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February 24, 2023

MEMORANDUM FOR: Tia Brown
Acting Director, PIFSC

FROM: Kate Taylor Kate Taylor Digitally signed by TAYLOR.KATE.LIN.1504959453 Date: 2023.02.24 16:21:05 -10'00'
PIR NEPA Coordinator

SUBJECT: Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center – Programmatic Environmental Assessment and Finding of No Significant Impact Review

This memorandum documents my review and comment on the subject Final Programmatic Environmental Assessment (PEA) and Finding of No Significant Impact (FONSI). This review is provided in accordance with National Marine Fisheries Service (NMFS) Policy 09-101, dated August 29, 2020: "Policy for National Environmental Policy Act Compliance." The initial review of the subject PEA was completed prior to its release for public comment in November 2015 by the previous NEPA Coordinator, Marilyn Luipold. This review was completed on August 5, 2022. I have provided suggestions on the PEA and FONSI that will support compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ) regulations, and guidance in NOAA Administrative Order (NAO) 216-6A's Companion Manual.

The Pacific Islands Fisheries Science Center (PIFSC) proposes to implement and/or fund a number of research activities over the next five years onboard NOAA owned and operated vessels, chartered vessels, or commercial fishing vessels in the Pacific Islands Region. Research would be conducted in four different research areas within the Pacific Islands Region: 1) Hawaiian Archipelago Research Area, 2) Mariana Archipelago Research Area, 3) American Samoa Archipelago Research Area, and 4) Western and Central Pacific including the Pacific Remote Islands Research Area. The purpose of the research is to produce scientific information necessary for the management and conservation of domestic and international living marine resources. PIFSC's research is needed to promote both the long-term sustainability of the resources and the recovery of certain species, while generating social and economic opportunities and benefits from their use.

The proposed action also includes the application to NMFS Office of Protected Resources by PIFSC for a Letter of Authorization issued under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA). The LOA would provide an exception to PIFSC from the take prohibitions for marine mammals under the MMPA, which may occur incidental to the conduct of research activities. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals to the level of least practicable adverse impact. Therefore, the

PEA also incorporates a range of mitigation measures in order to evaluate their ability to minimize potential adverse environmental impacts on marine mammals pursuant to the issuance of an LOA under the MMPA.

NMFS prepared the subject PEA to evaluate the potential environmental impacts of the proposed actions on the human environment. The PEA analyzes the following four alternatives in detail:

- **Alternative 1 – The Status Quo/No Action Alternative.** Under this alternative, PIFSC would conduct fisheries and ecosystem research using the same protocols as implemented from 2008 through 2021, including no change in the mitigation measures that were developed by PIFSC in consultation with marine mammal scientists and other protected species experts.
- **Alternative 2 – The Preferred Alternative.** Under this alternative, PIFSC would conduct most of the same fisheries and ecosystem research as implemented from 2008 through 2021 and would add new research surveys and projects or expand the geographic area of current surveys and projects. This alternative includes the same suite of mitigation measures as the Status Quo/No Action Alternative and adds the following: PIFSC would change the ratio of sinking and floating lines to reduce the risk of entanglements in lines at the surface of the water and implement improvements to its protected species training and reporting procedures.
- **Alternative 3 – Modified Research Alternative.** Under this alternative, PIFSC would conduct the same fisheries and ecosystem research and mitigation measures as described for the Preferred Alternative and would also implement a number of additional mitigation measures for trawl and longline surveys.
- **Alternative 4 – No Research Alternative.** Under this alternative, PIFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research and would not apply for a LOA.

The analysis in the EA indicates that the proposed action and alternatives are not expected to result in significant adverse effects on target or non-target species, protected species, essential fish habitat or other protected areas, or any considered resources in the socio-economic environment.

The subject FONSI documents that the proposed action and alternative will not significantly impact the quality of the human environment. The FONSI conforms to agency guidance in the Companion Manual, section 7, C and D, (“Determining if the Effects of an Alternative are Significant” and “Documenting the FONSI,” respectively).

Thank you for the opportunity to review the PEA and FONSI.

