Groner et al. 2016, Shea et al. 2020). In addition, infected escaped fish may become a disease vector to a wild population if the two populations come in contact (Krkosek et al. 2006).

Evidence from wild-cultured interactions in other regions indicates that disease and parasite transfer does occur and in the case of sea lice, the on-site presence of the parasite could amplify this transfer (Naylor et al. 2005; Tully et al. 1999; Bjorn et al. 2001; Bjorn and Finstad 2002, Marty et al. 2010). In Hawaii, one aquaculture operation recorded amplified levels of *Neobenedinia*, an ectoparasite commonly found on *Seriola* species, only on cultured fish, while the predominant ectoparasite on wild conspecifics is *Caligus* spp. (Seafood Watch Consulting Researchers 2020). Thus, while the presence of an ectoparasite is high on cultured *Seriola*, the same species is not observed in high quantities in the wild conspecifics that frequent the cages.

Feed Formulation Effects on Source Fisheries

Fish ingredients used in feeds for aquaculture are important to consider in this analysis, as the capture of wild fish to feed cultured fish could impact the environment of the PIR. Typically, feeds offered to cultured fish are commercially formulated; however, in some instances (e.g., when attempting to raise a new species in aquaculture) whole, wild fish could be used as feed.

Formulated aquafeeds depend on inclusion of fish meal and oil to provide the protein and nutrients necessary for proper growth of cultured carnivorous fish. Global averages for fish meal and fish oil inclusion in aquafeeds vary depending on the species being raised, but could range up to 55% for some of the more commonly raised carnivorous species (Tacon and Metian 2008). Advances in feed formulations for the predominant species cultured globally have reduced these inclusion rates. There is also a large interest in seeking alternative sources for these ingredients.[54]

The primary fish species used for feed in the U.S. are the Gulf and Atlantic menhaden, followed by Atlantic herrings and Californian pilchards. The PIR is not conducive to supporting large

[54] See the F3-Future of Fish Feed Collaborative: https://f3fin.org/about/

schools of small planktivorous pelagic fish suitable for fish meal and many similar regional fish are too valuable for use as fish meal. There are several studies to develop alternative feeds as well as utilize fish trimmings from local fisheries as a constituent of locally produced aquaculture feed in Hawaii (Johnson 2017).

During scoping, the public raised a concern that feeds that included genetically modified organisms (GMO) could in turn affect fish and the environment. Sanden et al. (2004) investigated the inclusion of genetically modified (GM) soy in salmon feeds and found that no DNA from the GM soy existed in the fish's tissues or muscles. Suharman et al. (2015) also found that GM soybean DNA used in Nile Tilapia (*Oreochromis niloticus*) feed was not present in fish tissues or muscles. These studies provide evidence that GM feed does not inhibit the ability of the fish to grow and remain healthy, and the organism does not incorporate the GM DNA into its own body. Other studies showed similar results with hens and pigs fed diets of GM soybean and GM corn (Ma et al., 2013, Sieradzki et al., 2013).

Summary of Local Wild Fish Stocks

Impacts applicable to all alternatives:

All alternatives allow the culture of native species, which is likely to require capture of broodstock from local stocks. This genetic similarity between wild and cultured stocks could be beneficial in protecting against negative genetic impacts from escapes. However, as the industry grows, there is a higher likelihood of further genetic separation between cultured fish and wild stocks.

The likelihood pathogen and parasite transfer between wild and cultured stock increases in areas where there are wild conspecifics.

As the aquaculture industry grows within the PIR, it would be imperative to consider the impacts of PIR-sourced fisheries for fish feed. Currently, aquaculture feeds do not typically use fishery products from the PIR. As the industry grows there may be an incentive to utilize species within the PIR rather than from other regions. Regardless, we expect minimal impacts to PIR species if the use of alternative feed products and fishery byproducts is encouraged.

Alternative 1:

For non-CRECS, there is currently no limitation on the species cultured in offshore facilities and NMFS does not have a regulatory mechanism to address this. Thus, this alternative has the potential for introducing non-native species, as well as genetically engineered species as a culture species. The permits under Alternative 1 consider the genetic and competitive impacts of potential escapes as well as the risks of pathogens and parasites on a case-by-case basis rather than within the context of a comprehensive program. The net effects of Alternative 1 are likely moderate to major adverse.

Alternatives 2 and 3:

Under Alternatives 2 and 3, the number of facilities would be restricted based on comprehensive siting analyses, thus preventing operation beyond the carrying capacity of a given area. These siting analyses would include the potential impacts from multiple facilities in a given area with regard to disease transfer and would require escape prevention and mitigation plans and measures as well as reporting. The limited entry system for both alternatives could reduce the risk for impacts of pathogen or parasite transfer between wild and cultured fish.

In both alternatives, allowable species would be restricted to native species, which would prevent the risk of introducing potentially invasive non-native species.

Both alternatives prohibit the possession or use of genetically engineered species, thereby reducing the potential risks associated with culturing these species.

The application process for a permit under both alternatives would consider impacts to source fisheries, including pathogen and parasite transfer.

Under both alternatives, operations could use a research and development permit to test new diets that are less dependent upon wild fisheries. The net effects of Alternatives 2 and 3 are likely moderate adverse the minor beneficial.

4.3.4 Other Marine Wildlife and Protected Species

Aquaculture operations may pose a risk of injury or mortality due to entanglement, direct physical impact, entrapment, attraction of predators to the area, collision with vessels, or exposure to facility discharges. Impacts could also include changes in behavior (e.g., attraction to the culture facility) and disturbances from human activity or equipment operation (e.g., noise). It may be difficult to find locations for aquaculture that do not overlap with protected species (Baird et al. 2013 as cited in NOAA 2017).

As noted in Chapter 3, relevant protected species in the PIR include corals, invertebrates, sea turtles, marine mammals, seabirds and elasmobranchs (sharks and rays).

Corals and invertebrates

The *Acropora globiceps* coral is the only ESA-listed coral found at locations greater than 3 nm from shore. Given the infrequency of encounters with the species within the action area, it is unlikely that aquaculture facilities would directly impact its survival. The final ESA listing for this species identifies vulnerabilities as follows: High vulnerability to ocean warming; moderate vulnerabilities to disease, ocean acidification, trophic effects of fishing, nutrients, and predation; and low vulnerabilities to sedimentation, sea-level rise, and collection and trade (79 FR 53851).

The chambered nautilus is not commonly encountered in the action area and would likely be unaffected by the presence of aquaculture facilities. The most significant threat to the chambered nautilus is overutilization through commercial harvest to meet the demand for the international nautilus shell trade (Miller 2017).

Sea Turtles

The ESA lists all sea turtles in U.S. waters as threatened or endangered. In the action area, green turtles and hawksbill turtles are the two species most vulnerable to anthropogenic impacts during all life stages from eggs to adults. Leatherback turtles, loggerhead and olive ridley sea turtles are all uncommon or rare throughout PIR (WPRFMP 2009b, 2009c, and 2009d).

Because these animals are protected, potential impacts to sea turtles are an environmental concern associated with marine cage aquaculture (Bridger and Neal 2004, Huntington et al. 2006, IUCN 2007, Borg et al. 2011, summarized in Price et al. 2017). Yet, relatively little is known about how sea turtles may be impacted by such facilities (Price et al. 2017), especially in the offshore marine environment. The primary concern with respect to these animals and marine cage culture tends to be the threat of entanglement with nets, lines or other floating equipment (Price et al. 2017).

Sea turtles are especially vulnerable to anthropogenic impacts related to exploitation of eggs and shells for human use, as well as loss of nesting habitat (NMFS and USFWS 1998d). Any aquaculture management program would not contribute to this level and type of exploitation for any of the alternatives.

Marine Mammals

The impacts of marine aquaculture on marine mammals has been a large field of study; however, much of this research focuses on nearshore facilities, rather than offshore facilities proposed in this PEIS (Clement 2013; Huntington et al. 2006; Kemper et al. 2003; Lloyd 2003; Price and Morris 2015; Price et al. 2017; Wursig and Gailey 2002).

Marine aquaculture operations may displace or modify how marine mammals use important habitats (Markowitz et al. 2004; Cañadas and Hammond 2008) or cause other disruptions to their behavior (Early 2001). Habitat exclusion could range from low to high risk depending upon the location and density of aquaculture facilities. The nature of the exclusion depends on the type of aquaculture facility, the cultured species, and the particular marine mammal species in the area.

Of all ESA-listed marine mammals occurring in the PIR, two are likely to interact with any aquaculture program: the MHI IFKW and Hawaiian monk seals. Each of these species occurs in potential siting areas for aquaculture.

Seabirds

The primary threats to seabirds throughout the PIR include the destruction of coastal breeding habitat by development at limited nesting sites, a limited breeding distribution of many species, plastics ingestion and contaminants, mortality due to predation by introduced species such as rats and mongoose throughout the region including the MHI, and incidental capture in commercial fisheries. To date, there are no directed studies indicating that offshore aquaculture activities have contributed to these threats, nor are there any known adverse bird-related interactions with the facilities currently permitted in Hawaii.

ESA-listed seabirds that are likely to interact with offshore facilities include the short-tailed albatross, the Newell's shearwater, and the Laysan albatross. Short-tailed albatross are rare in the action area, while the at-sea distribution of the Newell's shearwater is restricted to the waters surrounding the Hawaii Archipelago, with preference given to the area east and south of the MHI. Laysan albatross breed and nest in the Papahanaumokuakea Marine National Monument. None of the proposed alternatives allow aquaculture siting in Papahanaumokuakea Marine National Monument. Although the at-sea distribution of ESA-listed seabirds could overlap with the potential aquaculture project sites, it is highly unlikely that aquaculture would adversely impact these species, given the rarity of the species in the action area.

The Laysan albatross colony located in the NWHI on Midway Atoll is the largest colony of seabirds in Hawaii. During non-breeding months (July - October), Laysan albatross usually stay at least 20 to 30 kilometers offshore. The greatest threats to this population have included entanglement in commercial longline fisheries, predation by introduced (non-native animals), habitat loss, and contamination (Arata et al. 2009).

Sharks and Rays

Two of the protected elasmobranchs in the PIR may use habitat that would likely overlap with aquaculture sites: the oceanic whitetip shark and the giant manta ray.

The largest threat to sharks is entanglement or injury while trying to get to the fish inside the cage. One aquaculture facility has documented several interactions in Hawaii with blacktip sharks accessing the pens (Blue Ocean Mariculture 2017). Large scale fish releases and predation could occur if sharks are able to tear the netting (Holmer 2010).

Section 7 Consultations

In the PIR, there have been five consultations pursuant to Section 7 of the ESA regarding offshore aquaculture; all off the coast of Hawaii Island. Table 27 summarizes these consultations and outcomes.

Table 27. ESA Section 7 Consultations for Aquaculture Projects in the EEZ in the PIR.

Record ID	Working Title	Description
PIRO-2019-03142	Special Coral Reef Ecosystem Fishing Permit (SCREFP) renewal	NMFS determined that issuing a SCREFP to Forever Oceans, LLC to stock, culture and harvest kampachi in Federal waters using a net pen is not likely to adversely affect relevant protected species and associated critical habitat. This determination is a renewal of the same determination in 2015 (PIR-2015-9747) for the system that was under different ownership at that time. (Kampachi Farms).

Record ID	Working Title	Description
		Consultation completed in 2020.
PIRO-2019-00603	Kampachi Farms Blue Fields Macroalgae Aquaculture Research Project, Kona, Hawaii	NMFS provided a letter of concurrence to the USACE for a proposed feasibility study of offshore macroalgae aquaculture that the effects of the proposed action are likely insignificant for ESA listed species. Consultation completed in 2019.
PIRO-2018-00437	ACOE Blue Ocean Mariculture Operation and Installation of New Net Pens	NMFS is conducting a formal consultation for a proposed USACE permit for the continued operation and installation of new net pens at the Blue Ocean Mariculture facility in state waters. Consultation not yet been completed.
PIR-2015-9747	Kampachi Farms SCREFP	NMFS determined that issuing a SCREFP to Kampachi Farms to stock, culture, and harvest kampachi in Federal waters using a net pen is not likely to adversely affect relevant protected species and associated critical habitat Consultation completed in 2015.
PIR-2013-9191	Keahole Point Fish, LLC	NMFS provided a letter of concurrence to the USACE for proposal of an additional net pen and a stand-off mooring at the existing mariculture lease area off Keahole Point, Kona, Hawaii. Both agencies agree that the effects of the proposed action are not likely to adversely affect ESA-listed marine species or proposed critical habitat. Consultation completed in 2013.
PIR-2013-9310	Kampachi Farms, LLC	NMFS determined that issuing a SCREFP to Kampachi Farms, LLC for a limited-duration, small-scale open ocean aquaculture project may affect, but is not likely to adversely affect, endangered or threatened species or proposed Hawaiian monk seal critical habitat. Consultation completed in 2013.

Record ID	Working Title	Description
PIR-2011-02499	Kona Blue Water Farms	NMFS determined that issuing a SCREFP to Kona Blue Water Farms for a limited-duration, small-scale open ocean aquaculture project (Velella Concept) may affect, but is not likely to adversely affect, endangered or threatened species or proposed Hawaiian monk seal critical habitat. Consultation completed in 2011.
PIR-2009-02013	Kona Blue Water Farms, LLC	NMFS provided a letter of concurrence for the Kona Blue Water Farms, LLC project to modify open water aquaculture net pens and monitor efficiencies and effectiveness of Unualoha Point, Kona, Hawaii. NMFS determined that this was not likely to adversely affect ESA-listed marine species or proposed critical habitat. Consultation completed in 2009.

Injury or Mortality

Risk of injury or mortality of a protected species could be due to entanglement, direct physical impact, entrapment, attraction of predators to the area, collision with vessels, or exposure to facility discharges. A broad description of these impacts is below, with details relevant to each species group in the respective section.

Entanglement with loose lines or netting could lead to injury, reduced forage efficiency, interference with reproduction, or death. Potential injuries and their severity would depend on the complexity and duration of the entanglement. Injuries may include cuts, bruises, broken bones, slow amputation, or drowning if the entanglement prevents the protected species from swimming or accessing the surface. Any of these injuries could result in the animal's death.

Offshore aquaculture would deploy and recover objects, including anchors, net pens, small nets used for harvesting, or cage enclosures. It is possible that moving objects during these operations could physically strike or injure a protected species. A direct physical impact from a moving object could lead to adverse effects such as injury or death. Potential injuries and their severity would depend on the mass and velocity of the object, the strike mode and location on the animal, and the body part affected. Injuries may include cuts, bruises, broken bones, cracked or crushed carapaces, and amputations, any of which could result in the animal's death. An anchor or a ballast rock could also accidentally pin an animal, which could result in drowning.

Aquaculture facilities in the PIR will most likely be net pens that are fully enclosed and routinely positioned in a submerged state. It is possible that a protected species could be stressed, injured or may drown if it becomes trapped in a submerged net pen and is not able to surface for air.

However, cage installation procedures typically require that no partially assembled or disassembled cage be left unattended in a submerged state. Procedures could also require that top netting be removed first during net pen removal. These procedures would ensure that any animal entering a cage during the installation or removal period would always have direct access to the surface and the potential for entrapment in a net pen is extremely unlikely to occur.

Activities at aquaculture pens may attract predators, such as fish escapes, food drifting outside the pens, and other animals aggregating around the pens (i.e., FAD effect). An increase in the presence of predators of protected species could lead to adverse effects such as injury or death. Potential injuries and their severity would depend on the aggressiveness of the predator, the duration of the attack, and the body part impacted. Injuries may include cuts, bruises, broken bones, and cracked or crushed carapaces, any of which could result in the animal's death. The primary mechanism for predator attraction is fish escapes resulting from break or tear in the cage netting. However, the low frequency of net failures and fish escapes, and limiting the amount of pelleted food exiting the net pen, we expect the number of predators attracted to the net pen to be low.

Vessel collisions could cause injury or death. The severity depends on the speed and size of the vessel, the part of the vessel that strikes the animal, and the body part impacted. However, even in high density areas around Hawaii, collisions between protected species and vessels are relatively rare events.

Local and Federal regulations prohibit the intentional discharge of toxic wastes and plastics into the marine environment. The potential for fuel or oil leakages from the mariculture support vessels that transit to or are stationed at a facility, is extremely unlikely. An oil or fuel leak would likely pose a risk to the vessel and its crew and actions to correct a leak should occur immediately to the extent possible. While discharges and spills could occur, they would likely be infrequent, small, and quickly cleaned. Therefore, the effects of such spills are likely low to negligible. Furthermore, highly mobile animals can move away from the potential effects of such spills. Mariculture pollutants are primarily from effluent discharge comprised of nitrogen, phosphorous and carbon produced by the production biomass and any uneaten feed falling to the benthos and are not likely to impact sea turtles. Facilities would be required to monitor and adhere to discharge permits, thus we expect this stressor would have discountable effects on protected species.

Corals and invertebrates

Installing mooring lines for aquaculture facilities, and wastes, discharges or decreased water quality could impact the *Acropora globiceps* coral. However, since this species is found only in shallow water, it is unlikely that offshore facilities, constructed in deep water.

The chambered nautilus could risk injury if colliding with an aquaculture facility; however, given the infrequent encounters of the species within the action area, this is unlikely. The FAD effect of aquaculture facilities may attract the chambered nautilus; however, this would depend on the facility’s location within the water column.

Sea Turtles

Vertical lines in the water column could entangle sea turtles (NMFS 2015b, NMFS 2020c). Generally, fixed fishery gear poses one of the greatest risks to sea turtles due to entanglement in anchoring and buoy lines (NMFS and USFWS 1998a, 1998b, 1998c; NRC 2000; NMFS 2015b). However, these data are in reference to fisheries with lines that are highly flexible, lightweight, often float and could easily wrap around turtle flippers. These lines are used in gillnets, coastal fyke nets, and coastal traps. This is generally not the typical situation for aquaculture operations which would likely include fixed structures moored to the sea floor with thick metal cables or high tensile strength line, typically under high tension (Clement 2013, Price and Beck-Stimpert 2014; Price and Morris 2013). They may, however, pose a risk of collisions resulting in lacerations, scrapes and bruising injuries (Winn et al. 2008; Baldwin et al. 2012).

Larger facilities or a greater number of facilities could increase this risk under any of the alternatives. However, there is a low likelihood of mortality or serious injury resulting from collision with the facilities, laceration or bruising given the spatial extent of these facilities relative to the large open-ocean environment such that turtles could avoid them if necessary.

Due to the infrequent use of the action area by sea turtles and the low frequency of large object movements, we expect the potential for exposure to direct physical impacts with facility equipment to be highly unlikely and impacts from this interaction would be discountable.

Mortality due to fishery bycatch also occurs throughout the Central West Pacific. Particularly bycatch mortality of green turtles from longline, pole and line, and purse seine fisheries continue as threats to sea turtles in areas of the PIR. The FAD effect may increase commercial and non-commercial fishing around aquaculture facilities, which brings an increased potential for turtle bycatch if they are close to aquaculture cages or pens where other fishing is occurring.

Vessel strikes are unlikely, based on information from estimates around the MHI. NMFS conservatively estimated 37.5 sea turtle vessel strikes and mortalities per year from an estimated 577,872 vessel trips per year in Hawaii. This includes fishing and non- fishing vessels (NMFS 2008). This calculates to a 0.006% probability of a vessel strike with sea turtles for all vessels and trips, and many of these vessels are not likely reducing speeds or employing lookouts for listed species. Thus, NMFS expects this stressor would have discountable effects on sea turtles.

Marine Mammals

Much of the research on potential entanglement interactions has focused on pens located in productive, relatively shallow areas where they might overlap with a known feeding or summering aggregation of marine mammals, including large whales. These facilities often consist of multiple pens in an array, held together by loosely hung lines.

These nearshore facilities have little resemblance to the realities of aquaculture in the deeper, offshore waters of the PIR, as net pen arrays with loose lines are unlikely to be viable in an offshore environment. Echolocating marine mammals (toothed whales, dolphins and porpoises) appear to effectively perceive mussel and fish aquaculture facilities and, in most cases, navigate through or around them (Lloyd 2003, Markowitz et al. 2004), with numerous instances of dolphins feeding on schools of fish and swimming among anchor and spat lines with no documented entanglements (Heinrich 2006, Ribeiro et al. 2007). Nonetheless, baleen whales generally present a higher risk of entanglement than toothed whales, dolphins and porpoises because they rely on visual and audio cues, rather than echolocation (Lloyd 2003). Though rare, there are baleen whale entanglements in aquaculture gear, but only in nearshore waters among net pen arrays.[55] Research, documentation and analysis is currently underway by NMFS and others in the aquaculture industry to evaluate these attractions and potential interactions.

A direct physical impact from a moving object (e.g., movement of an operational support vessel) could lead to adverse effects such as injury or death. Due to the infrequent use of the action area by marine mammals and the low frequency of large object movements, we expect the potential for this interaction to be highly unlikely and exposure to this stressor would be discountable.

Kemper et al. (2003) evaluated negative interactions of marine mammals with aquaculture in the southern hemisphere and found that most known interactions occur at finfish facilities and involve pinnipeds. However, these results were from studies generally focused on coastal, shallow water pens where pinnipeds were abundant and in many cases had easy access to the aquaculture facilities. Off the coast of Canada, pinnipeds sometimes used salmon aquaculture structures as haulouts (Jamieson and Olesiuk 2002). Again, this was nearshore, near pinniped aggregations, and consisted of multiple pens. In Hawaii, there is only one pinniped species, the monk seal, and there is evidence that this species is attracted to aquaculture facilities in Hawaii.

On March 5, 2017, Blue Ocean Mariculture notified NMFS that they found a deceased Hawaiian monk seal in an empty, recently retired, net pen on the site. The monk seal entered the submerged net pen through a 1,600-sf opening in the netting created by Blue Ocean’s crew the previous day, but did not exit the pen through the same opening when it required air. A unique chain of circumstances apparently caused the monk seal's death. Specifically, the operation had recently completed harvesting from the net pen and planned to remove the net pen. The on-site crew decided to remove a large panel of netting rather than execute the normal safe release protocol for removing an unwanted animal in the net pen, and the monk seal was apparently unable to locate the 1,600-sf opening in the net pen when it required air (pers. comm. Lesley Hawn December 16, 2020). After this incident, Blue Ocean Mariculture updated their protocols to ensure they kept empty cages at the surface, in the event that an animal enters the cage during servicing. Proper implementation of these protocols ensures the safety of air-breathing wildlife.