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research Conducted and Funded

by the

Pacific Islands Fisheries Science Center

March 2023

Prepared for the National Marine Fisheries Service by:

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List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
°C	degrees Celsius
°F	degrees Fahrenheit
3D	3-Dimensional
ACL	Annual Catch Limit
ADCP	Acoustic Doppler Current Profiler
AFSC	Alaska Fisheries Science Center
APE	Area of Potential Effects
ARMS	Autonomous Reef Monitoring Structures
ASARA	American Samoa Archipelago Research Area
AUV	Autonomous Underwater Vehicle
BA	Biological Assessment
BiOp	Biological Opinion
BMPs	Best Management Practices
BMU	Bioerosion Monitoring Unit
BMUS	Bottomfish Management Unit Species
BotCam	Bottom Camera
BRFA	Bottomfish Restricted Fishing Areas
BRT	Bycatch Reduction Technology
BRUVS	Baited Remote Underwater Video Systems
CAU	Calcium Acidification Units
CCR	Closed Circuit Rebreather
CCRA	California Current Research Area
CEQ	Council on Environmental Quality
CFMP	Community-Based Fishery Management Program
CFR	Code of Federal Regulations
CHCRT	Currently Harvested Coral Reef Taxa
CITES	Convention on International Trade in Endangered Species
cm	centimeter
cm^2	square centimeter
CNMI	Commonwealth of the Northern Mariana Islands
CO_2	carbon dioxide
CPUE	Catch Per Unit Effort
CTD	Conductivity, Temperature, Depth instrument
CZMA	Coastal Zone Management Act
DAO	Department of Administrative Orders
DAR	Division of Aquatic Resources

DAS	Days at Sea
DAWR	Guam Division of Aquatic and Wildlife Resources
dB re 1µPa	decibel referenced to one micro pascal
DFG	Derelict Fishing Gear
DMWR	American Samoa Department of Marine and Wildlife Resources
DNLR	State of Hawaiʻi Department of Land and Natural Resources
DON	Department of the Navy
DOS	Department of State
DPS	Distinct Population Segment
DSLL	deep-set longline
EA	Environmental Assessment
EAR	Ecological Acoustic Recorders
ECS	Ecosystem Component Species
EEZ	Exclusive Economic Zone
eDNA	Environmental DNA
EFH	Essential Fish Habitat
EPF	Exempted Fishing Permit
EIS	Environmental Impact Statement
EM	electronic monitoring
ENSO	El Nino-Southern Oscillation
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESD	Ecosystem Sciences Division
ETP	Eastern Tropical Pacific
FEP	Fishery Ecosystem Plan
FMA	Fisheries Management Area
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FRMD	Fisheries Research and Monitoring Division
FSC	Fisheries Science Center
ft	feet
FTE	Full-time equivalent
FWCA	Fish and Wildlife Coordination Act
g	gram
GPS	Geographic Positioning System
HAPC	Habitat Areas of Particular Concern

HARA	Hawaiian Archipelago Research Area
HARP	High-frequency Acoustic Recording Packages
HAZMAT	Hazardous materials
HOV	Human Operated Vehicle
Hz	hertz
HSFCA	High Seas Fishing Compliance Act
HIHWNMS	Hawaiian Islands Humpback Whale National Marine Sanctuary
IAC	Inter-American Convention
IATTC	Inter-American Tropical Tuna Commission
IDCPA	International Dolphin Conservation Program Act
IEA	Integrated Ecosystem Assessment
IHA	Incidental Harassment Authorization
IMO	International Maritime Organization
ITA	Incidental Take Authorization
IR	infrared
ISC	International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean
ITS	Incidental Take Statement
IWC	International Whaling Commission
JIMAR	Joint Institute for Marine and Atmospheric Research
kHz	kilohertz
KIRC	Kahoʻolawe Island Reserve Commission
km	kilometer
km^2	square kilometer
kts	knots
lb.	pound
LME	Large Marine Ecosystem
LOA	Letter of Authorization
LOF	List of Fisheries
m	meter
M&SI	mortality and serious injury
MARA	Mariana Archipelago Research Area
MARPOL	International Convention for the Prevention of Pollution from Ships
MBTA	Migratory Bird Treaty Act
MHI	Main Hawaiian Islands
min	minute
MLCD	Marine Life Conservation District
mm	millimeter

MMED	Marine Mammal Excluder Device
MMPA	Marine Mammal Protection Act
MNM	Marine National Monument
MOU	Memorandum of Understanding
MOUSS	Modular Optical Underwater Survey System
MPA	Marine Protected Area
MPRSA	Marine Protection, Research and Sanctuaries Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mt	metric ton
MUS	Management Unit Species
NAO	NOAA Administrative Order
NAR	National Area Reserve
NDSA	Naval Defensive Sea Areas
NEPA	National Environmental Policy Act
NGO	non-governmental organization
NHO	Native Hawaiian Organization
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
nm	nautical miles
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NMSAS	National Marine Sanctuary of American Samoa
NOAA	National Oceanic and Atmospheric Administration
NPFC	North Pacific Fisheries Commission
NPFMC	North Pacific Fisheries Management Council
NPS	National Parks Service
NWFSC	Northwest Fisheries Science Center
NWHI	Northwestern Hawaiian Islands
NWHICRER	Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve
NWR	National Wildlife Refuge
OHA	Office of Hawaiian Affairs
OPR	NMFS Headquarters Office of Protected Resources
OMID	Operations, Management, and Information Division
ONMS	Office of National Marine Sanctuaries
PAM	Passive Acoustic Monitoring
PBR	Potential Biological Removal
PEA	Programmatic Environmental Assessment

PFMC	Pacific Fisheries Management Council
PHCRT	Potentially Harvested Coral Reef Taxa
PIFSC	Pacific Islands Fisheries Science Center
PIPA	Phoenix Islands Protected Area
PIRO	NMFS Pacific Islands Regional Office
PIT	Passive Integrated Transponder
PRD	Protected Resources Division
PRIA	Pacific Remote Islands Area
PSATs	Pop-off Satellite Archival Transmitting Tags
PSD	Protected Species Division
PSO	Protected Species Observers
PTS	permanent threshold shift
PUC	Programmable Underwater Collection Unit
RAMP	Reef Assessment and Monitoring Program
RAS	Remote Access Samplers
ROV	Remotely Operated Vessel
RFFA	reasonably foreseeable future action
RFMO	Regional Fisheries Management Organization
SAR	Stock Assessment Report
SARA	Samoa Archipelago Research Area
SCUBA	Self-Contained Underwater Breathing Apparatus
SfM	Structure from Motion
SHPO	State Historic Preservation Office
SMA	Special Management Area
SOD	Science Operations Division
SPRFMO	South Pacific Regional Fisheries Management Organization
SPTT	South Pacific Tuna Treaty
SSLL	shallow-set longline
STF	Subtropical Front
STR	Surface Temperature Recorder
SWFSC	Southwest Fishery Science Center
TDR	Time-depth Recorder
TED	Turtle Exclusion Device
TOAD	Towed Optical Assessment Device
TRP	Take Reduction Plan
TS	Threshold Shift
TTS	Temporary Threshold Shift
UAS	Unmanned Aerial Systems

UNESCO	United Nations Educational, Scientific and Cultural Organization
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VME	Vulnerable Marine Ecosystems
VMPA	Village Marine Protected Area
wt	mean weight
WCPFC	Western and Central Pacific Fisheries Commission
WCPRA	Western and Central Pacific Research Area
WPFIN	Western Pacific Fishery Information Network
WPRFMC	Western Pacific Regional Fisheries Management Council
WWII	World War II
XBT	Expendable bathythermograph

EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

The Federal government has a responsibility to protect living marine resources in waters of the United States of America (U.S.), also referred to as federal waters. These waters generally lie 3 to 200 nautical miles (nm) from the shoreline and comprise the Exclusive Economic Zone (EEZ)[1]. The National Oceanic and Atmospheric Administration (NOAA) has the primary responsibility for protecting marine finfish and invertebrate species and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources within the U.S. EEZ.

NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. So central is science-based management to NMFS fishery management efforts, it is listed among the ten National Standards set forth in the Magnuson-Stevens Fishery Conservation and Management Act (MSA): "(2) Conservation and management measures shall be based upon the best scientific information available." (16 U.S.C. §§ 1801-1884).

This Programmatic Environmental Assessment (PEA) evaluates the proposed implementation of Pacific Islands Fisheries Science Center (PIFSC) fisheries and ecosystem research activities for the next 5 years, or longer if the activities continue to be implemented as described in this document and the analysis of the environmental effects remains consistent and applicable with those activities. The purpose of this action is to produce scientific information necessary for the management and conservation of domestic and international living marine resources in a manner that promotes both the recovery and long-term sustainability of certain species and generates social and economic benefits from their use. The information derived from these research activities is necessary for the development of a broad array of management actions for fisheries, marine mammal, and ecosystem management actions taken not only by NMFS but also by other federal, state, and international authorities. The PEA also provides the basis for an application for the issuance of proposed regulations and subsequent Letter of Authorization (LOA) under Section 101(a)(5)(A) of the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 et seq.) that would govern the unintentional taking[2] of small numbers of marine mammals incidental to PIFSC fisheries and ecosystem research activities.