Seabirds

To date, there have been no documented reports of seabird interactions with offshore aquaculture facilities in the PIR. Generally, at coastal marine fish facilities, entanglement in the cage or anti-predator nets poses the biggest threat to seabirds, especially those that may dive to feed on fish or fouling organisms (Belle and Nash 2008; Northridge et al. 2013; Sagar 2013). However, this is due to multiple pens in areas where seabirds are abundant. Seabirds reported to congregate near marine fish aquaculture poses a low risk in terms of a predatory threat, though they may

[55] https://vancouversun.com/news/local-news/dead-humpback-whale-found-entangled-in-empty-aquaculture-lines

scavenge dead fish or pick off fish during transfer or harvest (Pearson & Black 2001; Nash et al. 2005; Huntington et al. 2006).

Notably, these reports are from coastal aquaculture facilities with multiple pens held at the surface in close proximity to each other. Birds can use these types of facilities as roosting perches as well as potential foraging locations. Potential offshore facilities in the PIR would consist of cages or pens that would be submerged or partially submerged, thereby minimizing perching or roosting opportunities for seabirds. Diving birds may still be at some risk of collision or entanglement with cages or mooring lines. However, cages or pens would consist of hard or rigid materials, including rigid anchor cables or lines, which would significantly reduce risk of entanglement (Price and Morris 2013). Fewer cages would also mean reduced potential for entanglement. Most seabird mortalities in aquaculture facilities worldwide have been cormorants, gulls of various species, and coastal diving ducks (NOAA 2017), none of which are present in EEZ in the PIR in great numbers.

Sharks and Rays

There are currently no published reports on shark or ray entanglements in aquaculture gear, possibly because offshore aquaculture operations are usually keep lines and nets under tension. There are limited reports on interactions with survey gear used in the oil and gas industry (NMFS 2020c). There is also limited information on additional interactions other than attraction to the site (Alston et al. 2005; Benetti et al. 2005; Nash et al. 2005; Papastimatiou et al. 2010). If anything, sharks likely pose a larger risk to the integrity of the operation (e.g., damage to equipment and risk of escapes).

Deakos et al. (2011) noted that there have also been at least two mortalities from boat mooring lines reported in Hawaii, but identified entanglement in monofilament fishing line as the greatest threat to giant manta rays. Known manta ray aggregation areas around Hawaii may pose a higher risk for interactions, and the siting analysis and development of BMPs for preventing interactions would consider this.

Changes in Behavior

Aquaculture operations may attract marine wildlife, including protected species through a variety of mechanisms, together classified as the FAD effect. These mechanisms could include fish escapes, excess feed or wastes drifting outside the pens, biofouling organisms present on the structures, and attraction of predators that feed on animals aggregating around the pens (Callier et al. 2018).

Corals and invertebrates

Offshore aquaculture facilities are unlikely to affect changes in behavior for ESA-listed corals or invertebrates.

Sea Turtles

Turtles may be attracted to aquaculture facilities as a potential source of prey, and as a source of refuge for smaller age classes. Growth of invertebrates and algae on submerged net pens may attract adult sea turtles foraging for food. Additionally, aquaculture facilities may "collect" sargassum rafts or interfere with their natural passive movements, which may capture or disrupt migratory movements of post-hatching or pelagic marine turtles associated with the rafts (Moore and Wieting 1999). The larger the facility, the more frequently these conditions may occur. Whether sea turtle movements or behavior would occur at a scale that would affect a local population is difficult to determine due to the numerous variables that could affect sea turtle behavior, including distance from shore, ocean currents, etc.

Marine Mammals

In other regions, studies have identified potential shifts in bottlenose dolphin populations due to the presence of aquaculture facilities in the open ocean (Piroddi et al. 2011, Bonizzoni et al. 2014). There is a potential for similar dynamics to occur in the PIR, and this could potentially extend to other dolphin species in the region (e.g., spinner dolphins and false killer whales). There are areas around the islands where marine mammals concentrate in larger numbers for foraging or resting. Under any alternative, the aquaculture permitting process would consider these areas.

Some mammal species may be attracted to the novel structures or habitat that the facility creates (i.e., increased foraging if the cage or pen acts as a FAD). Certain marine mammals may become normalized to the presence of a facility and, therefore, be unaffected by it. Existing studies cited in Markowitz et al. (2004) demonstrate the potential for protected species exclusion from foraging habitats, but these studies were conducted in nearshore waters where the aquaculture facilities had considerable overlap with marine mammals foraging habitat and distribution.

It is uncertain how or even if the results from nearshore studies pertain to offshore aquaculture activities in deep open ocean locations in the PIR, though there is evidence that Hawaiian monk seals are attracted to aquaculture pens in nearshore waters of the PIR, as outlined in the previous key indicator "Injury or Mortality." Additionally, NOAA Fisheries scientists have observed a very large female monk seal around a net pen array, and believe that the seal is obtaining nourishment from the pens, and that is the source of its unusual weight gain. That seal has been unsuccessful at weaning a pup over the last three years and it is possible that her lack of success is linked to her body condition (NMFS 2022).

Larger aquaculture facilities may overlap with MHI IFKW habitat in deeper waters within five miles of the coast. Placement of multiple facilities in depths greater than 1,000 m in the PIR could overlap with foraging habitats for most marine mammal species in the region. Spinner dolphins and false killer whales all forage in deeper waters, though often still within two miles from shore. Other cetaceans travel between deeper waters and waters <3300 ft (1,000 m) on a near daily basis during some seasons. The occurrence of other marine mammal species in deep waters of the PIR (e.g., baleen whales and sperm whales) is possible but considered highly unlikely.

Satellite tag data suggest that the likelihood of the MHI IFKW being in the vicinity (defined as within 5 km) of submerged net pens at Blue Ocean Mariculture (a nearshore facility in Hawaii) is relatively high (Robin Baird, personal communication, May 15, 2018). Blue Ocean Mariculture has not reported any depredation interactions with MHI IFKW in their 15+ years of operation, the species they raise (*Seriola rivoliana*) is not a known preferred prey item for MHI IFKW (NMFS 2021). The MHI IFKW consumes a variety of large, widely migratory fish species, which may include species raised in offshore aquaculture in the PIR. However, the MHI IFKW tends to be more cautious of unfamiliar items in the ocean waters when compared to other cetacean species. For example, the rough-toothed dolphin (*Steno bredanensis*) has been observed approaching and interacting with marine debris whereas the MHI IFKW tends to observe from a distance, preferring not to approach unknown items or debris (Robin Baird, personal communication, May 15, 2018).

Seabirds

Previous studies have found that birds are often present near finfish and invertebrate aquaculture areas, especially cormorants and gulls, and diving ducks such as eiders. Generally, placing a new structure such as an aquaculture pen in the open ocean is likely to attract local species, at least initially, due to curiosity, presence of potential food sources, or places to perch or rest. Seabirds may adapt to the new structure in the water and could benefit from using the facility for feeding on fish and epifauna around or on the cage.

Seabirds are more likely attracted to aquaculture facilities rather than displaced considering the facilities provide a potential source of prey. Larger cages or multiple cages at a facility could attract seabirds if facilities resulted in higher aggregations of prey. Fledgling seabirds may also be affected by additional lighting, if the facility uses additional lighting at night.

Sharks and Rays

Sharks are attracted to aquaculture facilities in the Pacific Northwest (Nash et al. 2005), Puerto Rico (Alston et al. 2005), the Bahamas (Benetti et al. 2005), Hawaii (Papastimatiou et al. 2011), the Southwest Indian Ocean (Loiseau et al. 2016), Latin America (Rojas & Wadsworth 2007) and Australia (Department of Sustainability, Environment, Water, Population and Communities 2013). In Hawaii, two offshore aquaculture facilities regularly observe tiger (*Galeocerdo cuvier*) and sandbar (*Carcharhinus plumbeus*) sharks around their operations. In these observations, tiger sharks pass the cages infrequently, but these cages may serve as “landmarks” for the sharks as they move throughout the islands (Papastimatiou et al. 2011).

Technological improvements in shark-resistant aquaculture cage material decreases the predation risk that sharks pose to aquaculture and may deter them from damaging facility equipment. Shark guards are small ridged mesh nets installed at the bottom of a fish cage to prevent sharks from damaging nets while attempting to feed on dead fish that have fallen to the bottom (Jamieson and Olesiuk 2002). Proper cage maintenance and promptly removing sick and dead fish can help avoid these impacts. The complete extent to which sharks are attracted to facilities to feed on wild fish and the resulting potential behavioral or ecological effects is unknown. Giant manta rays feed on plankton and are not likely attracted to offshore cages.

Disturbance from human activity or equipment operation

Aquaculture operations would often require divers, swimmers, vessels, and associated mechanical equipment to operate inside and around the net pens. Aquaculture operations may expose protected species to sounds, vibrations or sudden movements caused by human activity or equipment when installing new net cages and ongoing operations in the action area.

Anthropogenic noise is a pollutant (Radford et al. 2014). Sound travels much faster and further underwater than in air, with speed and distance dependent on temperature and pressure (NMFS 2016g). Boats may generate noise when traveling to and from the site; other potential noise sources include automatic feeders, motors, or generators on associated barges. Small daily tender boats with 25 to 40 horsepower outboard motors produce a mid-range frequency around 1 to 5 Hz, peaking at speeds of 20 kts (10 meters per second [m/s]. Generators could produce sharp tonal peaks, but tend to emit noise in the mid-frequency range (Hildebrand 2009).

Regular underwater noise from aquaculture facilities may repel or attract marine mammals. Whales and dolphins tend to be repelled, while pinnipeds may be attracted (Price et al. 2016). Noise from an aquaculture facility may add stress to those species that are repelled, or lead to entanglement or entrapment for those attracted (Price et al. 2016). Increased noise in the ocean environment may affect intra-species communication and tracking prey through echolocation (Hildebrand 2009; Radford et al. 2014).

Anthropogenic noise may also affect fishes and their relationship with each other and their environment (Radford et al. 2014). Slabbenkoorn et al. (2010) found that underwater anthropogenic noise affects communication, distribution, predator-prey interactions, and fitness. Most fishes are able to detect sounds from below 50 Hz to at least 500-1500 Hz (Radford et al. 2014). Several studies on boat traffic effects on fish show a reduced effective range of communication between individuals (Radford et al. 2014). Constant low to mid frequency boat noise may also displace fish, impair hearing, and increased stress response (Codarin et al. 2009).

Offshore placement of facilities limits cumulative noise effects. The Kampachi Velella Project stated that noise generated from the feed barge is equivalent to a single fishing boat for one hour. The associated EA concluded that their operation would impart an imperceptible impact due to noise (SCREFP No. WP-CRSP-03). Further, the Blue Ocean Mariculture EA concluded that the facility would have no effect on ambient noise levels (Blue Ocean Mariculture 2014).

Sea turtles, marine mammals, seabirds, sharks, and rays may have varied reactions to human activity or equipment operation, including calm curious investigation, avoidance, or startled and flight. It is possible that a panicked flight reaction could lead to stress or injury, but this is unlikely to reduce the animals' fitness or prevent them from foraging or resting activities in any meaningful way. Minor behavioral responses to sound are the most common kind of response and are highly variable and context-specific (see Southall et al. 2007 for a discussion). Based on existing research and literature, there is no reason to believe that noise associated with an aquaculture facility would generate enough noise with such frequency or of such duration that it would result in an auditory shift of hearing (referred to as temporary threshold shift or permanent threshold shift) to any marine mammal. The intensity of the noise levels produced must consider the hearing thresholds or vocalization range of the species involved. Operational noises such as winches or vessel engines often operate in mid-level ranges audible to dolphins and seals but not to baleen whales.

Minor behavioral responses to sound are the most common kind of response and are highly variable and context-specific (Southall et al. 2007). Inability to detect an overt response does not necessarily mean there is no subtle, albeit minor, behavioral (or other) effect. Furthermore, previous experience can have powerful effects on the processing and interpretation of sounds.

Human activity at an aquaculture site would likely be within the confined area of the net pen. Considering the distance from shore, most facilities would not have daily activities and would likely rely on remote monitoring for regular activities, such as feeding. The majority of human activity in the water would be for observation and inspection dives. Normal operations are unlikely to create hammering, drilling or loud noises. Operators may use hand tools and lift bags and these create little to no noise. While feeding operations may require heavier equipment, it is unlikely to add much to the ambient noise in the environment.

Summary of Other Marine Wildlife and Protected Species

Impacts applicable to all alternatives:

While entanglement is a common concern for fisheries with regard to protected species, offshore aquaculture facilities are more likely to use lines that are more rigid and easier to navigate around. This would reduce the chance for entanglement of ESA-listed species under all alternatives.

The FAD effect may lead to more frequent encounters with protected species, which could increase the likelihood of injury from structures or equipment associated with the facility. However, collisions between protected species and vessels are relatively rare events throughout the PIR and this is likely to be a minor effect.

Any future amendment to an FEP that may follow from the PEIS would comply with all of the ESA Section 7 requirements. *Sea turtles*

It is unlikely that offshore marine aquaculture operations would displace sea turtles or modify how they use important habitats given the spatial extent of facilities relative to the larger open ocean of the PIR. With the exception of potentially attracting sea turtles to net pens or cages as described above, sea turtle behavior would not likely be disrupted in a manner that would result in population-level changes.

Increased predation on sea turtles is unlikely, as most sea turtle predation occurs on land or in the nearshore environment. Predation under any alternative is negligible for sea turtles since any aquaculture would be sited in offshore locations.

Disturbance to turtles because of increased noise levels associated with the any aquaculture management program is unlikely for any of the alternatives considering the level of noise expected from these facilities as well as the specific hearing sensitivity of sea turtles.

Marine Mammals

It is unlikely that noise levels associated with aquaculture activities would increase to a level that would exceed thresholds sufficient to cause biologically significant behavioral changes of marine mammals in the action area. Underwater noise associated with routine day-to-day operations of vessels around aquaculture facilities would not introduce "new" sounds to the marine environment considering vessel traffic is common throughout the PIR. The potential implications of increased noise on marine mammal behavior would be a function of the intensity of the noise and the duration of exposure, which, based on experience both in Hawaii and elsewhere, are likely to occur at low levels and only occasionally. If operations use acoustic deterrents to prevent interactions with marine mammals, they would comply with the MMPA.

Aquaculture in the Pacific Islands Region is a commercial fishery. Under the MMPA, NMFS classifies commercial fisheries annually on the List of Fisheries (LOF) based on whether the fishery has frequent (Category I), occasional (Category II), or remote likelihood (Category III) of incidental mortality and serious injury of marine mammals. NMFS requires all fisheries, regardless of Category, to report every incidental death or injury of a marine mammal that results from commercial fishing operations (50 CFR 229.6). As a commercial fishery, aquaculture operations are currently subject to this requirement.

Anyone participating in a Category I or II commercial fishery is required to obtain a NMFS marine mammal authorization certificate to lawfully take incidentally non-ESA listed marine mammals (50 CFR 229.4; https://www.fisheries.noaa.gov/national/marine-mammal-protection/list-fisheries-summary-tables). The LOF classifies Hawaii offshore pen culture (aquaculture) as a Category III fishery and, as such, does not require a marine mammal authorization certificate (www.fisheries.noaa.gov/national/marine-mammal-protection/hawaii-offshore-pen-culture-fishery-mmpa-list-fisheries). If a new aquaculture operation were established that did not fit within the requirements for Category III, NMFS would add that fishery to the appropriate LOF category including the appropriate requirements. NMFS reviews all fishery categorizations annually.

Seabirds

While birds, including ESA-listed species, could use aquaculture facilities for perching or roosting, this is not likely to result in adverse effects on birds. It would be important to develop proper lighting at aquaculture facilities to minimize potential impacts experienced from urbanization such as that documented for Newell's shearwaters.

Prey availability around facilities is a benefit for seabirds but would depend on the facility location, the cultured species, or wild fish that may aggregate around the pen due to the FAD effect. Facilities in the open ocean are unlikely to displace seabirds in each region, and the impacts would be negligible under all alternatives.

Sharks and Rays

Sharks and rays may be attracted to the facilities due to the FAD effect, but are unlikely to experience other direct impacts from farm activities.

Alternative 1:

An EA or EIS for CRECS would consider protected species. For non-CRECS and non-MUS protected species, impacts would be considered on a case-by-case basis.

Under Alternative 1, the number of facilities is not restricted, regardless of whether the species is a CRECS. Without limitation on the number of facilities in an area, there would be a potential for larger impacts on protected species with regards to injury from facility-associated structures or equipment, as well as potential increases in noise impacts. The net effects of Alternative 1 are likely moderate to major adverse.

Alternatives 2 and 3:

Under Alternatives 2 and 3, the number of facilities would be restricted based on comprehensive siting analyses, thus preventing operation beyond the carrying capacity of a given area. These siting analyses would likely include the potential impacts from multiple facilities in a given area, as well as consideration for protected species.

The limited entry system would likely limit the potential impacts from development of an aquaculture industry.

For Alternatives 2 and 3, BMPs and identification of appropriate mitigation measures would be required for any permit application. BMPs would ensure operations use appropriate methods for preventing interactions with protected species. NMFS and the WPFMC would review mitigation measures to ensure they are appropriate for the system design and for the stated purpose of mitigating interactions with protected species. The best available science, including any outcomes and knowledge gained from current and previous aquaculture facilities in the PIR, would inform both BMPs and mitigation measures development. The net effects of Alternatives 2 and 3 are likely minor adverse to neutral.

4.3.5 Socioeconomic Impacts

The types of socioeconomic effects that could result from aquaculture facilities include: change in revenue earned from cultured fish, change in operating or compliance costs, change in revenue earned from wild-caught fish or nearshore aquaculture operations, change in employment, changes in fishing practices, changes in access for competing uses for ocean area, and impacts to cultural heritage.

Effects on Current Aquaculture Industry

Increasing demand for fish and other marine products, as well as growing demand for land and near shore waters for uses other than for food production, combined with technological improvements for aquaculture technology suggest that there is potential for the offshore aquaculture industry to continue to grow (Knapp 2008a; Holmyard 2016; Corbin et al. 2017).

Numerous factors could contribute to uncertainty in forecasting the effects of developing an aquaculture framework, especially given that the U.S. offshore aquaculture industry is in development. Aquaculture and community impact could vary by initial set up requirements, production technology, local economy, harvested product, local aquaculture infrastructure. Many factors could compound this uncertainty could be compounded, including the level of initial up-front investment required and dependence on markets or restaurants to increase interest in specific aquaculture products, among many other factors (Kirkley 2008; Knapp 2008b).

Changes in Market Value and Revenue

U.S. wild caught fisheries generally are not likely to be able to expand production and currently face competition with imported seafood as well as other domestic suppliers of animal products. At the same time, U.S. consumer demand for seafood has been increasing, and the U.S. cannot meet consumer seafood demand through domestic wild-caught fisheries alone.

With regard to competition with aquaculture production, many factors affect the extent to which increased offshore aquaculture production in PIR would affect wild caught fisheries. The effects would depend in part on whether the aquaculture production is a substitute for products supplied by U.S. wild-caught fisheries rather than imports, whether new markets are created for aquaculture products, and the speed and volume with which new production comes to the market (Rubino 2008; Valderrama and Anderson 2008; Knapp 2008a, 2008b; Anderson and Shamshak 2008).

The market competition between wild-caught and cultured products would be variable, and would likely be greatest if producers and fishermen market the same species in the same product form, and at the same time or through the same market channels/outlets (Clavelle et al. 2019, Bjorndal & Guillen, 2016). Globally, mariculture expansion has increased demand for seafood, but impacts at the local level will depend on a variety of factors, including the species raised and its similarity to other species on the market, the technologies involved, the fishery management regime and numerous other interactions outside the market (Clavelle et al. 2019). If offshore aquaculture operations sell their products to dealers who also buy from fishermen, offshore aquaculture products may be in direct competition with fishermen. Consequently, the price received by other fishermen could fall, depending upon the increase in supply caused by offshore aquaculture and assuming no other changes in supply and demand conditions that in turn could reduce fishermen's revenues from sales of those species. Alternatively, aquaculture production could provide new species to the market. This could create a market for wild capture of the same species.

Advantages of aquaculture include the ability to control the quality and consistency of the product and the possibility of producing product year-round. As a result, the potential exists for an aquaculture operation to adversely affect revenues earned by fishermen targeting the same or similar species in wild-caught fisheries. Offshore aquaculture operations could reduce competition with local fishermen by shifting their sales channels to target different consumers. Producers could further reduce competition by selling cultured products during the off season for wild harvests, or developing and marketing product forms that differ from common wild-caught fish products.

Changes in Employment

The impacts of implementing an aquaculture framework could affect wild-caught fisheries, existing near shore aquaculture facilities, and the community through employment, seafood markets, and the aquaculture support industries.

Aquaculture facilities operating closer to and on shore are generally less expensive to set up, operate and maintain when compared with offshore systems. Offshore facilities may need to pay higher wages for workers willing to work in riskier offshore environment and experience higher costs for setting up and operating systems in greater water depth and distance to markets (e.g., higher mooring costs, and higher transportation costs). As a result, offshore aquaculture systems are not likely to displace nearshore and onshore aquaculture facilities and related jobs.

However, nearshore aquaculture systems could still see some effects, especially in the longer term. If costs for offshore aquaculture fall sufficiently, or costs of operating in the nearshore environment increases dramatically, or if offshore cost disadvantages are sufficiently offset by improved water quality of offshore marine environment, offshore systems could become more competitive with nearshore facilities (Knapp 2008a). Offshore aquaculture might also become a more viable option if the availability of nearshore or onshore sites decline, potentially because of various competing uses such as housing, commercial development or nearshore activities and restrictions, so that facilities closer to shore would no longer able to meet demand. If offshore aquaculture systems become more competitive, then nearshore aquaculture facilities may face similar impacts to that of wild-caught fisheries, in terms of lower revenues, especially if the offshore facility produces a large amount of fish comparable to those produced by nearshore facilities and sell their product to the same suppliers.

Employment impacts could vary widely depending upon the species, region, and technology and scale of production. Offshore aquaculture facilities likely have higher mechanization with fewer employees working at the facilities than nearshore aquaculture facilities because of the more difficult working conditions and the higher cost of transporting workers to facilities located offshore (Knapp 2008a). On average, offshore aquaculture jobs are also likely to be higher-skilled when compared with jobs at nearshore facilities. Employees would need to work with specialized equipment and/or possess skills suited to maintain healthy fish production (e.g., fish nutrition or veterinary skills) (Knapp 2008a, 2013). Many of these new offshore aquaculture jobs created in PIR would seek the highest qualified applicants with the desired skill sets, which local residents may or may not have. To ensure that local residents have the opportunity to meet these qualifications, regional workforce training programs could be developed.

Some aspects of offshore aquaculture operations may actually require more labor compared with nearshore facilities. These could include the work of transporting fish, feed, and other inputs, equipment, and people (Knapp 2008a). Commercial fishermen, in particular might be well-suited for work involving transportation and vessel maintenance involved with open-ocean aquaculture, either as a new occupation or one that complements their fishing activities, as they would have detailed knowledge of local oceanic and weather conditions (Rubino 2007; Valderman and Anderson 2008). The number of new jobs created by any new offshore aquaculture facility would likely be even higher when evaluated among all aquaculture-dependent industries, such as aquaculture support industries, processing, markets, restaurants that potentially specialize in a particular aquaculture product, compared with the number of new jobs within the facility itself (Knapp 2008b). Furthermore, the seafood supply chain could benefit from having a predictable, increased supply of products (Rubino 2008) which would help maintain these new jobs.

Competing Uses for Ocean Area/Access

The development of an aquaculture industry could impact current fishing areas. This would apply not only to commercial fishermen, but also to recreational fishermen as well as those fishing for cultural reasons. There is evidence that this issue of space-related conflicts between aquaculture and other fishing activities exists in other locations throughout the world (Steins 1997; WSC 1998). Alternatively, aquaculture facilities could provide a benefit to fishermen who fish within the same general area, as the facilities would attract fish that are often target species for commercial and recreational fisheries (Clavelle 2019).

Cultural Heritage

The ocean has played an important role in native cultures throughout the PIR since it is not only a resource, but also provides physical and spiritual sustenance. Subsistence, and more broadly cultural practices, are recognized and protected throughout the region. Any aquaculture program would occur only in the EEZ outside of nearshore state/territorial waters. Proper planning and following mandates (e.g., NHPA) when establishing an aquaculture management program and when siting aquaculture operations insure they do not affect significant cultural resources, historic properties, or archaeological resources. Aquaculture activities would not likely significantly impact cultural or other uses from the sea as these resources are utilized primarily from more nearshore environments. Activities would not differ from other vessel traffic routinely conducted at harbors and would only minimally increase existing activity levels. Any aquaculture management program is not likely to impact historic, archaeological, or cultural sites where harbor activities exist.

Environmental Justice

Executive Order 12898, “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,” states that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” Federal agencies are required to conduct their programs, policies, and activities in a manner to ensure individuals or populations are not excluded from participation in, or denied the benefits of these activities. Additionally, Federal agencies shall ensure individuals or populations are not subjected to discrimination based on race, color, national origin, or income level.

As discussed throughout this chapter, the overall environmental effects from any of the action alternatives are unlikely to be substantial. In addition, implementing any of the action alternatives would not likely result in disproportionately high and adverse human health or environmental effects on any particular individual, group or population. If aquaculture activities change access to subsistence harvesting areas, this could affect Pacific Islanders, since their diets rely heavily on ocean and aquatic products. This analysis does not include nearshore areas, where most subsistence harvesting takes place. Any siting analysis would consider offshore subsistence harvesting areas. Thus, none of the alternatives considered would result in significant and adverse environmental effects on minority or low-income populations.

Summary of Socioeconomic impacts

Impacts applicable to all alternatives:

Permit transferability is common to all alternatives. A transferable permit would generate a direct economic benefit to owners of the permit because the permit would become a marketable asset for the duration of the permit, which potentially increases the value of the permit to the permit holder relative to one that is non-transferable. It would also allow the current permit holder to sell to another operator in the event that the permit holder could not continue the aquaculture operation for some reason. However, while the ownership of the permit could change, the parameters of the permit (location, allowable species, harvest limit, etc.) of the facility must remain the same. Transfer of a permit to another entity could also reduce the likelihood of a potential lapse in operations by reducing the time and money associated with acquiring a new permit. The transferability of permits, especially when combined with the longer permit duration, provides greater operational flexibility.

In cases where wild fisheries cannot meet market demand for a species of fish, aquaculture production could help meet that demand and would likely result in negligible impact to wild-caught fisheries overall. Still, fishermen targeting wild-caught CRECS could face competition in the market with cultured fish from PIR offshore facilities.

With regard to cultural heritage, activities would not differ from other vessel traffic routinely conducted at harbors and would only minimally increase existing activity levels. Any aquaculture management program is not likely to impact historic, archaeological, or cultural sites where harbor activities are conducted.

None of the alternatives would create an exclusive use zone for aquaculture activities, and in this way are not likely to impact cultural or other uses from the sea. None of the proposed alternatives would affect any existing subsistence fishing patterns.

Alternative 1:

For non-CRECS, applicants would need to work through the review and permitting processes with other Federal, state, or local agencies as appropriate to ensure the proposed activities meet agency stipulations and mandates. Though they would not have any NMFS siting restrictions within the EEZ, their setup and activities are still subject to other agency regulations.

Currently under Alternative 1, applying for and obtaining a special use permit to culture CRECS species under the SCREFP process is both lengthy and costly, as the current status quo reviews SCREFP on a case-by-case basis. Moreover, once issued, the permit is typically only valid for one to two years with renewal options, but overall is not designed for long-term operations and activities.

Under Alternative 1, non-CRECS facilities would not undergo any site evaluation by NMFS. Proposed CRECS operations would undergo a site evaluation by NMFS as part of the SCREFP process.

Alternative 1 does not provide a streamlined approach to ensuring aquaculture activities do not impede activities and access of other ocean users. The net effects of Alternative 1 are likely moderate adverse.

Alternatives 2 and 3:

By comparison, Alternatives 2 and 3, to varying degrees, aim to streamline the process of obtaining a permit to proceed with developing an offshore aquaculture operation. Developing a stable and predictable aquaculture regulatory regime under either Alternatives 2 or 3 would result in greater investment in offshore aquaculture and lower the financial burden of establishing and operating an aquaculture facility. Furthermore, an aquaculture program would establish application requirements, operational requirements, and restrictions for proposed aquaculture operations. The permitting process would likely be faster and simpler for both the applicant and NMFS.

Thus, under Alternatives 2 and 3, the more streamlined process through a coordinated interagency review with NMFS would offset any additional burdens associated with undergoing a NMFS review to obtain a NMFS aquaculture permit for non-CRECS.

Proper location of aquaculture facilities would ensure they do not disproportionately affect significant cultural resources, historic properties, or archaeological resources. Proper siting requirements, as outlined in Chapter 2, would ensure ocean access for affected users and consideration for cultural sites.

Permits under Alternative 2 would be limited to 10 years and might not be of sufficient duration to allow the facility to become operational or allow enough time for the production of a marketable product.

Alternative 2 would be restricted to certain gear types, which could expedite the process. However, this restriction could hamper efforts for innovation. The net effects of Alternative 2 are likely minor adverse to minor beneficial.

Permits under Preferred Alternative 3 would be limited to 20 years, which would provide permitees greater revenue over time and greater stability to aquaculture operations, as well as sufficient time to become fully operational. Furthermore, the flexibility to potentially culture a wider range of native species already listed in FEPs would allow greater marketing and business opportunities, which in turn could increase revenues for the aquaculture sector. If the program offers permits on a first come, first serve basis, this may require additional analysis. As in Alternative 1, all fishermen targeting wild-caught species that are also cultured could face direct competition in the market with cultured fish from PIR offshore facilities. The net effects of Alternative 2 are likely minor beneficial.

5 CUMULATIVE IMPACTS

This chapter discusses the cumulative impacts that would be expected to result in the action area from implementation of the No-Action Alternative (Alternative 1) and each of the action alternatives (Alternatives 2 and 3). Additionally, this section discusses the potential impacts from past, present and reasonably foreseeable future actions (RFFAs) that could affect a given resource.

The timeframe for this analysis is 2010 through approximately 2041. The first Federal permit to test gear for aquaculture activity in the offshore waters of the PIR was in 2011, and allowed Kona Blue Water Farms to culture Almaco jack roughly 6 nm off the Kona Coast of Hawaii. Therefore, this analysis uses the year 2010 as the benchmark prior to which no commercial offshore aquaculture facilities existed in this region. The analysis uses the duration of 20 years to represent the longest permit duration allowed in any of the alternatives (20 years for Preferred Alternative 3).

The analysis discusses potential impacts using the following terms:

- RFFAs - RFFAs are those that are likely to occur and are not purely speculative. Typically, these include existing plans, permit applications, or announcements demonstrating active progress on the action.
- Cumulative Impacts - Means "the impact on the environment which 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 non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

5.1 Incomplete and Unavailable Data

Pursuant to CEQ guidelines, when an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking.

In the event that there is relevant information, but the overall costs of obtaining it are exorbitant or the means to obtain it are not known (40 CFR 1502.22), the regulations instruct including the following:

- A statement that such information is unavailable.
- A statement of the relevance of such information to evaluate reasonably foreseeable significant adverse impacts.
- A summary of existing credible scientific evidence that is relevant to evaluating the reasonably foreseeable adverse impacts.
- The agency's evaluation of adverse impacts based on generally accepted scientific methods.

This programmatic assessment evaluates the impacts of any aquaculture management program. In addition, the action area consists of vast areas of open ocean where data collection on the environmental baseline may not have been undertaken. Therefore, the analyses presented herein reflect readily available scientific literature, and reports and data that may or may not cover the entire action area. To the extent practicable, analysts have identified instances where a lack of information may have implications for the conclusions about alternatives evaluated. Future data collection, if required by the chosen preferred alternative, would aim to address critical gaps regarding the affected environment and aid NMFS in future decision-making.

5.2 Methods for analysis

Relevant past and present actions (Federal and non-Federal) and events are those that have influenced the current condition of a resource, including both human controlled events (such as shipping or commercial fisheries), and natural events, such as predation. RFFAs (Federal and non-Federal human-controlled and natural) are those that:

- Have already been or are in the process of funding, permitting, or described in coastal zone management plans.
- Are included as priorities in government planning documents.
- Are likely to occur or continue based on environmental data, or historical patterns.

Judgments concerning the probability of future impacts must be informed rather than based on speculation.

RFAAs were screened for their relevance to the proposed alternatives, as well as the probability of occurring. Future actions and events were categorized as having a high probability of occurring based on whether they have undergone or are currently being evaluated by state or Federal agencies, or whether permits have been issued authorizing the activity (i.e., undersea cable projects). Other activities and natural events categorized as high probability include those that have occurred for several years previously and are likely to continue occurring such as recreational activities, tourism or tsunamis. Due to the large geographic scope of the action area, the identification of RFFAs was conducted on a broad scale, although some specific RFFAs were considered where applicable. Table 28 provides a list of past, present and RFFAs and natural events considered in the cumulative effects analysis in this PEIS.

The resource-specific cumulative effects analyses presented later in this chapter provide a resource-specific list of past, present and future actions and events that may have or could contribute to cumulative effects for that resource. In addition, Figure 60 through Figure 65 present existing and future activities in and around American Samoa, the MHI, and specific islands in the Mariana Archipelago based on available data for the following information:

- FAD (not associated with aquaculture).
- Boating facilities and common harbors.
- Moorings and anchorage areas.
- Subsea cables.
- Aids to navigation (ATON).

- Dumping areas.
- Restricted areas and military training areas.
- Marine protected areas.

There is no available information for these activities in a format that could be mapped for the other regions within the action area. The activities shown in Figure 53 and Figure 54 are external to the action area for any aquaculture management program and could contribute to cumulative effects on resources evaluated in this chapter. The EFH layer represented in Figure 60 through Figure 64 is specific to bottomfish habitat (330-1,300 ft [100-400 m depth]). Figure 65 shows the areas of marine debris encounters as recorded by NMFS observers between 2007 and 2015 in the PIR region. Figure 4 provides a map of the existing Marine National Monuments within the action area. Chapter 3 provides additional information on Marine National Monuments specific to each region in more detail.

Summary of Relevant Past, Present, and RFFAs in the PIR

Table 28. Past, Present and Reasonably Foreseeable Future Actions and Natural Events within the PIR.

ID	Activity/ Event Type	Action/ Natural Event	Name of Company/ Agency	Time of Initial Activity/ Event	Location	Affected Ocean Area	Additional Description	Current Status
1	Alternative Energy	Big Wind	Molokai Renewables LLC	2011	Molokai, Lanai, AuAu Channel	Hawaii EEZ	In 2011, Molokai Renewables and Pattern Energy made a joint venture for a 200-megawatt wind farm on Molokai and Lanai with undersea cables delivering electricity to Oahu. This became the Big Wind Project. Due to lack of funding and support, the project was discontinued. See article in Pacific Business News for more detail.	Discontinued in 2014
2	Alternative Energy	AWH Oahu Northwest Project AWH Oahu South Project	AW Hawaii Wind LLC	Lease application 2015	12 mi W of Ka'ena Point, Oahu, 17 mi S of Waikiki, near Penguin Banks	Hawaii EEZ	AW Hawaii Wind LLC, a member of the Alpha Wind Energy (AWE) group of companies, has shown interest in developing a 400MW offshore wind energy. The Project would comprise large-scale offshore wind turbines on WindFloat foundations. The project would transmit electricity to the island of Oahu via undersea cables.	In development
3	Alternative Energy	South of Oahu Offshore Wind Project	Progression Hawaii Offshore Wind, Inc.	Lease application 2015	9 mi SSE of Barber’s Point	Hawaii EEZ	The Project would comprise large-scale offshore wind turbines on WindFloat foundations. The project	In development

							would transmit electricity to the island of Oahu via undersea cables.	
4	Alternative Energy	Honolulu Seawater Air Conditioning	Honolulu Seawater Air Conditioning, LLC	Undetermined	From shore to 4 mi South of Honolulu	Hawaii EEZ	Honolulu Seawater Air Conditioning, LLC is developing a 25,000-ton seawater air conditioning district cooling system for commercial and residential properties in downtown Honolulu. This project would pull cold deep seawater through pipes, pass it through a heat exchanger at an onshore cooling station, administer it to buildings, and then return it to the ocean.	EIS Completed early 2017, construction likely completed in 2022
5	Alternative Energy	MCBH Wave Energy Test Site	United States Navy	2015	State waters off Mokapu, Oahu	Hawaii EEZ	Between 2003 and 2011 Ocean Power Technologies (OPT) tested a single 40 kW buoy in 30 m depth water near Kaneohe Marine Corps Base Hawaii (MCBH) on the windward (northeast) coast of the island of Oahu, providing data on the function of environmental power, wave power, and ocean current data.	Ongoing and maintaining of testing site
6	Commercial Fishing	Longline Fishing, Trolling, Handline	Multiple	Ongoing	PIR	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ	Commercial fishing throughout the PIR. Chapter 3, and the annual SAFE reports contain details on commercial fisheries.	Ongoing

						Hawaii EEZ		
7	Non-Commercial Fishing	Subsistence, Cultural, Recreational, Charter, Fishing	Multiple	Ongoing	PIR	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	Fishing for subsistence, cultural or recreation is an important activity throughout the Western Pacific Region. In Hawaii, eleven annual fishing tournaments occur between June and September, with most operating out of Kona, Hawaii and on Oahu. Chapter 3 and the annual SAFE reports contain details on non-commercial fishing.	Ongoing
8	Undersea Cables	Inter-Island Energy Transmission	NextERA	2014-2016	Maui to Oahu	Hawaii EEZ	One or more inter-island cables connect the islands with power and high-speed broadband, known as the "undersea transmission cable" or "interisland cable." By connecting the islands' transmission systems, an inter-island cable will promote more renewable energy projects, helping the state reach 70% renewable energy by 2030.	Discontinued
9	Undersea Cables (Hawaii)	Installation of undersea cables	Southern Cross Cable Network Asia American Gateway Cable	2000 2009 2009 2010	Kahe Point, Oahu Kawaihae, Hawaii	PIR EEZ Hawaii EEZ	Submarine cables lay on the seabed between land-based stations, carrying telecommunication signals across the Pacific basin. Modern cables use optic fiber technology to carry digital	Ongoing

			American Samoa-Hawaii Honotua Hawaiki Japan-U.S. Cable Network South America Pacific Link SEA-US	 2018 2001 2019 2017	Kapolei, Oahu Kawaihae, Hawaii Kapolei, Oahu Makaha, Oahu Makaha, Oahu Honolulu, Oahu		data, which includes telephone, public internet, and private traffic data.	
10	Undersea Cables (Mariana Arch.)	Installation of undersea cables	Asia American Gateway Cable (2009) Guam Okinawa Kyushu Incheon (2013) Hong Kong-Guam (2019) SEA-US (2017) PIPE Pacific Cable (2009)	2009	Marianas: Tanguisson Point, Guam Tumon Bay, Guam Piti, Guam	PIR EEZ CNMI EEZ Guam EEZ	Same as above	Ongoing
11	Undersea Cables (Am. Samoa)	Installation of undersea cables	Southern Cross Cable Network (2000)	2000	American Samoa: Pago Pago	PIR EEZ American Samoa EEZ	Same as above	Ongoing

			American Samoa-Hawaii (2009) Hawaii (2018)					
12	Military	Guam and CNMI Military Relocation SEIS	United States Marine Corps.	2015	Guam, CNMI	PIR EEZ CNMI EEZ Guam EEZ	As part of the reorganization of the Pacific theater, the military is relocating the U.S. Marine Corps, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force from Okinawa, Japan to Guam. This move involved construction of new military facilities, and harbor and other in-water dredging.	Ongoing
13	Military	Mariana Islands Training and Testing	United States Navy	2015 (new EIS every 7 years)	Marianas	PIR EEZ CNMI EEZ Guam EEZ	U.S. Navy and Marines conduct at-sea training and testing activities, including active sound navigation and ranging (sonar) and explosives while employing marine species protective mitigation measures. These activities have been occurring in the area for decades. The most recent EIS from 2020 is available online.	Ongoing
14	Military	Hawaii-Southern California Training and Testing	United States Navy	2013 (new EIS every 7 years)	Hawaii	PIR EEZ, Hawaii EEZ	Activities include the use of active sound navigation and ranging (sonar) and explosives that may occur during vessel transit between the Hawaii and Southern California Range	Ongoing

							Complexes and the Temporary Operating Area west of the Hawaii Range Complex. The most recent EIS from 2018 is available online.	
15	Military exercises	Multiple, including Rim of the Pacific Exercise, Large Scale Exercise, Fleet Battle Problem, among others	DOD	continuous	Hawaii	PIR EEZ,	Throughout Hawaii, multinational maritime exercises occur with several nations to conduct joint training for integration of manned and unmanned platforms such as manned and unmanned vessels, submarines, aircraft and associated weapon, radar and communication systems	Ongoing
16	Military	CNMI Joint Military Training	United States Marine Corps.	Draft EIS published February 2016	CNMI (Tinian and Pagan)	PIR EEZ CNMI EEZ	The U.S. is rebalancing military forces in the Asia-Pacific region. In support of this, the U.S. military is proposing to increase joint military training capabilities by developing live-fire ranges and training areas on the islands of Tinian and Pagan. The U.S. Marine Corps is leading this joint service initiative on behalf of the U.S. Pacific Command. This proposed action, which involves land, air, and sea space.	Awaiting final draft
17	Tourism/ Recreation	Inter-Island Canoe/Paddle/ Sailing Races	Pailolo Challenge	September October	Channel waters between	Hawaii EEZ	Canoe races with outrigger canoe clubs across all the Hawaiian Islands	Annual

			Molokai Hoe Maui Nui Race Molokai 2 Oahu	August May	Hawaii Island, Kahoolawe, Lanai, Maui, and Molokai		Pailolo Challenge Molokai Hoe Maui Nui Race Molokai 2 Oahu Map of Channels	
18	Tourism/ Recreation	Inter-Island Swim Challenges	Hawaii Swim Maui Channel Swim Relay	September	Channel waters between all MHI	Hawaii EEZ	Individuals or teams of 6 people swim in a relay across the channel, each with an escort boat. Hawaii Swim Maui Channel Swim Relay	Annual
19	Tourism/ Recreation	Whale/Dolphin Watching	Multiple	Seasonally/ Annually	Hawaii, CNMI, Guam, American Samoa	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	Minimal operations in American Samoa 15 operators in Guam and the CNMI 67 operators in Hawaii.	Seasonally/ Annually
20	Tourism/ Recreation	Cruise Ships	Multiple	Ongoing	Hawaii, CNMI, Guam, American Samoa	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	9 Cruise ships visit American Samoa (2019) ~200 Cruise ships visit Hawaii (2019) Undetermined number visit Guam and the CNMI	Ongoing
21	Tourism/ Recreation	Shark, turtle, dolphin, manta ray boat tours	Multiple	Ongoing	Oahu	Hawaii EEZ	Boat based tours to get in the water near animals. At least 10 operators in Hawaii. Undetermined number in American Samoa, Guam and the CNMI.	Ongoing