This PEA is being prepared using the 1978 Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA regulations was September 14, 2020. This review began on September 15, 2015 and the agency has decided to proceed under the 1978 regulations.

[1] An area over which a nation has special rights over the exploration and use of marine resources.

[2] The term "take" under the MMPA means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The MMPA defines "harassment" as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption or behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment)." (16 U.S.C. Sec 1361 *et seq.*)

Fisheries Science Centers

In order to direct and coordinate the collection of scientific information needed to make informed fishery conservation and management decisions, NMFS established six regional Fisheries Science Centers (FSCs)[3], each a distinct organizational entity and the scientific focal point within NMFS for region-based federal fisheries-related research in the United States.

The FSCs conduct primarily fisheries-independent research studies4 but may also participate in fisheries-dependent and cooperative research studies. This research is aimed at monitoring target species stock recruitment, survival and biological rates, abundance and geographic distribution of species and stocks, and providing other scientific information needed to improve our understanding of complex marine ecological processes and promote NMFS' strategic goal of ecosystem-based fisheries management.

Pacific Islands Fisheries Science Center Research Activities

PIFSC is the research arm of NMFS in the Pacific Islands Region. Headquartered in Honolulu, Hawai'i, PIFSC has taken a leading role in marine research on ecosystems, both in the insular and pelagic environments. Originally called the Honolulu Laboratory and part of the Southwest FSC for over 40 years, PIFSC became its own science center when the NMFS Pacific Islands Region was established in 2003. PIFSC implements a multidisciplinary research strategy including scientific analysis and an ecosystem observation system to support an ecosystem-based approach to the conservation, management, and restoration of living marine resources. PIFSC conducts a wide range of activities including resource surveys and stock assessments, fisheries monitoring, oceanographic research and monitoring, critical habitat evaluation, life history and ecology studies, advanced oceanographic and ecosystem modeling and simulations, and economic and sociological studies.

PIFSC conducts research and provides scientific advice to managers of fisheries and protected resources for the State of Hawai'i, Territory of American Samoa, Territory of Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Remote Island Areas. This PEA assesses the impacts of research activities conducted by PIFSC in four different research areas (Figure 1.1-2): 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) western and central Pacific including the Pacific Remote Islands Research Area (WCPRA). The HARA, MARA, and ASARA extend approximately 24 nm from the baseline of the respective archipelagos (i.e., to approximately the outer limit of the contiguous zone5). The fourth research area, the WCPRA, includes the remainder of the archipelagic U.S. EEZs, the central and western Pacific Ocean between the archipelagos, and the waters around the Pacific remote islands. These research areas and related Large Marine Ecosystems (LMEs) are described in detail in Section 3.1.1.

[3] The six regional FSCs are: Northeast FSC, Southeast FSC, Southwest FSC, Northwest FSC, Alaska FSC, and Pacific Islands FSC.

[4] Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals, and includes research directed by PIFSC scientists and conducted on board NOAA-owned and operated vessels or NOAA-chartered vessels. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by the PIFSC, but researchers collect data on the commercial catch. Cooperative research programs are those where PIFSC scientists play a significant role in some aspect of study design, administration, or assessment of results but which are carried out by cooperating scientists (other agencies, academic institutions, commercial fishing-associated groups, or independent researchers) on board non-NOAA vessels.

[5] Presidential Proclamation 7219 extended the U.S. contiguous zone from 12 to 24 nm on September 2, 1999.

NMFS has prepared this PEA to evaluate several alternatives for conducting and funding these fisheries and ecosystem research activities as the primary federal action. NMFS is also evaluating a number of mitigation measures that may be implemented to reduce potential impacts on marine mammals as part of compliance with the MMPA. Additionally, because the proposed fisheries and ecological research activities occur in areas inhabited by a number of marine mammals, birds, sea turtles, corals, and fishes listed under the Endangered Species Act (ESA) as threatened or endangered, this PEA evaluates activities that could result in unintentional impacts on ESA-listed species. In addition, because the proposed research activities occur partially within the boundaries of National Marine Sanctuaries (NMS), and within areas identified as Essential Fish Habitat (EFH), this PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the National Marine Sanctuaries Act (NMSA) and section 305(b)(2) of the MSA respectively.