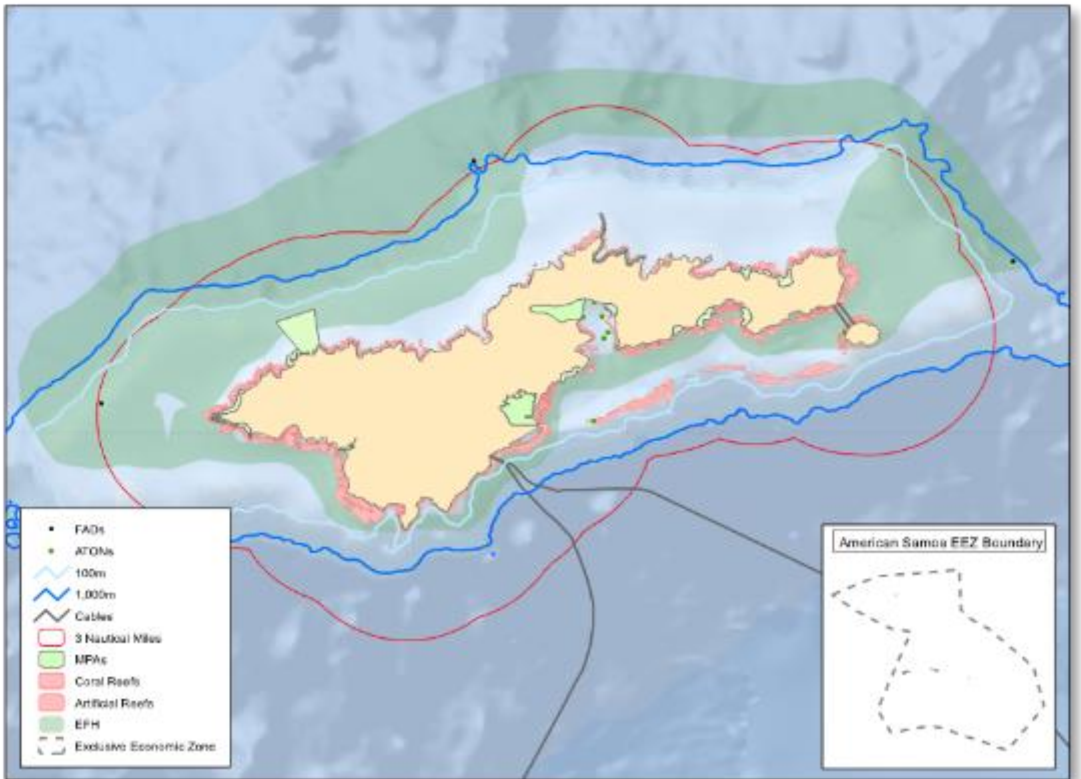
22	Marine Managed Areas	National marine sanctuary designations of marine national monument areas.	U.S. Federal Government	Ongoing	Hawaii, Mariana Arch., American Samoa, PRIA	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	Marine sanctuary designations under consideration for some marine national monument areas previously established by Presidential proclamation.	Ongoing
23	Marine Managed Areas	Development of Management Plans	U.S. Federal Government	2009-present	Mariana arch.	PIR EEZ CNMI EEZ Guam EEZ	NMFS and USFWS are working with the CNMI Government, DOD, Department of State, USCG, and others to develop a monument management plan to collaborate for the long-term protection of the Mariana Trench Marine National Monument.	Ongoing
24	Marine Managed Species	Enhanced protections for Hawaiian spinner solphins	U.S. Federal Government	2005-present	Hawaii	Hawaii EEZ	Proposed regulation to enhance protections for Hawaiian Spinner Dolphins. The "Approach Rule" prohibits approaching or swimming with Hawaiian spinner dolphins in coastal waters of Hawaii. The "Time Area Closure Rule" proposes to close portions of 5 bays on Hawaii Island and Maui during designated times.	Ongoing
25	Natural Events	Hurricane/ Typhoon	N/A	Ongoing	Hawaii, CNMI, Guam,	PIR EEZ	In the Pacific basin, there are an average of 16 tropical storms annually, with 9	Ongoing

					American Samoa		becoming hurricanes, and 4 becoming major hurricanes.	
26	Natural Events	Climate Change	N/A	Ongoing	Global	Global	Increased ocean temperatures, increased ocean acidity, shift in currents, emergent disease, and sea level rise.	Ongoing
27	Natural Events	Tsunami	N/A	Ongoing	American Samoa, CNMI, Guam, Hawaii	PIR EEZ	2009 Tsunami and earthquake -American Samoa More information at tsunami.gov and noaa.gov.	Ongoing
28	Ports and Harbors	Port Master Plans	Port of Guam Honolulu Harbor	2007 (ongoing) 2015 (ongoing)	Guam Hawaii	Guam EEZ Hawaii EEZ	Expansion of Guam harbor and redesign of available berths to accommodate more vessels and traffic. Expansion of Honolulu Harbor to support larger shipping vessels.	Ongoing
29	Shipping	Traffic	Harbors	Ongoing	American Samoa, CNMI, Guam, Hawaii	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	Honolulu Harbor sees 20-36 ships incoming/outgoing each day. Hawaii Harbors saw in increase in cargo traffic from 25,000 to 35,000 [in 1,000 short tons] over twenty years (1994 -2014).	Ongoing
30	Scientific Research	Hawaii Ocean Time Series and Station ALOHA	University of Hawaii	Ongoing	60 miles North of Oahu	Hawaii EEZ	Station ALOHA is a circle of 6-mile radius in the Pacific Ocean north of Hawaii where varied oceanographic research projects converge to produce a remarkable collection of observations about our dynamic oceans and atmosphere.	Ongoing

31	Scientific Research	Aquaculture technology research and development	Kampachi Farms, Forever Oceans	Ongoing	6 miles west of Hawaii Island	Hawaii EEZ	Research and development in aquaculture cage, mooring, and monitoring design. Several past projects operated by Kampachi Farms (Velella Beta, Gamma and Delta). Forever Oceans currently operates the mooring for Velella Delta array.	Ongoing
32	Scientific Research	Hawaii-Southern California Training and Testing Monitoring Projects	DOD	Ongoing	Hawaii Range Complex	PIR EEZ Hawaii EEZ	Research surveys and monitoring of protected species occurring throughout the PIR, in support of the HSTT MMPA requirements.	Ongoing
33	Overexploitation	Shark fin trade	N/A	Early 20th Century to present	Pacific Islands Region	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	Sharks are particularly vulnerable to IUU fishing as part of the international shark fin trade.	Ongoing
34	Predation	N/A	N/A	Ongoing	PIR	PIR EEZ	Predation of animals in their environment by natural predators (i.e., sharks preying on seabirds and monk seals in the NWHI or fish predation in the ocean) or introduced predators such as rats that prey on seabirds or sea turtles (eggs).	Ongoing
35	Marine Debris	Accumulation of garbage and	N/A	Ongoing	PIR	PIR EEZ	"Pacific Garbage Patch." Wind and wave action continuously	Ongoing

		flotsam, particularly within ocean gyres					mix debris and disperses is widely both over huge surface areas and throughout the top portion of the water column. It is possible to sail through the "garbage patch" area and see very little or no debris on the water's surface. It is also difficult to estimate the size of these "patches," because the borders and content constantly change with ocean currents and winds.	
36	Sedimentation, erosion	Coastal Development	NA	Ongoing	Coastal waters of PIR	PIR EEZ American Samoa EEZ CNMI EEZ Guam EEZ Hawaii EEZ	Development along coastlines could release of contaminants into the marine environment and increase erosion, sedimentation and other disturbances	ongoing
37	AOA identification	Planning: spatial and environmental analyses	NOAA	TBD	PIR	TBD	Identification of AOAs under E.O. 13921. An AOA is a small, defined geographic area that NOAA has evaluated through both spatial analysis and the NEPA process and determined to be environmentally, socially, and economically appropriate to support multiple commercial aquaculture operations. This is a planning effort; aquaculture	Under consideration

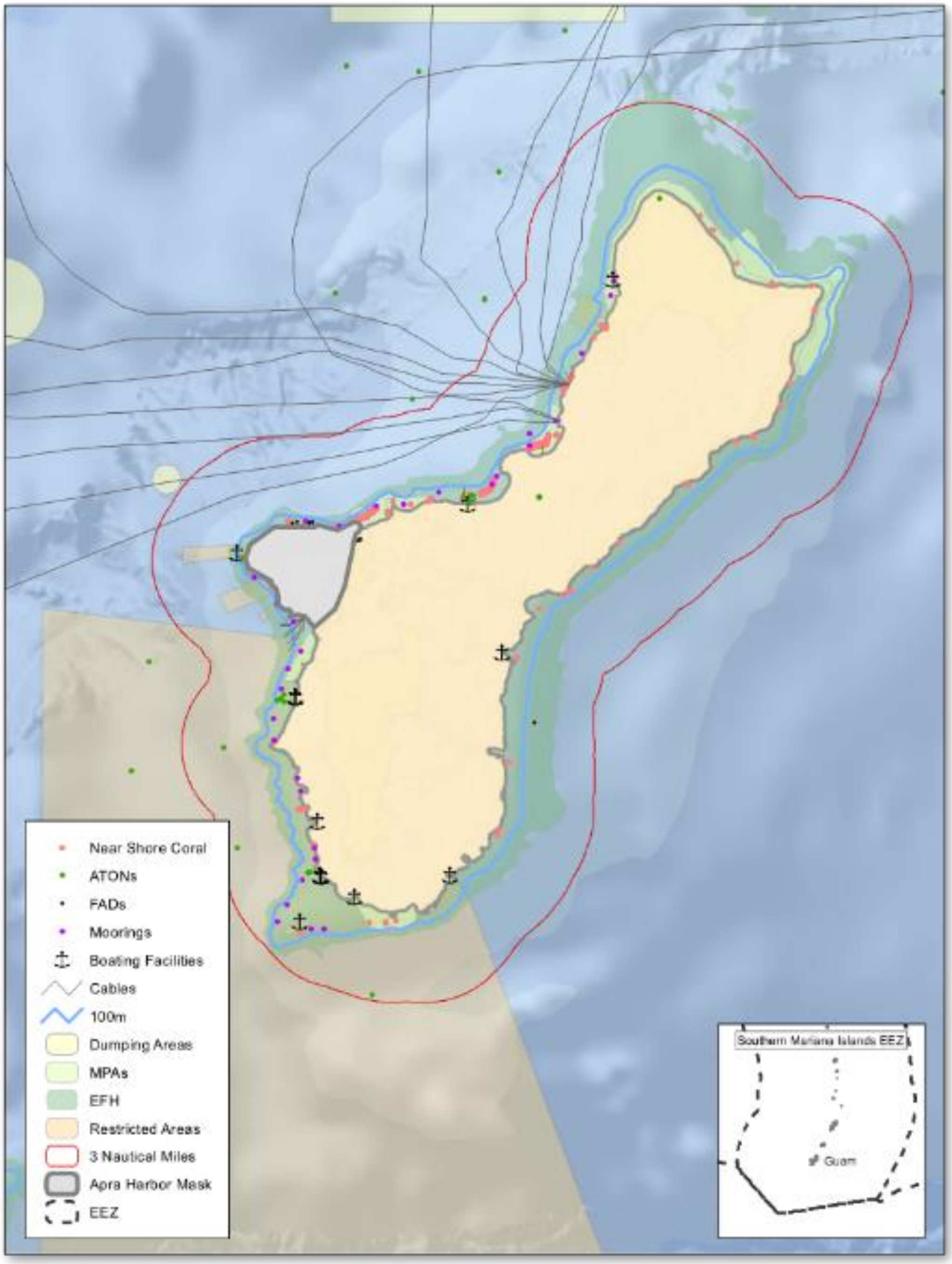
							operations proposed within potential future AOAs would be managed consistent with any future aquaculture management program in the PIR.	



Map by: R. O'Conner, NOAA Fisheries Pacific Island Regional Office, 10-17-2017.

Figure 60. Past, Present and Future Actions around Tutuila in American Samoa.

Note: The EFH layer is specific to bottomfish habitat (100-400 m depth). Based on available data.



Map by: R. O'Conner, NOAA Fisheries Pacific Island Regional Office, 10-26-2017.

Figure 61. Past, Present and Future Actions around Guam.

Note: The EFH layer represented is specific to bottomfish habitat (100-400 m depth). Based on available data.

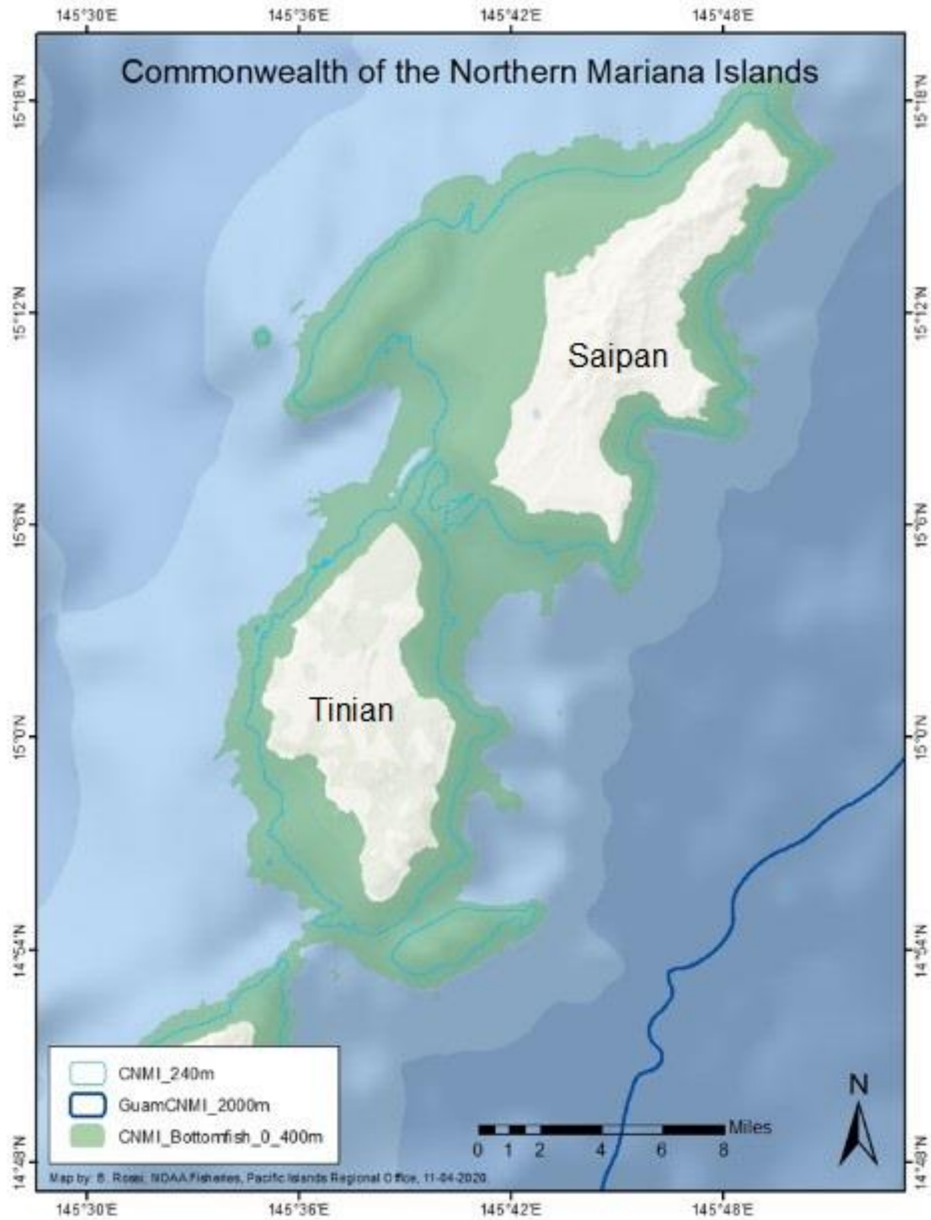
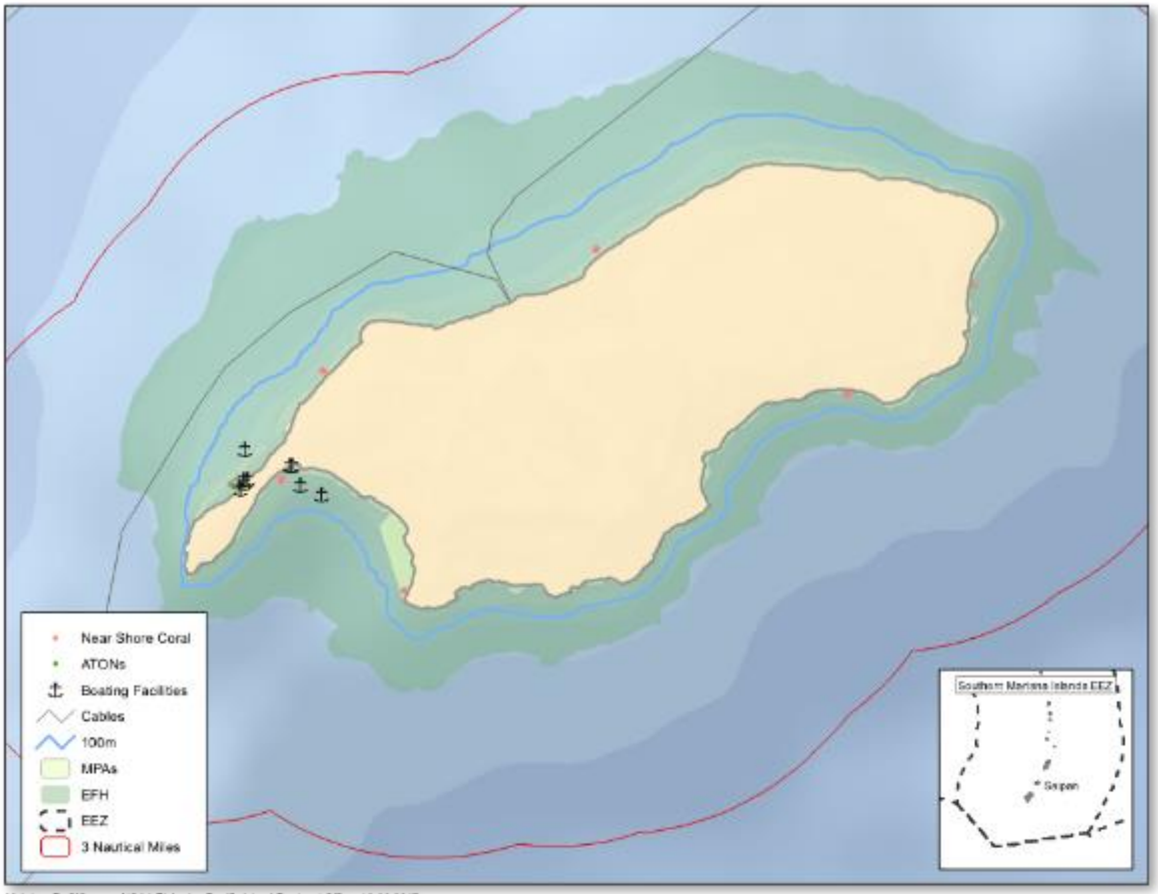


Figure 62. Past, Present and Future Actions around Tinian and Saipan in the CNMI

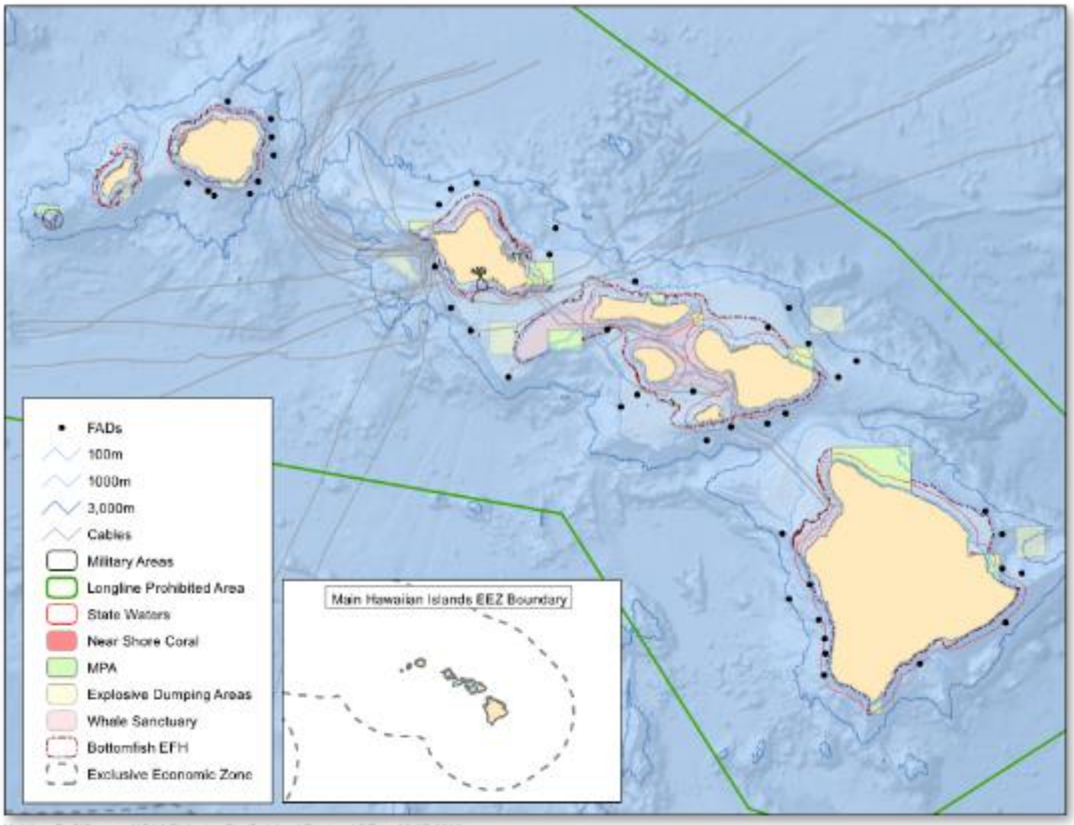
Note: The EFH layer represented is specific to bottomfish habitat (100-400 m depth). Based on available data.



Map by: R. O'Conner, NOAA Fisheries Pacific Island Regional Office. 10-26-2017.

Figure 63. Past, Present and Future Actions around Rota Island in the CNMI.

Note: The EFH layer represented is specific to bottomfish habitat (100-400 m depth). Based on available data.



Mab by: R. O'Conner, NOAA Fisheries Pacific Island Regional Office, 03-27-2018

Figure 64. Past, Present and Future Actions around the MHI.

Note: The EFH layer is specific to bottomfish habitat (100-400 m depth). Based on available data.

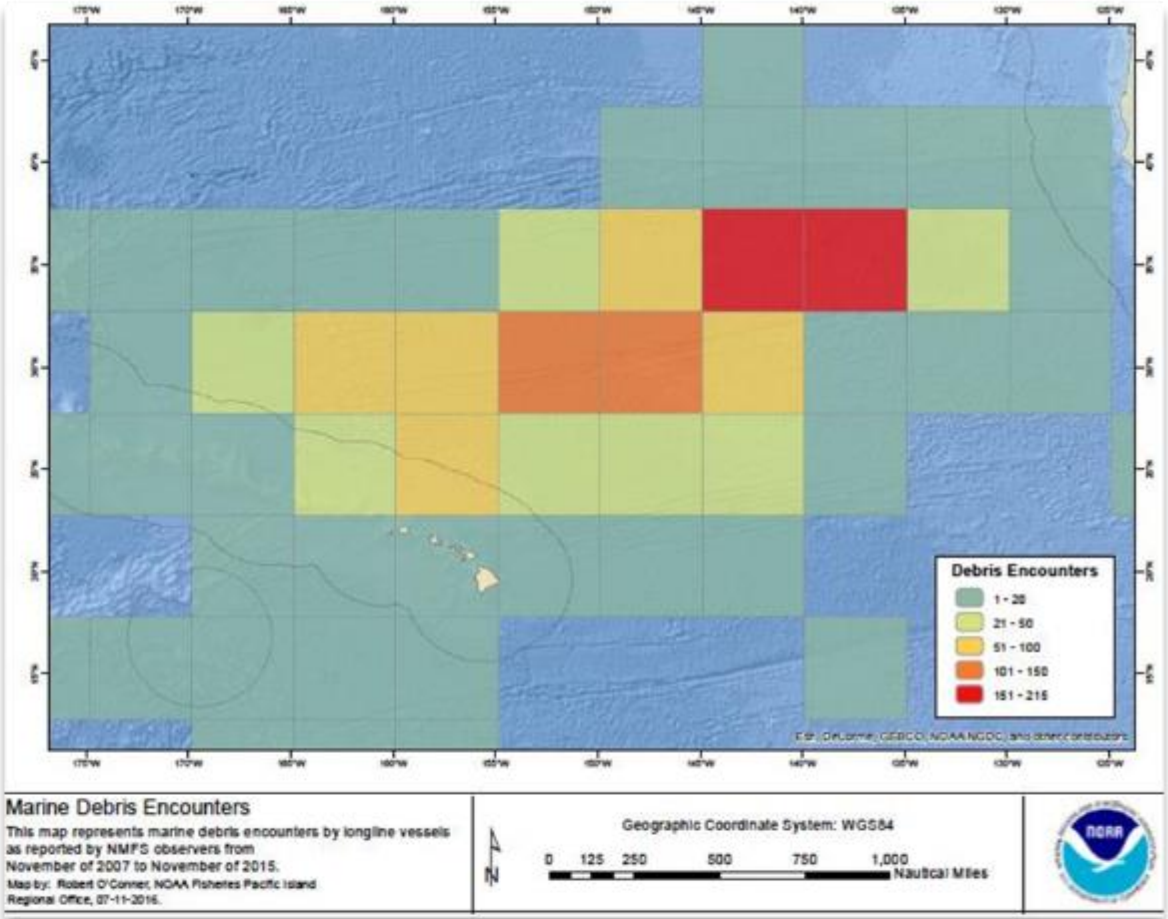


Figure 65. Marine Debris Encounters by Longline Vessels (2007-2015), as Reported by NOAA Observers.

5.3 Effluents, Emissions and Water Quality

Cumulative effects on water quality within the EEZ from aquaculture would be minor due to the small spatial scale at which effects may occur and, with the exception of plastics (Eriksen et al. 2014), the negligible influx of pollutants from other sources in the offshore environment (Table 29). Vessels and permanent structures in the water would always have a potential to release contaminants into the ocean, but large-scale releases are unlikely. The nutrient addition associated with feed inputs and the associated waste products may be detected as indirect impacts; however, they are unlikely to result in major effects due to currents at deepwater sites that are adequate to dilute the effects of excess nutrients or pollutants. Physical parameters (e.g., turbidity, dissolved oxygen) are not a concern for offshore facilities of any size (Price and Morris 2013, Gentry et al. 2017).

Military activities in the region are expected to deposit various equipment and supplies, including flares, chaff, munitions, and personal gear. Various EISs on these military activities describe the level of impact and the mitigation measures to minimize these impacts.

The proposed action would take place in an open ocean environment that is dynamic and subject to the long-term impacts of global climate change. Marine resource managers expect substantial changes to the marine environment from climate change, regardless of whether NMFS and WPFMC implement one of the action alternatives. Climate change would play a role in water quality in the future, given parameters like increasing ocean temperature, changes in circulation and changes in salinity and dissolved oxygen levels. Increased levels of CO_2,[56] resulting in ocean acidification, would also impact water quality (Hoegh-Guldberg 2010). Changes in rainfall and increases in frequency of extreme weather events could also impact water quality (Maulu et al. 2021).

Table 29. Past, Present and RFFAs Potentially Affecting Effluents, Emissions and Water Quality.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Potential for chemical spill
Commercial and Recreational Fishing	6, 7	Minor Adverse	Release of gasoline, grey water, deck wash and debris
Military Training and Testing	13, 14, 15, 16	Minor to Moderate Adverse	Release of contaminants, chaff, flares, and other disposable material
Cruise Ships, Shipping	20, 29	Minor to Moderate Adverse	Release of gasoline, grey water, deck wash, contaminants and debris Introduced non-native species
Marine Managed Areas	22, 23	Minor Beneficial	Habitat protection
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Potential exposure to contaminants from land and vessels
Climate Change	26	Minor to Major Adverse	Change in circulation patterns, including upwelling Change in rain patterns
Change in rain patterns	28	Minor Adverse	Potential release of contaminants

[1]The ID number corresponds to the number listed in Table 28.

5.4 Habitat and Ecosystem Function

5.4.1 Geologic Features Cumulative Effects

Dozens of trans-Pacific undersea cables cross the seafloor that run through all PIR regions and future cables are planned. Modern cables are typically about 1in. (2.5 cm) in diameter and weigh

[56] http://hahana.soest.hawaii.edu/hot/hot_jgofs.html, accessed 16 June 2020

about 2.5 tons per mile. Installing these cables could disturb the benthic habitat; however, studies have indicated that cables pose minimal threats to the benthic environment, and in some cases provide habitat for invertebrates to grow (Carter 2009). Impacts of new cables and pipes are likely similarly minor. New FAD may be placed in Federal waters around the PIR, requiring anchors that would impart minor effects to the geological environment, similar to those discussed for aquaculture facilities.

In Hawaii, there is a wind farm proposal off the coast of Oahu, which would likely affect the geologic features of the area where the anchors are set. Plans for seawater air conditioning for the commercial buildings in downtown Honolulu would require water uptake pipes that would extend four miles off shore, disturbing geological features of the area during construction. These potential future actions would disturb the benthic environment and likely kill organisms during installation of cables/pipes, resulting in localized effects, though the environment should recover. Mitigation is also planned for coral colonies affected by construction of the undersea pipes.

Military training is unlikely to impact offshore geologic resources, although missile testing, and other exercises may accumulate munitions and other military hardware on the seabed. In some instances, missile targeting practices use derelict vessels, which is likely the most significant type of military debris that could affect offshore geologic resources. Natural disasters known to occur in the region (i.e., tsunamis, hurricanes, typhoons) could cause the deposition of various debris and structures on the seabed as well.

Climate change impacts on habitat would be similar to those acting on water quality (see Section 5.3).

Overall, the cumulative effects of any aquaculture management program, when combined with other past, present and future actions in the EEZ, would likely result in negligible cumulative effects on geologic features. Aquaculture could alter habitat that is directly under anchors, anchor chains, cables, or pipes. Large objects deposited on the seabed would also have an impact, although these items are new habitat in a relatively homogenous, flat environment. Nevertheless, the spatial extent of these impacts would involve a small, localized area. While these effects could be long-term, the magnitude of these effects would not likely alter habitat function or cause widespread changes to the geologic structure of the area or region.

Table 30. Past, Present and RFFAs Potentially Affecting Geological Features and Physical Benthic Habitat.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Benthic disturbance
Honolulu Sea Water Air Conditioning	4	Minor Adverse	Benthic disturbance
Undersea Cables	8, 9, 10, 11	Minor Adverse	Benthic disturbance
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Benthic disturbance Munitions and other military hardware on the seabed
Marine Managed Areas	22, 23	Major Beneficial	Reduced disturbance Habitat protection
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Potential for equipment, vessels, and land-based structures to be deposited on seabed Habitat alteration
Climate Change	26	Minor to Major Adverse	Habitat alteration
Port and Harbor Construction	12, 28	Minor to Moderate Adverse	Nearshore benthic disturbance Nearshore habitat alteration
Scientific Research	30, 31, 32	Minor Beneficial and Adverse	Gain knowledge of seafloor Benthic disturbance

[1]The ID number corresponds to the number listed in Table 28.

5.4.2 Aquatic Plants Cumulative Effects

Direct and indirect effects on aquatic plants is negligible, as are most actions listed in Table 31. Facilities sited in waters shallower than 200 m may impact aquatic plants during construction, but would most likely impart a minor beneficial long-term impact as they would provide a surface on which plants could attach. Activities that could be vectors for invasive species introduction (e.g., cruise ships, shipping, military vessels) could adversely affect aquatic plants. Climate change could alter the ecosystem in ways that could benefit or adversely affect plants, including temperature and nutrient influx changes. Commercial fishing and recreational activities occurring in offshore waters would not affect aquatic plants. The contribution of aquaculture facilities under any alternative would result in negligible cumulative effects when combined with other activities taking place 3 to 200 nm (5.5 to 370 km) offshore, primarily given that most areas would involve deep water (>656 ft [200 m]) where plants do not typically grow.

Table 31. Past, Present and RFFAs Potentially Affecting Aquatic Plants.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Introduced non-native species
Cruise Ships, Shipping	20, 29	Minor to Moderate Adverse	Introduced non-native species
Climate Change	26	Minor to Major Beneficial and Adverse	Alter nutrient flow Alter temperature regime Changes to species' native range

[1]The ID number corresponds to the number listed in Table 28.

5.4.3 Benthic Organisms Cumulative Effects

Other activities in the action area that may affect benthic organisms include undersea cables, FAD, seawater air conditioning, and windfarms as described in section 5.5.1 above. Cumulative impacts on benthic organisms from aquaculture and these past, present and future actions are likely minor. The contribution of aquaculture on cumulative effects to benthic organisms would be negligible relative to other stressors listed in

Table 32 due primarily to the fact that aquaculture sites are likely to be sited in deeper water with adequate flushing and mortality (if it occurs) would not cause population-level impacts. Specifically, benthic organisms directly under anchors, anchor chains, cables, or pipes would perish. However, these impacts would occur over a small, localized area for each occurrence, and would not cause widespread mortality.

Table 32. Past, Present and RFFAs Potentially Affecting Benthic Organisms.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Disturbance of habitat Localized mortality of benthic organisms
Honolulu Sea Water Air Conditioning	4	Minor Adverse	Disturbance of habitat Localized mortality of benthic organisms
Undersea Cables	8, 9, 10, 11	Minor Adverse	Disturbance of habitat Localized mortality of benthic organisms
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Disturbance of habitat Potential release of contaminants Toxicity effects from munitions and other military hardware on the seabed

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Marine Managed Areas	22, 23	Major Beneficial	Habitat protection
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Habitat alteration
Climate Change	26	Minor Adverse	Habitat alteration Alter nutrient flow Alter temperature regime Introduced non-native species
Port and Harbor Construction	12, 28	Minor to Moderate Adverse	Nearshore benthic disturbance Nearshore habitat alteration
Scientific Research	30, 31, 32	Minor Beneficial and Adverse	Gain knowledge of marine life Benthic disturbance

[1]The ID number corresponds to the number listed in Table 28.

5.4.4 Sensitive Areas Cumulative Effects

Coral reefs are among the world's most sensitive and endangered marine ecosystems (Wilkinson 2004). The potential impacts of aquaculture operations to sensitive reefs in U.S. waters has been identified as a concern, especially for nearshore reefs which already experience considerable stress from anthropogenic sources including terrigenous sediments and nutrients (Torres 2001, Smith et al. 2008, Otero 2009), and sewage outfall (Kaczmarsky et al. 2005, Nagelkerken 2006, Sutherland et al. 2011). Climate change has led to massive coral bleaching events with permanent consequences for local habitats (Donner et al. 2005; NMFS 2014b). Climate change will likely impact these marine habitats by increasing mortality from heat stress and frequency and severity of storms, severely reducing or redistributing existing habitats due to changes to water depth and tides (Harley et al. 2006). Nearshore reefs in the PIR are not located within Federal waters and aquaculture activities in any aquaculture management program would not likely impact these reefs. Deep sea corals have not experienced the same severity of impacts from climate change, however, since some of the beds lie within the EEZ aquaculture activities could impact them.

Based on the characteristics of the action area, aquaculture is not likely to contribute anything but negligible or minor cumulative effects on coral reefs or other sensitive areas for any of the proposed alternatives (Table 33). While Preferred Alternative 3 could result in projects being permitted for up to 20 years, which could increase the potential for effects associated with waste deposition, for example, the magnitude of these effects in deeper ocean water are likely negligible to minor. Even multiple cages would likely be placed far enough offshore, or in deeper water where coral reefs are not located, such that it is highly unlikely that there would be any potential for impacts to coral reef ecosystems which largely occur in waters <165 ft (50 m) in depth.

Table 33. Past, Present and RFFAs Potentially Affecting Sensitive Areas.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Fishing	6, 7	Minor to Moderate Adverse	Potential reduction in fish species or biomass resulting in loss of diversity necessary to health and function of coral reefs
Tourism, snorkelling and dive tour boats	19, 21	Minor Adverse	Disturbance to marine species Possible disturbance to bottom due to anchoring or incidental abrasion in coral reef areas
Climate Change	26	Minor to Major Adverse	Destruction of sensitive areas such as coral reefs or coastal seagrass/mangrove areas Bleaching and acidification of reefs Potential loss of species diversity and biomass Potential loss or reduction in area of sensitive areas such as seagrass beds or coral reefs due to disease
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Major Adverse	Potential loss of nearshore sensitive areas such as reefs Sedimentation
Port and Harbor Construction	12, 28	Minor to Moderate Adverse	Disturbance from development Habitat alteration Possible sedimentation to nearshore sensitive areas Ocean outfalls resulting in increased pollution Potential exposure to contaminants Potential abrasion on ocean floor due to anchoring Contaminants entering marine ecosystem and food chains
Coastal Development, Erosion	36	Minor to Major Adverse	Exposure to contaminants Potential loss due to sedimentation Potential changes in habitat availability due to sedimentation and disturbance of nearshore areas

[1]The ID number corresponds to the number listed in Table 28.

5.4.5 Ecosystem Function Cumulative Effects

The ecosystem of the tropical pelagic environment is primarily low biomass and relatively homogenous in the surface layer. For any of the past, present and RFFAs to cause cumulative effects, the action would need to be spatially connected to aquaculture facilities. Because of the vast, relatively undifferentiated environment of the action area, the contribution of aquaculture to cumulative effects on the ecosystem are likely minor. The addition of new FAD around the PIR would likely cause an increase in biomass and biodiversity around the facilities. This could alter the local habitat around the facility, as well as shift the habitat if it attracts fish away from nearby seamounts and other existing features. The increase in FAD in the area would also have a minor effect on predator-prey relationships as marine predators may use the FAD as a food source, and fishermen could target the FAD to fish for pelagic species. FAD use may also impact migratory patterns, although scientific evidence on this effect is sparse.

New trans-Pacific cables and construction of a deep-sea air conditioning pipe would cause mortality of the benthic ecosystem directly beneath the cables, though the surrounding ecosystem should recover to a pre-cable environment. In Hawaii, offshore windfarms are expected to be placed off Oahu. These could act similar to FAD, and could cause an increase in biodiversity and biomass in the offshore area surrounding the turbines, potentially attracting fish away from other habitats, affecting the ecosystems at the natural and the artificial sites. Fisherman targeting FAD may create changes in predator-prey relationships. The effects of climate change (e.g., changes in ocean temperature, current and wind patterns, nutrient flow affecting productivity, and the distribution of invasive species) could have a much greater effect on ecosystem function relative to any aquaculture management program.

Other activities such as commercial and recreational fishing, swim races, and canoe races would have a minor impact on the ecosystem as these have been occurring for years and do not likely affect the biodiversity or biomass within the PIR.

Table 34. Past, Present and RFFAs Potentially Affecting Ecosystem Function.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Alter migratory patterns and species distributions Mortality from fisherman targeting fish on FAD
Fishing	6, 7	Minor to Moderate Adverse	Potential entanglement leading to injury or mortality Alter distribution and migration Increase mortality due to targeted fishing Alter species composition through targeting specific species
Marine Debris	35	Minor to Major Adverse	Mortality and serious injury Habitat modification
Marine Managed Areas	22, 23	Major Beneficial	Reduced Disturbance Habitat protection
Predation	33	Minor to Major Beneficial and Adverse	Excess mortality and serious injury leading to population-level effects Population control as a natural cycle
Climate Change	26	Minor to Major Beneficial and Adverse	Changes in productivity Changes in temperature and current patterns Changes to species' native range Changes in prey availability (i.e., increase or decrease)

[1]The ID number corresponds to the number listed in Table 28.

5.5 Local Wild Fish Stocks Cumulative Effects

Climate change may have effects on weather patterns and sea surface temperature, which may shift the distribution of fish populations around the PIR. Climate change may also impact disease transmission and virulence, while rising temperatures could impact immune systems for wild species (Maulu et al. 221). Changes in oceanographic conditions may alter rates of direct and incidental harvests or interactions with marine resources in commercial fisheries. Ocean climate fluctuations that change the habitat quality or the prey availability of ocean resources have the potential to affect a species short- or long-term distribution and abundance. The magnitude of potential effects is uncertain, but these impacts would show as variability in stock size, recruitment, growth rates, or other factors for marine species in stock assessment reviews.

Other activities in the action area that may affect fish include the placement of new FAD and an offshore windfarm in Hawaii. When considering any aquaculture management program and past, present and future actions, cumulative impacts on fish overall is minor (Table 35). New structures (effectively, FAD) would attract aggregations of fish offshore, and may shift the behavior of the fish. However, fish have been observed successfully moving in and out of FAD.

The increase in FAD in the area is likely to have a minor effect on behavior, but a moderate effect on survival as an increase in FAD could mean an increase in fishing mortality.

Electromagnetic fields emitted by submarine cables could have a minor impact on marine species of fish, particularly those that are benthic or demersal (Bastien et al. 2018). These impacts could impede or alter an organisms' navigation capabilities, predator-prey interactions, or general behavior. Other activities in the action area, such as swim races, and boat races would likely have negligible effects on fish populations. Aquaculture's contribution to the effects on fish relative to other external actions in the area are likely negligible to minor adverse depending on site-specific conditions described above.

Table 35. Past, Present and RFFAs Potentially Affecting Fish.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Alter distribution and migration Mortality due to targeted fishing
Fishing	6, 7	Minor Adverse	Alter distribution and migration Increase mortality due to targeted fishing Alter species composition through targeting specific species
Undersea Cables	8, 9, 10, 11	Minor Adverse	Potential effects from electromagnetic fields
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Habitat disturbance Mortality Physical or behavioral disturbance Potential exposure to contaminants
Shark Tours	21	Minor Adverse	Disturbance Alter distribution and migration
Marine Managed Areas	22, 23	Major Beneficial	Reduced Disturbance Habitat protection Reduced mortality
Climate Change	26	Minor to Major Beneficial and Adverse	Habitat alteration Alter distribution and migration Changes in prey availability (i.e., increase or decrease) Disease transmission

[1]The ID number corresponds to the number listed in Table 28.

5.6 Other Marine Wildlife and Protected Species

5.6.1 Sea Turtles Cumulative Effects

Climate change, and its associated impacts, is a global threat to marine turtles throughout the PIR (Hawkes et al. 2007; Fuentes et al. 2011). Resulting temperature changes and sea level rise are likely to change ocean currents and the movements of hatchlings, surface-pelagic juveniles, and adults (Hawkes et al. 2009; Poloczanska et al. 2009; Cavallo et al. 2015). Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches, particularly on low-lying, narrow coastal and island beaches (Fish et al., 2005; Baker et al., 2006; Jones et al., 2007; Fuentes et al., 2009; Hawkes et al. 2009, Anastácio et al. 2014, Pike et al. 2015). Effects of storms may exacerbate these impacts. For example, Hurricane Walaka severely degraded key nesting beaches for green sea turtles in the Papahanaumokuakea Marine National Monument in 2018. Warming temperatures may also alter the sex ratio of sea turtles (Jensen et al. 2018). Climate change effects on the distribution, amount, and types of seagrasses and macroalgal species (Harley et al. 2006) may alter green turtle foraging habitat (Hawkes et al. 2009).

Ocean acidification is likely to affect the forage-base of green turtles and hawksbill turtles, including invertebrates, seagrasses, and algae. However, it is not clear how these changes would impact the turtles (Hamann et al. 2007, Poloczanska et al. 2009). This may also have moderate to major impacts to turtles due to population-level effects (Table 36).

All proposed aquaculture alternatives would have a negligible contribution to the potential cumulative effects of climate change, warming waters, acidification, and rising sea level on sea turtle populations and their habitat.

Potential beneficial effects (e.g., increased food availability from cages or pens) and or adverse effects (e.g., potential bycatch due to increased commercial or non-commercial fishing in the area due to the FAD effect) could occur for sea turtles in the action area. Relative to the other risks described here, the contribution of any aquaculture management program would likely be negligible or minor under all alternatives.

Table 36. Past, Present and RFFAs Potentially Affecting Sea Turtles.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Overexploitation	31	Moderate to Major Adverse	Historically Major Adverse - mortality of eggs and adults Reduced survivorship Reduced Production Issue in some areas of action area for eggs and meat (green turtles) and eggs, meat and shell (hawksbill turtles)
Fishing	6, 7	Minor to Moderate Adverse	Potential entanglement leading to injury or mortality
Predation	32	Minor to Moderate Adverse	Mortality of eggs and hatchlings due to nest predation from wild and feral animals Reduced survivorship Increased mortality Natural predation of hatchlings in marine environment

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Turtle Tours	21	Minor Adverse	Disturbance Risk of injury due to ship strikes
Climate Change	26	Minor to Major Adverse	Destruction of nesting habitat Reduced Productivity and survivorship of all ages Destruction and alternation of foraging habitats including seagrass beds and reefs Loss of foraging habitat in coral reefs (hawksbill and green turtles) Loss of nearshore habitats
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Disturbance Habitat alteration or Loss Loss of nests, production and nesting habitats Reduced productivity Mortality or injury
Port and Harbor Construction	28	Minor to Moderate Adverse	Disturbance from development Habitat alteration Potential exposure to contaminants and pollution Contaminants entering marine ecosystem and food chains
Habitat Loss - Coastal Development, Erosion,	36	Minor to Moderate Adverse	Exposure to contaminants Loss of foraging habitat in coastal reefs and grass beds Loss of nesting habitats Loss of Productivity Changes in prey availability (i.e., increase or decrease) Sedimentation of reefs and coastal foraging areas
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Habitat and behavioral disturbance

[1]The ID number corresponds to the number listed in Table 28.

5.6.2 Marine Mammals Cumulative Effects

To varying degrees, marine mammals in the Western Pacific Region face numerous natural and anthropogenic threats to their continued existence. These threats include oceanic and climatic regime shifts, habitat degradation, fisheries interactions, vessel strikes, and disease amongst other disturbances. Fishery interactions with protected species likely have the greatest impact on marine mammals worldwide, including in the PIR. NMFS routinely evaluates and addresses risk and mitigation of these interactions through the preparation and issuance of environmental impact analyses, biological opinions, stock assessments, and regulatory measures to reduce interactions[57].

The majority of impacts on marine mammals arising from RFFAs are associated with potential collision, hooking, entanglement, disturbance (including vessel or human presence and underwater noise), habitat alteration, and potential exposure to contaminants (e.g., fuel spills). These impacts arise from vessel activities, commercial fisheries, undersea cables, whale and dolphin watching tours, shipping and cruise ships, and military training activities occurring or proposed to occur within or near the action area.

Cumulative effects of climate change on marine mammals result in changes in sea temperature, prey availability, changes in the frequency of major storm events and changes in habitat. Some marine mammal species would be more likely to adapt to major climate shifts and ecosystem disturbances (Moore and Huntington 2008). It is difficult to predict how cumulative effects may impact specific marine mammal species in any given location; however, the contribution of climate change to cumulative effects could range from minor to major depending on the specific species and the context of their exposure to other stressors (Table 37). For cetaceans, the most likely impact of climate change could be changes in population distribution, due to factors such as the distribution of prey species with particular thermal requirements (NMFS 2016h). According to McLeod (2009 as cited in NMFS 2016h), ranges of approximately 88% of cetaceans may be affected by changes in water temperature resulting from global climate change.

The combined effects of climate change and any aquaculture management program on marine mammals potentially affected by aquaculture activities is considered negligible to minor adverse, particularly within the context of other past, present and RFFAs listed in Table 37.

Military training and testing activities in the PIR may impact marine mammals, either temporarily or longer-term. Underwater acoustic and sonar disturbances from these activities are generally low impact to marine mammals given their infrequent and sporadic nature.

Ingestion of or entanglement with plastics, fishing nets and other marine debris poses threats to marine mammals in the PIR and may result in serious injury, mortality or reproductive effects. There are two large garbage patches in the Pacific Ocean, collectively referred to as the “Great Pacific Garbage Patch.” The “Western Pacific Garbage Patch” occurs off the coast of Japan and the “Eastern Pacific Garbage Patch” is located between Hawaii and the coast of California; both of connect through the subtropical convergence zone.

Marine mammals could benefit from marine managed areas due to reduced disturbance, protection of prey species, and reduced risk of entanglement or collision, among other benefits, as well as potentially offsetting some adverse cumulative effects from other human-induced or natural events.

[57] https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments

Table 37. Past, Present and RFFAs Potentially Affecting Marine Mammals.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Disturbance Potential entanglement leading to injury or mortality
Fishing	6, 7	Minor to Moderate Adverse	Potential entanglement leading to injury or mortality
Undersea Cables	8, 9, 10, 11	Minor Adverse	Disturbance Potential entanglement leading to injury or mortality
Military Training and Testing	13 14, 15, 16	Minor Adverse	Disturbance Potential ship strike leading to mortality or injury Potential exposure to contaminants
Whale/Dolphin Watching Tours	19	Minor to Moderate Adverse	Disturbance
Cruise Ships, Shipping	20, 29	Minor to Moderate Adverse	Disturbance Potential ship strike leading to mortality or injury Introduced non-native species Potential exposure to contaminants
Marine Debris	35	Minor to Major Adverse	Mortality and serious injury Habitat modification
Marine Managed Areas	22, 23	Major Beneficial	Reduced Disturbance Habitat protection Reduced risk of hooking, entanglement or ship strike
Marine Managed Species	24	Major Beneficial	Reduced Disturbance Habitat protection
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Disturbance Habitat alteration Potential exposure to contaminants Mortality or injury
Port and Harbor Construction	12, 28	Minor to Moderate Adverse	Disturbance Habitat alteration Potential exposure to contaminants
Climate Change	26	Minor to Major Beneficial and Adverse	Mortality or injury Habitat alteration Changes to species’ native range Changes in prey availability (i.e., increase or decrease)

[1]The ID number corresponds to the number listed in Table 28.

5.6.3 Seabirds Cumulative Effects

Any aquaculture program under any of the proposed alternatives would contribute adverse effects on seabirds due to the very low likelihood that mooring lines or cages could entangle seabirds (Table 38). Minor beneficial effects could also occur as a result of seabird prey aggregating around cages. Relative to other more notable stressors for seabirds in the PIR, aquaculture is not likely to contribute to overall adverse cumulative effects on seabirds.

Climate change and consequent changes to sea-surface temperature and marine chemistry will likely have severe impacts on marine ecosystems (IPCC 2007). Wind and current patterns could alter the distribution of prey species, which in turn could affect the behavior and movements of predators including seabirds (Behrenfeld et al. 2006, Polovina et al. 2008). Seabirds may expend more energy to find food if their foraging habitat becomes degraded or is redistributed to different areas (Suryan et al. 2008). Coral bleaching and inhibited coral growth could also negatively affect marine communities that support prey species in the most convenient foraging habitats for nesting seabirds.

Changes in foraging habitat may result in negative consequences on reproductive success for seabirds such as albatrosses (Kappes et al. 2010).

The combination of other stressors such as habitat modification or loss due to human activities (e.g., urbanization) or large storm events in addition to effects of climate change could place additional stress on seabird reproduction or foraging. For example, sea-level rise and increased storms would likely lead to more frequent over-wash of nesting islands by waves, and eventually to complete inundation on many islands and atolls used by breeding seabirds (Webb and Kench 2010).

Two major storms and the tsunami generated by an earthquake in Japan in 2011, created waves that over-washed nesting islands in the NWHI. These three events resulted in the estimated loss of at least 252,000 Laysan Albatross nests and 30,405 Black-footed Albatross nests (at least 45 and 38%, respectively, of the estimated total nests for each species) and the death of a minimum of 2,000 adult and subadult albatrosses of both species (USFWS 2012). An increase in storm activity would likely result in continued threats to these species on a large scale (USFWS 2012).

Ingestion of or entanglement with plastics, fishing nets and other marine debris poses threats to seabirds in the PIR and may result in serious injury, mortality or reproductive effects. Oil spills, while potentially catastrophic, likely account for a small proportion of the total annual seabird mortality (Thompson and Hamer 2000) compared to other threats that cause long-term population-level effects, such as bycatch and marine pollutants (Finkelstein et al. 2010 as cited in USFWS 2012).

A report by Sagar (2013) concludes that harmful effects of aquaculture on seabirds are not significant in most circumstances, given the largest threats are loose and thin lines. Offshore aquaculture facilities to not typically use either thin or loose lines. In conclusion, any aquaculture program is not likely to contribute meaningfully to overall cumulative effects on seabirds compared to these other stressors. Recommended aquaculture mitigation and monitoring strategies could include careful site selection to avoid threatened, endangered or protected bird species' home ranges, critical breeding and foraging habitats and migration routes. Minimizing marine debris, using minimal lighting at night, and using downward-pointing and shaded lights could also reduce potential impacts. Management could address these activities easily on a site-by-site basis.

Table 38. Past, Present and RFFAs Potentially Affecting Seabirds.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Fishing	6, 7	Minor Adverse	Potential entanglement leading to injury or mortality
Predation	34	Minor to Moderate Adverse	Mortality of eggs and hatchlings due to predation of ground nesting birds from wild and feral animals Loss of production Decreased survivorship to adulthood
Marine Debris	35	Minor to Major Adverse	Mortality and serious injury Habitat modification
Climate Change	26	Minor to Major Adverse	Destruction of nesting habitat Reduced egg production and survivorship Potential loss of habitat with sea level rising Potential loss of foraging habitat Potential redistribution of prey Loss of nearshore habitats
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Potential loss of roosting and nesting habitats Loss of nests and production Reduced survivorship of hatchlings Potential increased mortality of adults
Port and Harbor Construction	12, 28	Minor Adverse	Habitat Alteration and Destruction Disturbance Potential exposure to contaminants and pollution Contaminants entering food chains
Habitat Loss - Coastal Development, Erosion,	36	Minor to Moderate Adverse	Exposure to contaminants Potential loss of nesting habitats Potential changes in prey availability (i.e., increase or decrease) due to sedimentation of nearshore areas
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Disturbance Potential strike

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
			Habitat disruption or alteration

[1]The ID number corresponds to the number listed in Table 28.

5.6.4 ESA-Listed Sharks and Rays Cumulative Effects

Cumulative and RFFA effects on sharks and rays could include entanglement, hooking, vessel strikes, overexploitation, and tourism. In general, the entanglement risk for oceanic whitetip sharks and manta rays is very rare, but could occur with commercial fishing lines or marine debris (NMFS 2020c). Oceanic whitetip sharks, in particular, may be more at risk for entanglement with marine debris since they are often associated with surface waters. Manta rays may risk ingestion of microplastics associated with marine debris, since they are filter feeders, and could also become entangled, though this is less likely (NMFS 2017a).

Commercial and non-commercial fisheries could target manta rays, primarily for meat. Oceanic white tip sharks are particularly vulnerable to Illegal, Unregulated and Unreported fisheries associated with the shark fin trade. Both species interact with commercial fisheries (e.g., longline fisheries) as a bycatch species in the South Pacific (Miller and Klimovich 2017, Young et al. 2017).

Manta rays are likely at risk of predation, particularly from sharks; however, oceanic whitetip sharks have a lower predation risk in the PIR (Miller and Klimovich 2017, Young et al. 2017).

Both species are highly migratory and occupy a range of habitats. Manta rays have very low habitat specificity but they do rely on coral reef habitat and planktonic food sources, both of which are highly sensitive to environmental changes. Climate change is likely to effect the distribution and behavior of manta rays (NMFS 2017a). Oceanic whitetip shark habitat is the water column to a depth of 1,000m and from the shoreline to the outer limit of the EEZ. The climate change effects for this species are unclear; however, changes in ocean temperatures, currents, and food chain dynamics due to climate change are likely to impact them (Young et al. 2017).

Tourism activities are likely to affect manta rays, as diving tours could target them, particularly in the MHI. Observed unintended consequences like fewer emergent zooplankton and lower biodiversity in high use dive spots when compared to less used dive spots (Osada 2010) and altering manta ray behavior (Anderson, R.C. et al. 2011) have been observed, though codes of conduct implemented among members of the dive industry may help alleviate these impacts (Miller and Klimovich 2017)

Manta rays aggregate in certain locations, for either feeding, cleaning, or courtship. Boat strikes may also pose a threat, particularly if a boat transits an area with high aggregation of manta rays (Miller and Klimovich 2017). The site selection process for an aquaculture facility in the PIR could avoid these areas.

Table 39. Past, Present and RFFAs Potentially Affecting Sharks and Rays.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Overexploitation	33	Moderate to Major Adverse	Reduced survivorship Reduced Production Issue in some areas of action area for targeted catch, IUU catch
Fishing	6, 7	Minor to Moderate Adverse	Potential hooking or entanglement leading to injury or mortality Potential bycatch species
Cruise Ships, Shipping	20, 29	Minor Adverse	Potential for boat strikes if passing through area of manta ray aggregation
Predation	34	Minor to Moderate Adverse	Reduced survivorship Increased mortality Natural predation of manta rays in marine environment
Shark/manta tours	21	Minor to Moderate Adverse	Changes in behavior due to intentional attraction in localized area for dive sites
Climate Change	26	Minor to Major Adverse	Disturbance of habitat, prey distributions Reduced Productivity and survivorship Loss of foraging habitat in coral reefs
Port and Harbor Construction	12, 28	Minor to Moderate Adverse	Disturbance from development Habitat alteration Potential exposure to contaminants and pollution Contaminants entering marine ecosystem and food chains
Marine debris	35	Minor to Moderate Adverse	Potential ingestion of marine plastics Potential entanglement with marine debris
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Changes in behavior Disturbance

[1]The ID number corresponds to the number listed in Table 28.

5.7 Socioeconomic Impacts

Because of their greater distance from shore, offshore facilities are likely to experience fewer conflicts with other economic, cultural and recreational uses of the environment (Knapp 2008a). Climate change impacts to fishing communities can include secondary effects from impacts on habitat and water quality (e.g., loss of stock, shifting migration patterns, shifting disease patterns, increased risk for zoonotic transfer[58]), and these could result in lost revenue (Sony et al. 2021). Extreme weather events could also impact not only fishery participants but also fishery supply chains (Suh and Pomeroy 2020, de Souza Valente and Wan 2021).

Table 40 provides the past, present actions and RFFAs that could potentially overlap in time and space and contribute to cumulative effects to wild caught fisheries and fishing communities.

Table 40. Past, Present and RFFAs Potentially Affecting Wild-Caught Fisheries Participants and Fishing Communities.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Wind and Wave Energy development	1, 2, 3, 5	Minor Adverse	Shifting target stock distributions and/or densities due to benthic disturbance Shifting target stock distributions and/or densities due to FAD effect
Honolulu Sea Water Air Conditioning	4	Minor Adverse	Shifting target stock distributions and/or densities due to benthic disturbance
Undersea Cables	8, 9, 10, 11	Minor Adverse	Shifting target stock distributions and/or densities due to benthic disturbance
Military Training and Testing	13, 14, 15, 16	Minor Adverse	Shifting target stock distributions and/or densities due to benthic disturbance Munitions and other military hardware on the seabed Shifting stock distributions due to physical disturbance
Marine Managed Areas	22, 23	Major Beneficial	Increased species abundance due to reduced disturbance Improved stock health due to habitat protection
Hurricanes, Typhoons, Tsunamis	25, 27	Minor to Moderate Adverse	Loss of equipment, potential for equipment, vessels, and land-based structures to be deposited on seabed Reduced stock health due to habitat alteration
Climate Change	26	Minor to Major Adverse	Loss of productivity Loss of income Loss of equipment due to storms or other natural disasters Vulnerability of supply chains Epizootic transfer and emergent disease

[58] Zoonotic transfer is disease transmission from an animal host to a human.

Action or Natural Event	Past, Present, RFFA ID Number[1]	Net Effect	Types of Potential Effects
Port and Harbor Construction	12, 28	Minor to Moderate Adverse	Shifting target stock distributions and/or densities due to nearshore benthic disturbance Shifting target stock distributions and/or densities due to nearshore habitat alteration
Scientific Research	30, 31, 32	Minor Beneficial and Adverse	Gain knowledge of seafloor Benthic disturbance

[1]The ID number corresponds to the number listed in Table 28.

6 APPLICABLE LAWS

6.1 National Environmental Policy Act

In accordance with NEPA, CEQ implementing regulations, and NOAA Administrative Order (NAO) 216-6A - *Compliance with the National Environmental Policy Act, Executive Orders 12114, Environmental Effects Abroad of Major Federal Actions; 11988 and 13690, Floodplain Management; and 11990, Protection of Wetlands*, NMFS must consider the effects of proposed agency actions and alternatives on the human environment. As part of this process, NMFS and the WPFMC provide opportunities for interested and affected members of the public to be involved before making a decision. NMFS and the WPFMC prepared this PEIS in accordance with NEPA and its implementing regulations, at 40 CFR 1500-1508, and in coordination with various Federal and local government agencies represented by the WPFMC. NMFS would use this EIS to consider the effects of the proposed action on the human environment, taking into consideration public comments on the proposed action presented in this document, and to determine whether the proposed action would have a significant environmental impact requiring the preparation of an environmental impact statement.

This PEIS is prepared using the 1978 CEQ NEPA Regulations (40 CFR Parts 1500-1508). The CEQ published new NEPA regulations on July 16, 2020 that entered into effect on September 14, 2020 (85 FR 43304). This PEIS was under development prior to September 14, 2020, and, thus, has been prepared in accordance with the 1978 CEQ NEPA regulations that applied prior to the new regulations entering into effect.

6.2 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) requires a determination that a recommended management measure has no effect on the land, water uses, or natural resources of the coastal zone or is consistent to the maximum extent practicable with an affected state's enforceable coastal zone management program. The CZMA also requires that any applicant for a required Federal license or permit to conduct an activity affecting any land or water use or natural resource of the coastal zone of a state or territory shall provide a certification to the permitting agency that the proposed activity complies with the enforceable policies of the state or territorial approved coastal zone management program.

6.3 National Historic Preservation Act

The NHPA requires Federal agencies undergo a review process for all federally funded and permitted projects that will impact sites listed on, or eligible for listing on, the National Register of Historic Places.

6.4 Endangered Species Act

The ESA provides for the protection and conservation of threatened and endangered species. Section 7(a)(2) of the ESA requires Federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the critical habitat of such species.

6.5 Marine Mammal Protection Act

The MMPA prohibits, with certain exceptions, the take of marine mammals in the U.S. and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. The MMPA gives NMFS as delegated by the Secretary of Commerce, the authority and duties for all cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions, except walruses). With this responsibility, NMFS required to prepare and periodically review stock assessments of marine mammal stocks.

The MMPA works in concert with the provisions of the ESA. The Secretary of Commerce is required to consider all factors regarding regulations applicable to the "take"[59] of marine mammals such as the conservation, development, and utilization of fishery resources, and the economic and technological feasibility of implementing the regulations.

6.6 Migratory Bird Treaty Act

The MBTA makes it illegal to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird, or the parts, nests, or eggs of such a bird except under the terms of a valid Federal permit.

6.7 Rivers and Harbors Act

The U.S. Army Corps of Engineers (USACE) is responsible for issuance permits for offshore aquaculture facilities under Section 10 of the Rivers and Harbors Act. Section 10 of the Rivers and Harbors Act (33 U.S.C. 403) prohibits the creation of structures not authorized by Congress that obstruct U.S. navigable waters, unless permitted. USACE permitting process (33 CFR 322)

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[59] The MMPA defines "take" broadly to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

assesses the environmental effects of a structure and any operations associated with the structure, including effects on U.S. navigable waters. NMFS may provide comments to the USACE regarding impacts to marine resources of proposed activities and could recommend methods for avoiding such impacts.

6.8 Clean Water Act

The Clean Water Act (CWA) (33 U.S.C. 1251-1387) is intended to maintain and restore waters of the United States. The CWA authorizes water quality and pollution research, provides grants for sewage treatment facilities, sets pollution discharge and water quality standards, addresses oil and hazardous substances liability, and establishes permit programs for water quality, point source pollutant discharges, ocean pollution discharges, and dredging or filling of wetlands or waters of the United States. USACE and the EPA both have permitting authority under the CWA.

Title 40 CFR Parts 122-124 implement the EPA's NPDES Program under sections 318, 402, and 405 of the CWA. Water quality and effluent standards and criteria for the NPDES are described in 40 CFR, Parts 125, 129, 133, 136, 400-471, and 503. The EPA also published a final rule on August 23, 2004 (69 F.R. 162) establishing CWA effluent limitations, guidelines, and new point source pollution standards for concentrated aquatic animal production facilities, including facilities that produce 100,000 pounds or more per year of aquatic animals in net pens or submerged cage systems.

Pursuant to Section 404 of the CWA, USACE has authority to issue permits regulating the discharge of dredged or fill material into U.S. waters. Title 33 CFR Section 323 prescribes the policies, practices, and procedures the ACOE follows when reviewing permits to authorize the discharge of dredged or fill material. The CWA Section 404 program and its 404(b)(1) guidelines prevent destruction of aquatic ecosystems unless the action will not individually or cumulatively adversely affect the ecosystem. NMFS may provide comments to USACE regarding impacts to marine resources of proposed activities and could recommend methods for avoiding such impacts.

6.9 National Marine Sanctuaries Act

The National Marine Sanctuaries Act (NMSA) (16 U.S.C. 1431 et seq.) directs the Secretary of Commerce to designate and manage areas of the marine environment with nationally significant aesthetic, ecological, historical, or recreational values as national marine sanctuaries. Regulations implementing the NMSA are at 15 CFR Part 922. These regulations serve to safeguard resources within sanctuary boundaries and include prohibitions or limitations on some activities, such as discharge and disturbance of the seabed. These regulations also provide the National Marine Sanctuary Program with authority to issue permits to allow certain activities beneficial to sanctuaries that would otherwise be prohibited.

6.10 Antiquities Act

The Antiquities Act of 1906 (54 U.S.C. 3203), authorizes the President to establish national monuments on Federal lands that contain "historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest." The following presidential proclamations have established or modified marine national monuments in the PIR under the Antiquities Act:

- No. 8031: Establishment of the Northwestern Hawaiian Islands Marine National Monument (June 15, 2006)
- No. 8112: Amending Proclamation 8031 of June 15, 2006, To Read, "Establishment of the Papahanaumokuakea Marine National Monument" (February 28, 2007)
- No. 8335: Establishment of the Marianas Trench Marine National Monument (January 6, 2009)
- No. 8336: Establishment of the Pacific Remote Islands Marine National Monument (January 6, 2009)
- No. 8337: Establishment of the Rose Atoll Marine National Monument (January 6, 2009)
- No. 9478: Papahanaumokuakea Marine National Monument Expansion (August 26, 2016)

6.11 National Invasive Species Act

This act reauthorized and amended the Non-Indigenous Aquatic Nuisance Prevention and Control Act of 1990 (P.L. 101-646). Congress passed the act in response to the zebra mussel invasion of the Great Lakes and required ships heading for the Great Lakes to exchange their ballast water at sea. In 1996, Congress reauthorized the act and encouraged all vessels arriving from outside the EEZ to exchange their ballast water. The Act requires all ships to report whether or not they exchanged their ballast water.

6.12 Outer Continental Shelf Lands Act

Congress created the Outer Continental Shelf Lands Act in 1953. The Act defines the Outer Continental Shelf (OCS) as all submerged lands between the seaward extent of state coastal waters and the seaward extent of Federal jurisdiction. The purpose of the Act was to assure national security and reduce dependence on foreign sources. The Secretary of the Interior is responsible for the administration of mineral exploration and development of the OCS. The Act provides the Secretary of the Interior authority to grant leases through competitive bids and to promulgate regulations consistent with the provisions of the Act. The 1978 amendments to the Act provided for cancellation of leases or permits if continued activity is likely to cause serious harm to life, including aquatic life. These amendments also stipulated that OCS management consider economic, social, and environmental values of renewable and nonrenewable resources.

6.13 National Sea Grant College and Program Act

Congress passed the National Sea Grant College and Program Act in 1966, and subsequently amended several times. The act authorizes the establishment of Sea Grant colleges and programs. The intent of the Act was to initiate and support educational and research programs related to the development of marine resources.

6.14 Executive Orders

6.14.1 EO 11987 Exotic Organisms

This Executive Order requires Federal agencies, to the extent permitted by law, to:

1. Restrict the introduction of exotic species into the natural ecosystems on lands and waters owned or leased by the United States;
2. Encourage states, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the U.S.;
3. Restrict the importation and introduction of exotic species into any natural U.S. ecosystems as a result of activities they undertake, fund, or authorize; and
4. Restrict the use of Federal funds, programs, or authorities to export native species for introduction into ecosystems outside the U.S. where they do not occur naturally.

The order authorizes the Secretaries of Agriculture and Interior to allow exotics import and native species export if this activity will not adversely affect natural ecosystems.

6.14.2 EO 12866 Regulatory Planning and Review

A "significant regulatory action" means any regulatory action that is likely to result in a rule that may -

1. Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal government or communities;
2. Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
3. Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
4. Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

Should an aquaculture permitting program be enacted, NMFS will determine whether the action is significant for the purpose of E.O. 12866

6.14.3 EO 13089 Coral Reef Protection

The Executive Order on Coral Reef Protection requires Federal agencies whose actions may affect U.S. coral reef ecosystems to identify those actions, utilize their programs and authorities to protect and enhance the conditions of such ecosystems. This order also authorizes Federal agencies, to the extent permitted by law, to ensure that actions that they authorize, fund or carry out do not degrade the condition of that ecosystem. This PEIS identifies numerous areas where coral reefs occur and will ensure proposed actions do not degrade these coral reef areas.

6.14.4 EO 13112 Invasive Species

The Executive Order established an Invasive Species Council and specified the duties of Federal agencies whose actions may affect the status of invasive species. The Order requires Federal agencies to use relevant programs and authorities to

1. Prevent the introduction of invasive species;
2. Detect and respond rapidly to control the spread of such species;
3. Monitor invasive species populations accurately and reliably;
4. Provide for restoration of native species and habitat conditions in ecosystems that have been invaded;
5. Conduct research to prevent introduction; and
6. Promote education on invasive species.

The Invasive Species Council oversees the implementation of the order, has prepared an invasive species management plan, develops guidance to Federal agencies, and encourages planning and action at local, regional, and national levels.

6.14.5 EO 13132 Federalism

The objective of E.O. 13132 is to guarantee the Constitution's division of governmental responsibilities between the Federal government and the states. Federalism implications are defined as having substantial direct effects on states or local governments (individually or collectively), on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government. NMFS and the WPFMC do not expect that this action would impact or alter the relationship between the Federal government and the government of the State of Hawaii or the territories of American Samoa, the CNMI or Guam.

6.14.6 EO 13158 Marine Protected Areas

This Executive Order requires Federal agencies to consider whether their proposed action(s) will affect any area of the marine environment that Federal, state, territorial, tribal, or local laws or regulations have reserved to provide lasting protection for part or all of the natural or cultural resource within the protected area.

6.14.7 EO 12898 Federal Actions to Address Environmental Justice in Minority and Low-Income Populations

E.O. 12898 requires Federal agencies to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. E.O. 12898 also provides for agencies to collect, maintain, and analyze information on patterns of subsistence consumption of fish, vegetation, or wildlife. That agency action may also affect subsistence patterns of consumption and indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, and minority populations. Agencies should also consider environmental justice when conducting NEPA analyses.ch programs related to the development of marine resources.

6.14.8 EO 13792 Review of Designations under the Antiquities Act

This E.O. instructed the Secretary of the Interior to review all monument designations or expansions made since January 1, 1996 to determine whether each designations was made with adequate public outreach and coordinating with state, tribal and local officials. This review included the following marine monuments located in the PIR: Marianas trench MNM, Pacific Remote Islands MNM, Papahanaumokuakea MNM, and Rose Atoll MNM. Executive Order 13990 revoked this order on January 20, 2021.

6.14.9 EO 13795 Implementing an America-First Offshore Energy Strategy

This E.O. outlined steps towards a streamlined permitting process for offshore energy production and instructed the Secretary of Commerce to review monument designations or expansions between April 28, 2007 and April 28, 2017. Executive Order 13990 revoked this order on January 20, 2021.

6.15 Paperwork Reduction Act

The purpose of the Paperwork Reduction Act is to minimize the paperwork burden on the public resulting from the collection of information by or for the Federal government. It is intended to ensure the information collected under the proposed action is needed and is collected in an efficient manner (44 U.S.C. 3501(1)).

6.16 Information Quality Act

The IQA and NOAA standards (NOAA Information Quality Guidelines, September 30, 2002) recognize information quality is composed of three elements: utility, integrity, and objectivity. National Standard 2 of the Magnuson-Stevens Act states that an FMP's (FEP's) conservation and management measures shall be based upon the best scientific information available.

6.17 Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires government agencies to assess and present the impact of their regulatory actions on small entities, including small businesses, small organizations, and small governmental jurisdictions. The agency would prepare an Initial Regulatory Flexibility Analysis (IRFA) and Final Regulatory Flexibility Analysis (FRFA) for each proposed and final rule, respectively. Under the Regulatory Flexibility Act, an agency does not need to conduct an IRFA or FRFA if they can certify that the proposed rule, if adopted, will not have a significant adverse economic impact on a substantial number of small entities. NMFS may request that the Department of Commerce Chief Counsel for Regulation certify to the Small Business Administration that the proposed permitting system and specifications would not have a significant economic impact on a substantial number of small entities.

6.18 Animal Health Act

The Animal Health Act of 2002 (7 U.S.C. 8301 et seq.) provides the authority to the Secretary of Agriculture to administer and promulgate animal health regulations for the prevention, control, and management of infectious diseases for all animals, except humans. The focus of the Act is the management of diseases in cultured animals but the scope also includes disease management in wildlife that have the potential to impact cultured animals.

6.19 Administrative Procedure Act

All Federal rulemaking is governed under the provisions of the Administrative Procedure Act (5 U.S.C. Subchapter II) which establishes a “notice and comment” procedure to enable public participation in the rulemaking process. Under the APA, NMFS is usually required to publish notification of proposed rules in the *Federal Register* and to solicit, consider and respond to public comment on those rules before the finalize the rule.

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8 AGENCIES, ORGANIZATIONS, AND RECEIVING COPIES OF THE FPEIS

American Samoa Community College/Sea Grant
American Samoa Department of Commerce
American Samoa Department of Marine and Wildlife Resources
City and County of Honolulu, Department of Planning and Permitting
Center for Tropical and Subtropical Aquaculture
CNMI Bureau of Environmental and Coastal Quality
CNMI Department of Lands and Natural Resources, Division of Fish and Wildlife
CNMI Indigenous Affairs Office
CNMI Northern Marianas College, Cooperative Research and Extension Education Services (CREES)
CNMI Northern Marianas College, Sea Grant
CNMI Office of the Governor, Youth Affairs
Guam Bureau of Statistics and Plans, Coastal Management Program
Guam Department of Agriculture, Division of Aquatic and Wildlife Resources
Guam Department of Chamorro Affairs
Hawaii Department of Agriculture
Hawaii Department of Aquatic Resources
Hawaii Department of Business, Economic Development and Tourism, Office of Sustainable Planning
Hawaii Department of Land and Natural Resources
National Park Service
Natural Energy Laboratory of Hawaii Authority
NMFS Pacific Islands Regional Office
NMFS Pacific Islands Fisheries Science Center
NMFS Silver Spring Office
NOAA Office of Law Enforcement
NOAA Office of National Marine Sanctuaries
Oceanic Institute
Office of Hawaiian Affairs
Office of Samoan Affairs
Papahanaumokuakea Marine National Monument
United States Air Force
United States Army
United States Army Corps of Engineers, Honolulu District
United States Marine Corps
United States Coast Guard 14th District
United States Environmental Protection Agency, Region 9
United States Fish and Wildlife Service
United States Food and Drug Administration
United Sates Navy
University of Guam Sea Grant
University of Guam Marine Lab
University of Guam, College of Natural and Applied Sciences
University of Hawaii Hilo, PACRC

University of Hawaii Sea Grant
Western Pacific Fishery Management Council

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APPENDIX A: SUMMARY OF PUBLIC COMMENTS ON DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT FOR A PACIFIC ISLANDS AQUACULTURE MANAGEMENT PROGRAM

Summary of Public Comments and Responses on
Draft Programmatic Environmental Impact Statement for
Pacific Islands Aquaculture Management Program

(RTID 0648-XA867)

Pacific Islands Regional Office
National Marine Fisheries Service (NMFS)
National Oceanic and Atmospheric Administration (NOAA)

CONTENTS

1 INTRODUCTION

The National Marine Fisheries Service (NMFS) has prepared a draft Programmatic Environmental Impact Statement (DPEIS) to support planning for a future aquaculture management program in the Pacific Islands Region (PIR) and evaluate the potential effects of alternatives currently under consideration. Although the management program is currently conceptual, aquaculture in Federal waters would be managed under revised Fishery Ecosystem Plans (FEP) and their implementing regulations. A final PEIS, including the comments received on the DPEIS, will inform early program planning and coordination with the Council and interested and affected members of the public, completion of a programmatic review of potential management considerations, and an analysis of potential environmental impacts. The PEIS would support tiered environmental effects analyses in the future, if necessary.

NMFS published the DPEIS on May 7, 2021, in the *Federal Register* (86 FR 24616). The comment period ended on August 5, 2021.[60] NMFS also held four virtual public meetings between June 15 and June 24, 2021 (noticed at 86 FR 27836, May 24, 2021), to record oral comments on the DPEIS. This report summarizes written and oral comments received throughout the comment period, the demographics of commenters, the key themes of their statements, and includes responses to the comments. This includes the written comments and summaries of the public meetings that contain paraphrased transcriptions of the oral comments. This report serves as a guide for reviewing the comments and should not substitute for reading the comments directly. The public can view comments at https://www.regulations.gov/document/NOAA-NMFS-2021-0044-0003/comment.

2 METHODS

NMFS analyzed public comments by sorting and summarizing submissions into categories based on common themes. The goal of this process was to ensure that NMFS reviewed and synthesized each substantive comment that was pertinent to the proposed action. Substantive comments constitute assertions, suggested alternatives or actions, data, background information, and/or clarifications relating to development of the draft or final PEIS document. NMFS then assigned each substantive comment to an issue category listed in Section 4 of this document.

NMFS synthesized comments into succinct comment summary statements that are intended to capture the particular concern within each issue category. Comment summary statements capture the range of concerns received on a specific issue.

3 DESCRIPTION OF COMMENTERS

3.1 Oral Commenters

Fifty-two people attended the four virtual public meetings and ten people provided oral comments. NMFS employees facilitated the meetings and provided a brief presentation about the PEIS followed by the opportunity for oral comments from attendees. Table 1 outlines attendance and number of comments received at each meeting.

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[60] https://www.regulations.gov/docket/NOAA-NMFS-2021-0044

Table 41. Summary of attendance for public comment meetings held for the Aquaculture PEIS. All times are in Hawaii Standard Time.

Meeting Date and Time	Number of Attendees	Number of Commenters
Tuesday, June 15, 2021, 4 p.m. to 6 p.m., and 7 p.m. to 9 p.m.	17	2
Tuesday, June 22, 2021, 11 a.m. to 1 p.m.	27	7
Thursday, June 24, 2021, 7 p.m. to 9 p.m.	8	1

3.2 Written Commenters

There were 150 total written comments submitted on *regulations.gov*. There were 127 submissions from individuals or businesses, 2 from small groups of individuals, 16 from non-governmental organizations (NGOs), and 5 from government representatives or agencies. One NGO submitted a letter for itself and listed 24,399 of its members in an attachment. There was evidence of collaboration and networking among stakeholders in developing comments, with one form letter submitted by 42 individuals. These duplicate or quasi-duplicate letters may have been written by an organization(s) as a template and then distributed.

Table 42. List of organizations and government entities that submitted written or oral comments on the DPEIS.

Organization names A through L	Organization names M through Z
• Aina Momona	• Monterey Bay Aquarium
• American Samoa Department of Agriculture	• Natural Energy Laboratory of Hawaii Authority (NELHA)
• Blue Ocean Mariculture	• Natural Resources Defense Council
• Blue Revolution Hawaii	• Northern Marianas College
• Center for Biological Diversity	• Ocean Era Inc.
• Center for Food Safety	• Ocean Stewards Institute
• Clean the Pacific	• Pacific Whale Foundation
• Department of the Interior	• Sierra Club
• Department of the Navy	• Sierra Club of Hawaii
• Environmental Protection Agency	• Sierra Club of Hawaii, Hawaii Island Group
• Friends of Animals	• Surfrider Foundation's Kona Kai Ea Chapter
• Friends of the Earth	• Monterey Bay Aquarium
• Friends of the Mariana Trench	• Natural Energy Laboratory of Hawaii Authority (NELHA)
• Forever Oceans Corporation	• Natural Resources Defense Council
• Hawaii Island Reef Keepers (network)	• Northern Marianas College
• Legacy Reed Foundation	• Ocean Era

Table 43.List of individuals that submitted written or oral comments on the DPEIS.

Individual names A through K	Individual names L through Z
• Adams, L.	• Lacks, Kelley
• Ahlstrand, Heidi	• Lenchner, Nicholas
• Anonymous (9)	• Lish, Christopher
• Bender, Doug	• Lizzi, Christina
• Bishaw, Rene	• Lo, Nanea
• Blair-Stahn, Chai	• Lyerly, Linda
• Boisvert, Denise	• M., L.
• Bonar, Marjorie	• MacCausland, Janet
• Breda, Bo	• Mangel, David
• Brown, Puanani	• Martin, Drew
• Canright, Mark	• Martyn, Ken
• Canright, Rebecca	• Matinjussi, Valarie
• Carpenter, Carol	• McClintock, B.A.
• Carroll, Linda	• McMaster, Michael
• Chapman, Kerry	• Melamed, Naomi
• Chun, Lori	• Mennel-Bell, Mari
• Coccari, Taylor	• Milisen, Jeff
• Collins, Carol	• Monasevitch, Nina
• Cooley, James	• Morningstar, Sage
• Coon, Richard	• Neste, Lisa
• Corley, Dr. Cris	• Norman, Colly
• Crumrine, S. Beth	• Oldy, Iris
• Delgadillo, Sarah	• O'Neill, Calley
• DeVille, Lisa	• Osterer, L.
• Duval, Kathryn	• Ozkan, Dogan
• Egger, Tricia	• Paselk, Steve
• Esposito, Dan	• Patterson, Carol Joan
• Faubel, Holly	• Perruso, Amy
• Feldman, Aileen	• Plauche, Elisa
• Fitzsimmons, Kevin	• Raney, Dave
• Fong, Georgie	• Ratcliff, Philip
• Frazer, Neil	• Reynolds, Kathryn
• Freid, Steven	• Roach, Rose
• Frohn, Joyce	• Roberts, Leona
• Fugate, Peggy	• Rodar, Jodi
• Garrison, Rob	• Savage, Gary (2)
• Gorresen, Brenna	• Schweitzer, Marsha
• Hafer, Sarah	• Shapiro, Beppie
• Hage, Catherine	• Simpliciano, Joseph

Individual names A through K	Individual names L through Z
• Hansen, Amy	• Skarada, Darcy
• Harden, Cory	• Smith, Melissa
• Harp, Isaac (2)	• Sogi, James
• Harris, Kym	• Stanojevic, Erica
• Harrold, Gary	• Steiner, A.L.
• Isoda, Andrew	• Stone, Johanna
• Jack, Don	• Stroud, Dr. Jo C.
• Jaecker, Donna	• Summers, Jess
• Johnson, Mary	• Taylor, Bill
• Jones, Ninette	• Thayer, Jeff
• Jorgensen, Kim	• Thelander, Donna
• Kassel, Joseph	• Tidwell, Marion
• Kim, Earl	• Tokuda, Tlaloc
• Kisor, Dave	• Valentine, Jennifer
• Kite, Richard	• Ware, Diane
• Knapp, Dawna	• Watts, Elizabeth
• Knutsen, Maureen	• Weiss, Valerie
• Koppel, Mark	• Wilson, Pete
• Kripli, Paul	• Wood, Helene
• Kuoha, Keoni	• Young, Joslynne

4 COMMENTS AND RESPONSES

4.1 General Comments

4.1.1 Investing in alternative aquaculture methods, rather than offshore aquaculture

Comment: NOAA should invest more in non-offshore aquaculture methods as a means to address food security. Raising species other than finfish (e.g., shellfish and/or seaweeds), utilizing Hawaiian fishponds, land-based recirculating aquaculture systems (RAS), or aquaponics would require less input to produce protein. NOAA should consider prohibiting aquaculture operations in the Pacific Islands Region, on the basis of the Precautionary Principle, as an alternative action.

Response: The PEIS recommends the development of an offshore aquaculture management program that incorporates the beneficial aspects of existing nearshore and land-based aquaculture practices in Sections 2.2.4, 3.1.3, 3.2.3, 3.3.3, and 3.4.3. These aspects could include raising multiple species (i.e., polyculture) or using culture methods designed to raise species representing multiple trophic levels in one facility (i.e., integrated multitrophic aquaculture). The PEIS also encourages culturing less-intensive species, such as seaweeds and shellfish.

NOAA supports Hawaiian fishpond (loko ia) revitalization in a variety of ways, including providing funding opportunities, supporting regulation reform, and serving as a stewardship partner through the National Estuarine Research Reserve System.[61] At the national level, there are multiple funding opportunities available for aquaculture projects.[62] Several current and formerly funded projects focus on loko ia needs, from research efforts aimed at increasing production and economic sustainability,[63] to education and training programs focused on loko ia restoration and management.[64] The PIRO Federal Programs Office Annual Reports webpage summarizes aquaculture work that NMFS has funded across the region over the last several years. [65] Between 2011 and 2015, PIRO also joined other government, non-government, and stakeholder partners in a process that streamlined State of Hawaii and Federal permitting processes for loko ia.[66]

NOAA did consider prohibiting aquaculture in Section 2.1.4, but determined that prohibiting aquaculture would not help the U.S. meet consumers' growing demand for seafood and reduce the Nation's dependence on seafood imports. This alternative would not meet the purpose and need of the action. The commenter suggested analyzing a comparison of impacts between offshore aquaculture and land-based aquaculture systems, but this would be outside the Action Area and the scope of the document.

4.1.2 Support for Alternative 1

Comment: NMFS and the Council should pursue Alternative 1 (no action) and should not pursue developing an aquaculture management program because the potential effects of offshore aquaculture require further scientific study before moving forward with developing an aquaculture management program.

Response: The PEIS is a foundational step that allows for, and would require, environmental impact analysis both in general and for specific aquaculture projects. Aquaculture projects are currently allowed in Federal waters. Though individual projects must meet some local, state, and Federal requirements, there is no comprehensive system in place for managing offshore aquaculture. Creating a potential aquaculture management program would support sustainable development of offshore aquaculture and ensure protection for the region's physical, biological and socioeconomic environment. (See PEIS Sections 1.1, 1.4, and 2.1)

4.1.3 Support for Alternative 2

Comment: NMFS and the Council should pursue Alternative 2 based on the 10-year permit duration, requirement for a decommissioning plan, and more stringent requirements for

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[61] https://coast.noaa.gov/nerrs/reserves/hawaii.html

[62] https://www.fisheries.noaa.gov/national/aquaculture/aquaculture-funding-opportunities-and-grants
[63] https://www.fisheries.noaa.gov/feature-story/hatchery-born-mullets-spell-new-things-ancient-hawaiian-fishponds
[64] https://arcg.is/1m4fTi
[65] https://www.fisheries.noaa.gov/resource/document/pacific-islands-regional-office-federal-programs-office-annual-reports
[66] https://dlnr.hawaii.gov/occl/hoala-loko-ia/

allowable species and gear types. The PEIS and any future aquaculture program development should include additional outreach for more thorough investigation into socioeconomic impacts.

Response: Throughout the management program development process, NMFS would rely on the best available scientific information to inform program requirements and ensure they meet the most relevant, up to date information possible. While NMFS would operate the aquaculture management program, education and outreach would be a joint effort shared between NMFS and the Council (Section 1.5.3). Cultural, fishing, and economic impact considerations are in PEIS Sections 4.3.5 and 5.7. These sections outline potential changes in revenue, market value, and employment. Aquaculture facility siting will consider the ongoing activities and culturally important areas to ensure people are not denied any benefits or excluded from these activities (PEIS Section 4.1.1). Both action alternatives include decommissioning plans.

4.1.4 Support for Alternative 3

Comment: NMFS and the Council should pursue alternative 3 based on the longer permit durations, the requirement for decommissioning plans, and the expansion of allowable gear types and species. The benefits of expanding the aquaculture management program is a means to increase food security.

Response: Throughout the management program development process, NMFS would rely on the best available scientific information to inform program requirements and ensure they meet the most relevant, up to date information possible. Both action alternatives include decommissioning plans. NMFS agrees that aquaculture can be one of the many means to increase food security in the Pacific Islands Region.

Comment: The scope of allowable gear types should be expanded to include ocean-resident platforms with onboard thermal energy conversion power generation.

Response: Alternative 3 includes any aquaculture system, including ocean-resident platforms, as an allowable gear type.

4.1.5 Suggestions for future management program details

Comment: Suggestions for consideration in a future management program for offshore aquaculture include:

- “[A] public reporting requirement and mechanism, such as a data portal, to make non-proprietary data publicly available, thereby increasing transparency and accessibility.”
- “[P]recautionary and adaptive management approaches that consider the likely impacts of climate change in siting and monitoring.”
- Detailed descriptions of mitigation and compliance measures.
- “[A]bility, capacity and infrastructure for proper governance should be considered in assessing risk and viability of an aquaculture facility in the open ocean.”
- An additional alternative “that prohibits aquaculture facilities and associated activities within the EEZ around Guam and the Northern Mariana Islands.”

- Greater clarity around chemical use reporting requirements.
- Levels of acceptable impacts and monitoring requirements, specifically for habitat conservation.
- Development of far offshore aquaculture zones.
- Expedited permitting for research licenses.
- Direct engagement with local fishing organizations to ensure that they are able to benefit from the FAD-effect of aquaculture facilities.

Response: NMFS appreciates these comments and suggestions. The PEIS analyzes possible environmental impacts of a potential aquaculture management program. These suggestions are relevant to and would be considered in the next phase of developing a potential aquaculture management program for the PIR.

4.2 Legal Authorities

4.2.1 Legal status of offshore aquaculture in Federal waters

Comment: Open ocean aquaculture is prohibited in Federal marine waters because of the proven negative impacts that industrial/commercial aquaculture has on ocean ecosystems and wild fish populations.

Response: NMFS disagrees with the comment. Aquaculture, defined under the NOAA Marine Aquaculture Policy as the "propagation and rearing of aquatic organisms for any commercial, recreational, or public purpose," may be conducted in the U.S. EEZ to the extent consistent with applicable federal laws and regulations. Limited culture or propagation and harvest operations have been permitted and regulated by NMFS in the marine waters of the PIR for over a decade. In fact, a lawsuit challenging NMFS's authority to regulate a small aquaculture operation in the PIR was rejected by both a federal district court and the Ninth Circuit Court of Appeals. *KAHEA v. National Marine Fisheries Service*, Civ. No. 11-00474 (D. Haw. April 27, 2012), *aff'd in part* 544 Fed. Appx. 675 (9th Cir. 2013).

4.2.2 Federal authority

Comment: NMFS lacks authority to permit aquaculture under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), especially considering a decision from the U.S. Fifth Circuit Court of Appeals.

Response: NMFS disagrees with the comment. While the U.S. Fifth Circuit decision in *Gulf Fishermens Association v. National Marine Fisheries Service*, 968 F3d 454 (5th Cir. 2020) addressed NMFS's authority to regulate aquaculture in the Gulf of Mexico, that decision is not controlling authority in this jurisdiction. The PEIS discusses NMFS regulatory authority and relevant statutes in Sections 1.5.3 and 1.5.4. Importantly, in 2013, the U.S. Court of Appeals for the Ninth Circuit affirmed a decision by the U.S. District Court for the District of Hawaii upholding NMFS' permit issued under the Magnuson-Stevens Act that allowed the controlled culture and harvest of a coral reef ecosystem Management Unit Species (Almaco jack) using a net pen at sea. *See KAHEA v. National Marine Fisheries Service*, Civ. No. 11-00474 (D. Haw. April 27, 2012), aff'd in part 544 Fed. Appx. 675 (9th Cir. 2013). These decisions confirmed that NMFS' authority to regulate "fishing" extends to controlled culture and harvest activities involving regulated fish stocks in the U.S. EEZ.

We will continue to work with stakeholders through existing policies to develop programs that continue to be and are consistent with applicable law.

Comment: The U.S. Federal government should not have authority in Hawaii, considering the illegal overthrow of Hawaiian Kingdom by the United States in 893. A recent court filing in the U.S. District Court for the District of Hawaii (*Hawaiian Kingdom v. Biden*, Civ. No. 1:21-cv-00243 (D. Haw.) calls for reinstatement of the Hawaiian Kingdom government as a sovereign nation.

Response: Sovereignty is outside the scope of the PEIS. With that said, the District Court for the District of Hawaii dismissed the above-referenced case. *Hawaiian Kingdom v. Biden*, Civ. No. 1:21-cv-00243, ECF No. 234 (D. Haw. June 9, 2022). NMFS has the authority through the Magnuson-Stevens Act to manage fishing for marine resources within the U.S. Exclusive Economic Zone (EEZ) around Hawaii, Guam, the Commonwealth of the Northern Mariana Islands, and American Samoa.

4.2.3 Statutory Requirements

Comment: NMFS is not adhering to the National Environmental Policy Act (NEPA) process due to a failure to take a hard look at the direct, indirect, and cumulative impacts of the project, lack of environmental analysis for protected species and wildlife, lack of disclosure on unavailable information, lack of definition in existing alternatives, failure to consider reasonable intermediate alternatives, inadequate consideration for human health impacts, failure to adequately consider mitigation measures, and inadequate disclosure of allegations of mismanagement, misuse of power, and conflict of interest issues with the Council.

Response: Prior to publishing the draft PEIS, the document went through extensive internal NMFS review at both the regional and national level. NMFS prepared the PEIS to meet the requirements for a programmatic EIS provided in the Companion Manual for NOAA Administrative Order 216-6A.[67] The Companion Manual provides these major considerations:

> "Programmatic" reviews are broad or high-level NEPA reviews that assess the environmental impacts of proposed policies, plans, programs, or projects for which subsequent actions will be implemented either based on the programmatic EA (PEA) or programmatic EIS (PEIS), or based on subsequent NEPA reviews tiered to the programmatic review (e.g., a site- or project-specific document). Programmatic NEPA reviews can provide the basis to approve broad or high-level decisions such as identifying geographically bounded areas within which future proposed activities may be taken or identifying broad mitigation and conservation measures that may be applied in subsequent tiered reviews. Effective programmatic NEPA analyses should present

[67] Available at https://www.noaa.gov/sites/default/files/2021-10/NOAA-NAO-216-6A-Companion-Manual-03012018%20%281%29.pdf.

document reviewers with NOAA's anticipated timing and sequence of decisions, which decisions are supported by the programmatic NEPA document and which decisions are deferred for some later time, and the time frame or triggers for a tiered NEPA review.

Programmatic reviews should be considered, in particular when a decision maker is (1) initiating or revising a national or regional rulemaking, policy, plan, or program; (2) adopting a plan for managing a range of resources; or (3) making decisions on common elements or aspects of a series or suite of closely related projects. The decision maker should consider including other NOAA programs or Line or Staff Offices that may benefit from a cooperative approach to the broader or programmatic EIS or EA.

The PEIS is a broad, high-level NEPA review that guides the development of a management plan that may include regulations for determining whether and how to permit aquaculture in Federal waters of the region. This proposed action is the initial step to developing a comprehensive management program for offshore aquaculture in the PIR. Developing a comprehensive program will require subsequent processes through rulemaking, where the details of a program will be brought to the public for additional comment. The development process would also entail consultation under other applicable statutes (e.g., Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA)) and possibly additional NEPA analysis for the program requirements. Under any established program, individual projects and their applications will be evaluated against the program requirements and could entail project-specific NEPA analysis if not already covered under the program-wide analyses.

The PEIS Chapter 2 discusses the two action alternatives at an appropriate level of detail required for a programmatic EIS at this stage in development of a management program. Throughout Chapter 2, the PEIS identifies relevant management and mitigation measures that could be included in a management program, and in an effort to ensure such a program remains current with the best available science, these details will be further determined during a future rulemaking process.

We address each NEPA topic of concern noted in the comments below followed by a list of related changes made to the PEIS.

- Adherence to NEPA process: NEPA is a procedural law that requires Federal agencies to undertake environmental review procedures relevant to an action. As described above, this environmental analysis is suited to the high-level programmatic nature of the proposed program.
- Lack of environmental analysis: The PEIS describes the available information to date related to site-specific proposals, future aquaculture siting, allowable gear, etc. throughout the analyses in Chapters 4 and 5. As site-specific information becomes available, we anticipate additional environmental reviews and analyses will be undertaken as appropriate.
- Lack of definition in existing alternatives: Chapter 2 defines existing alternatives to a practical extent for the high-level nature of the PEIS.

- Consideration for intermediate alternatives: The PEIS defines a reasonable range of alternatives pursuant to the scope of the PEIS. There is no requirement for considering additional intermediate alternatives.
- Consideration for mitigation measures: The PEIS adequately considers mitigation measures suitable for the broad programmatic nature of the current proposed aquaculture management program. Both action alternatives discuss mitigation measures in Chapter 2 and throughout Chapter 4 relative to the impact that is being mitigated.
- Consideration for allegations against the Council: This is out of scope of the PEIS.
- NMFS has made several changes to improve the PEIS clarity as it relates to NEPA requirements, including:
- Adding a table summarizing key differences between the alternatives (Section 2.2).
- Adding clarification regarding coordination of permit applications, reviews, and reporting requirements with other relevant agencies (Sections 2.2.2, 2.2.6).
- Adding clarification to framework regulations and procedures that would follow a final PEIS and during program development and implementation (Section 2.3.1).
- Adding clarification regarding the availability and analysis of research that is specifically for offshore aquaculture (Section 4.1.1).
- Adding a summary table for environmental consequences of the alternatives (Section 4.2).
- Adding information about potential greenhouse gas emissions associated with aquaculture (Section 4.3.1).
- Adding language to ensure potential for invasive species introductions are accurately outlined (Section 4.3.2).
- Clarifying information around logistics and potential for recapturing escaped fish (Section 4.3.3).
- Clarifying potential impacts related to cultural heritage and environmental justice (Section 4.3.5).

Comment: The PEIS does not sufficiently address mandates under the Migratory Bird Treaty Act (MBTA), ESA, MMPA, and the National Historic Preservation Act (NHPA) and offshore aquaculture may violate the Public Trust Doctrine.

Response: The PEIS addresses requirements under the MBTA, ESA, NHPA and MMPA, as appropriate for this action. The PEIS identifies species and habitats protected under each act, including critical habitats for listed species under the ESA, and indicates that any future management program would require adherence to mandates under these acts (Sections 3.1.2, 3.2.2, 3.3.2, 3.4.2, 4.3.4, 3.5.2, 6.4, and 6.5). Tables 12 and 14 in the PEIS covers all non-ESA seabirds that are protected by the MBTA. Tables 9, 13, and 16 include species protected by the MMPA. Tables 10 and 11 include species protected by the ESA. We have added the MBTA to Chapter 6 Applicable Laws.

Any future amendment to an FEP that may follow from the PEIS would comply with any applicable NHPA, MBTA, MMPA, and ESA Section 7 requirements prior to permitting any activities. PEIS Sections 4.2 and 6.3 specifically note that NHPA would be followed when considering proposed siting for any particular aquaculture operation under any of Alternatives 1, 2, or 3.

Aquaculture in the PIR is considered a commercial fishery, which are managed under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). This act incorporates the public trust doctrine and NOAA works to uphold its mandate to hold ocean resources in trust for the benefit of all its citizens. In particular, Magnuson-Stevens Act Section 301(a) requires that all NMFS fishery management plans and regulations are consistent with ten national standards for fishery conservation and management, which incorporate public trust principles.

Under the MMPA, commercial fisheries are categorized based on their frequent, occasional, or remote likelihood of incidental mortality and serious injury to marine mammals (50 CFR 229.2). All commercial fisheries, regardless of category, are required to report every incidental death or injury of a marine mammal that results from commercial fishing operations (50 CFR 229.6). As a commercial fishery, aquaculture operations are subject to this requirement. Fisheries listed in the ‘frequent’ or ‘occasional’ categories must obtain a marine mammal authorization certificate from NMFS to incidentally take non-ESA listed marine mammals.

We have added clarifying information about the MMPA and List of Fisheries to PEIS Section 4.3.4

Comment: The PEIS should consider a U.S. Department of the Interior review that recommends allowing fishing in the Pacific Remote Islands and Rose Atoll Marine National Monuments. The PEIS should also include information from a Secretary of Commerce report covering impacts of sanctuaries and monuments on energy and mineral development.

Response: Although these reports are not mentioned by name in the draft PEIS, we considered their potential outcomes in the list of reasonably foreseeable future actions (see item 21 in Table 26 of the PEIS Section 5.2). The Executive Orders that precipitated these reports are no longer effective because Executive Order 13990 revoked them on January 20, 2021 (www.federalregister.gov/documents/2021/01/25/2021-01765/protecting-public-health-and-the-environment-and-restoring-science-to-tackle-the-climate-crisis). PEIS Sections 5.3, 5.4.1, 5.4.3, 5.4.5, 5.5, 5.6.2, and 5.7 consider the potential impacts of opening current marine monuments to fishing activities. Though revoked, we have added the prior Executive Orders to Chapter 6 Applicable Laws for reference purposes only, not to suggest that they remain in effect.

4.3 Effluents

4.3.1 Water quality impacts

Comment: Areas surrounding an aquaculture facility will have excess amounts of organic pollution (e.g., fecal matter, feed), chemical pollution (e.g., antibiotics, other therapeutants) and anthropogenic pollution (e.g., ropes, nets, plastics).

Response: Any potential aquaculture management program will address water quality issues, especially since the U.S. Environmental Protection Agency (EPA) is a cooperating agency on this document and we will continue to engage them throughout the development of any program. Any future management program will require water quality monitoring according to the National Pollution and Discharge Elimination System (NPDES) (see PEIS Section 1.5.6). Marine debris, chemicals, and pollution were all identified during the previous scoping for the PEIS and addressed in PEIS Sections 2.2.1, 2.2.6, 4.3.1, 4.3.3, and 5.3. The NPDES regulates water quality affected by fecal matter produced by finfish aquaculture at 40 CFR 122.24. All projects, regardless of the alternative selected, will need to pass standards set by the NPDES and Clean Water Act (see PEIS Sections 4.3.1 and 6.7).

Recent advances in husbandry and maintenance over the past two decades have decreased the chemical use and consequential release into the environment (see PEIS Section 4.3.1). The Food and Drug Administration (FDA) must approve antibiotics and chemicals allowed for use under any alternative (see PEIS Table 1 and Table 24). Any potential aquaculture management program will align with FDA approval, reporting, and other requirements. These will be determined during the development phase of an aquaculture management program.

We have added clarifying information to Sections 2.2.2 Applications and 2.2.6 Recordkeeping and Reporting Requirements regarding FDA requirements and engagement.

4.4 Habitat and Ecosystem Functioning

4.4.1 Fish Aggregating Device (FAD) effect

Comment: Aquaculture facilities may attract a variety of fish and other wildlife, which could result in entanglements, vessel strikes, and incidental fisheries bycatch.

Response: The PEIS considers potential FAD effects in Sections 4.3.2 and 4.3.4. The PEIS considers risks and potential impacts of entanglement, vessel strikes, and anthropogenic sound effects in PEIS Section 4.3.4. We will incorporate this information into future consultations under Section 7 of the ESA and reporting and authorization under the MMPA. Additional information regarding FAD effects and wildlife is covered below (see this document section 4.5 “Other Marine Wildlife and Protected Species”). We have clarified FAD effects in Section 4.3.2.

4.4.2 Habitat conservation

Comment: The PEIS requires further detail and more clearly stated intent to preserve habitat when considering site selection for offshore aquaculture.

Response:

The PEIS considers impacts on essential fish habitat (EFH), ESA critical habitat and habitat areas of particular concern (HAPC) for all three alternatives (See PEIS Table 1 and Table 24; Sections 1.5.4, 2.2.3, 3.1.1, 3.1.2, and 4.3.2). Table 7 in the PEIS identifies EFH and HAPC definitions for the Western Pacific region. We have updated this table to include a more comprehensive list. We have added clarifying information related to habitat to PEIS Sections 1.5.4, 2.2.3, 3.1.1, 3.1.2, and 4.3.2. For the two action alternatives, the siting analysis would consider all critical habitat, EFH, and HAPC.

4.4.3 Siting concerns

Comment: Aquaculture siting should:

- Avoid creating exclusive aquaculture use areas.
- Consider climate change and potential habitat impacts.
- Target areas that have minimal impact on the environment (deep water, strong currents, and far offshore).
- Consider potential disease transfer to wild stocks in siting decisions.
- Avoid military areas (danger zones, firing ranges, etc.).

Response: Each action alternative would require mitigation measures and a siting analysis (PEIS Section 2.3.3). None of the alternatives designates exclusive use areas for aquaculture activities. The PEIS considers potential habitat and disease impacts in the Executive Summary, Table 1, and in Section 4.2, Table 25. PEIS Section 3.1.3 characterizes optimal sites related to water quality, weather conditions, and ease of access. NMFS is working with the U.S. Department of the Navy, which is now a cooperating agency on this document, to ensure that any potential aquaculture siting excludes incompatible military areas. We have added more detailed information and maps to PEIS Sections 3.3.3 and 3.4.3 to reflect such areas identified by the Navy in its comments on the draft PEIS. NMFS has added climate change forecasting to the potential siting restrictions listed in Section 2.2.3.

Comment: Guam and the Commonwealth of the Northern Mariana Islands (CNMI) have limited infrastructure to support monitoring requirements, so NMFS should avoid promoting ocean aquaculture within the EEZ in and around the Marianas Trench Marine National Monument units (Trench, Volcanic and Islands Unit) and other marine protected areas (MPAs).

Response: The PEIS provides a foundational framework for a potential future aquaculture management program and does not promote aquaculture in any specific area. Marine national monuments and other protected areas are included in siting considerations outlined in Chapter 2. The PEIS also includes information about Federally managed sanctuaries, monuments and wildlife refuges in each relevant archipelagic region (see PEIS Sections 3.1.3, 3.2.3, 3.3.3, 3.4.3, and 3.5.3.)

Comment: The PEIS should include a reference to the Antiquities Act and the relevant Presidential Proclamations establishing marine national monuments in the PIR.

Response: We have added the Antiquities Act and the relevant Presidential Proclamations to Chapter 6 Applicable Laws.

4.5 Local Wild Fish Stocks

4.5.1 Source of broodstock

Comment: Future management programs should consider sustainability of the wild stocks captured as broodstock for cultured fish.

Response: Under all alternatives, operations that collect broodstock from the wild will require a comprehensive plan and rigorous documentation (see PEIS Section 2.2.2). Action Alternatives 2 and 3 include a permit application process that would require stock status consideration for each proposed cultured species (see PEIS Section 2.2.5).

4.5.2 Potential for fish escapes

Comment: Offshore aquaculture carries a risk for cultured fish escapes and the PEIS should include more investigation into the potential impacts of such escapes.

Response: The PEIS considers potential genetic and competition impacts of cultured fish escapes in Section 4.3.3. Potential impacts from, and additional prevention and mitigation measures for, fish escapes are being studied. Any future development and implementation of an aquaculture management program is a dynamic process and, as such, relevant results of such studies will be incorporated into the program as results become available.

4.5.3 Disease transfer

Comment: Offshore aquaculture carries a risk of disease transfer (e.g., bacterial, viral, parasitic, etc.) from aquaculture to wild stocks, or from wild and aquaculture stocks to humans (i.e., epizootic transfer [sic]). This should be considered further in the PEIS.

Response: The PEIS considers disease transmission between wild and aquaculture stocks in Sections 2.2.6 and 4.3.3, and between aquaculture stocks and other species in Section 4.3.4. The PEIS does not currently consider human health related impacts. We have added potential zoonotic transfer and updated several of the references in the socioeconomic impacts in PEIS Section 5.7. Potential disease transmission and human health impacts are currently being studied. Any future development and implementation of an aquaculture management program is a dynamic process and, as such, relevant results of such studies will be incorporated into the program as they become available.

4.5.4 Feed content

Comment: Using wild fish in aquaculture feeds is concerning. It is important that a management program encourages sourcing wild fish ingredients sustainably and encourages using alternative ingredients.

Response: The two action alternatives require consideration for impacts on source fisheries used for feed (see PEIS Table 1 and Table 24). The PEIS discusses potential impacts on wild fish inclusion in aquaculture feeds and cites current advances in aquaculture feed formulations that have already reduced reliance on wild fish oil and fish meal sources in feed formulations (see PEIS Section 4.3.3). We have added clarification to the recordkeeping requirements in Section 2.2.6 to include source fisheries used in feeds.

4.6 Other Marine Wildlife and Protected Species

4.6.1 Protected species concerns

Comment: Gear and equipment associated with aquaculture facilities can lead to protected species entanglement. Aquaculture sites have associated FAD effects, which could result in an increased chance for vessel strikes and anthropogenic sound affecting cetacean behavior.

Response: The PEIS considers entanglement, vessel strikes, and anthropogenic sound effects in Section 4.3.4. The PEIS covers FAD effects in Sections 4.3.2 and 4.3.4. This information will be incorporated into future consultations under ESA Section 7, and reporting and authorization requirements under the MMPA. As they become available, any relevant results from ongoing and possible future research and development related to potential effects on marine species and mitigation measures will be incorporated into any future management program.

4.6.2 Wildlife behavior alteration

Comment: The physical presence of an aquaculture facility affects native fish movement and schooling behavior. Larger predators (e.g., sharks, dolphins) may change foraging tactics when in close proximity to a facility.

Response: PEIS Section 4.3.4 covers changes in behavior for ESA-listed species. The PEIS considers direct impacts on fish stock migrations and movements with regards to aquaculture facilities under the FAD effects outlined in Section 4.3.2. This information will be incorporated into future consultations under Section 7 of the ESA, and reporting and authorization requirements under the MMPA. These consultations and authorizations will analyze in depth all potential effects, including fish movement and schooling behavior, and foraging tactics. We have added information regarding documented cases of aquaculture interactions with protected species and the FAD effect in PEIS Section 4.3.4.

4.7 Socioeconomic Impacts

4.7.1 Cultural resources and consultation

Comment: The State of Hawaii Office of Hawaiian Affairs, Federally recognized Native Hawaiian Organizations, and relevant non-governmental organizations (NGO) were not adequately consulted prior to PEIS publication and they should have an additional comment period.

Response: NMFS provided opportunity for public comment and review of the PEIS in accordance with NEPA requirements. NMFS notified the State of Hawaii, American Samoa, Guam, and CNMI resource management agencies, and local, regional, and national NGOs in advance of the publication. NMFS also sent the PEIS to parties that had commented on or requested notification during the scoping period. PEIS Chapter 8 lists the government entities. NMFS created a webpage for the PEIS (https://www.fisheries.noaa.gov/action/potential-aquaculture-management-program-pacific-islands) that contains links to the *regulations.gov* docket and all of the relevant *Federal Register* notices associated with PEIS development. The comment period duration (90 days) is the maximum required. We have added information to

Sections 2.2.2 Applications and 2.2.3 Siting Analysis to clarify responsibilities relevant to cultural consultation. Additional outreach and comment opportunities for public agencies, indigenous organizations, interest groups, and individuals will occur during any FEP amendment and rulemaking processes for a potential aquaculture management program.

4.7.2 Context with American Samoa Deeds of Cession

Comment: Offshore aquaculture activities could interfere with the American Samoa Deeds of Cession, specifically within the context of recent litigation between American Samoa and NMFS.

Response: The PEIS provides a framework for a potential future aquaculture management program and does not authorize aquaculture activities in any specific area. Any aquaculture projects proposed for American Samoa would be reviewed before approval to ensure compliance with all applicable federal laws. In addition, the MSA requires NMFS to consider, among other things, the impact of permitted activities on fishing and fishing communities, which would include the impact on cultural fishing in American Samoa.

4.8 Climate Change

Comment: The PEIS needs to incorporate further analysis on climate-related impacts (e.g., sea level rise, changes in migration patterns, changes in disease patterns, extreme weather events, slowing ocean currents).

Response: The PEIS considers climate change impacts for each impact area in Chapter 5. We have added further information regarding potential climate change impacts throughout the cumulative effects analyzed in Chapter 5. NMFS and the Council regularly monitor the operations and require reporting for all federally managed fisheries within their jurisdiction. The same would be true under a Federal aquaculture program, as described in PEIS Chapter 2. This regular monitoring and reporting not only provides information on the effects of the fisheries' ongoing operations on a changing environment, but also the effects of changing environmental conditions on the fisheries. This information factors into ongoing NMFS and Council management decisions. Likewise, any relevant results from ongoing and possible future research related to potential effects of climate change and their relation to offshore aquaculture will be incorporated into any aquaculture management program as they become available.