CHAPTER 2 – ALTERNATIVES

Review under NEPA requires federal agencies to evaluate alternatives to a proposed federal action. This assists the decision maker in ensuring that any unnecessary impacts are avoided through an assessment of alternative ways to achieve the underlying purpose of the proposed action that may result in less environmental harm.

To warrant detailed evaluation under NEPA, an alternative must be reasonable and meet the stated purpose and need for the proposed actions (see Section 1.3). Additionally, review under NEPA requires consideration of a "no action" alternative, which is Alternative 1 in this PEA. For this PEA, NMFS has applied the following screening criteria to a range of alternatives to identify which ones should be brought forward for detailed analysis:

Screening Criteria

To be considered "reasonable" for purposes of this PEA, an alternative must meet the following criteria:

- The action must not violate any federal statute or regulation.
- The action must be consistent with reasonably foreseeable funding levels.
- The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts or consider no federal funding availability for fisheries research.
- To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research should address at least some of the following goals related to fisheries management:
    - Methods and techniques must provide standardized, objective, and unbiased data consistent with past data sets (time series) in order to facilitate long-term trend analyses.
    - Collected data must adequately characterize living marine resource and fishery populations and the condition of their habitats.
    - The surveys must enable assessment of population status and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.

- Research on new methodologies to collect fisheries and ecosystem information (e.g., active and passive acoustic instruments, video surveys of benthic habitats in lieu of dredge gear or bottom trawls), and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies must be conducted with experimental controls sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria. Based on this evaluation, the No-Action/Status Quo Alternative and two other action alternatives have been identified as reasonable and are being carried forward for more detailed evaluation in this PEA. NMFS will also evaluate a second type of no-action alternative that considers no federal funding for fisheries research activities. This will be called the No Research Alternative to distinguish it from the No-Action/Status Quo Alternative. The No-Action/Status Quo Alternative will be used as the baseline to compare all of the other alternatives.

Three of the alternatives include a program of fisheries and ecosystem research projects conducted or funded by PIFSC as the primary federal action. Because this primary action is connected to a secondary federal action (also called a connected action under NEPA), for NMFS to consider promulgation of regulations and subsequent issuance of a LOA under Section 101(a)(5)(A) of the MMPA for the incidental but not intentional, taking of marine mammals, NMFS must identify as part of this evaluation under the MMPA "(t)he means of effecting the least practicable adverse impact on the species or stock and its habitat." As a result, NMFS will identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals that occur in PIFSC research areas. In addition, because this NEPA document will be used to initiate section 7 consultation under the ESA and for compliance with other conservation laws, each of which may recommend or require mitigation measures, the consideration of mitigation measures is extended to all protected species. These mitigation measures are considered as part of the identified alternatives in order to evaluate their effectiveness to minimize potential adverse environmental impacts. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the Migratory Bird Treaty Act (MBTA).

PIFSC fisheries and ecosystem research activities also include several international fisheries technology research programs, including bycatch reduction research projects that take place outside of U.S. jurisdiction, in foreign territorial seas. Under Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions, Department of Commerce, Department of Administrative Orders (DAO) 216-12, and NOAA Administrative Order (NAO) 216-6A Section 7, NMFS is required to consider the environmental effects of federal actions outside of the United States. Because these international fisheries technology research programs, including bycatch reduction research projects, are not being evaluated under NEPA, they will be considered separately from the NEPA alternatives in this PEA, and are described in Section 2.7 at the end of this chapter. In compliance with EO 12114, this PEA describes and analyzes the potential effects of the proposed action and alternatives on the environment outside of the United States. Federal actions may be exempt from this EO if the action will not have a significant effect on the environment outside of the United States as determined by the agency (EO 12114, Section 2-5), or if the action is carried out with participation from the foreign nation (EO 12114, Section 2-3(b)).

Alternative 1—No-Action/Status Quo Alternative—Conduct Federal Fisheries and Ecosystem Research with Scope and Protocols Similar to Past Effort

The No-Action/Status Quo Alternative (Status Quo Alternative) includes fisheries and ecosystem research using the same protocols as were implemented in the recent past (considered to be from 2008 through 2021 for the purposes of this PEA). These federal research activities are necessary to fulfill NMFS' mission to provide science-based management, conservation, and protection of living marine resources in four different research areas: 1) HARA; 2) MARA; 3) ASARA; and 4) WCPRA. Under the Status Quo Alternative, PIFSC would conduct the same scope of research as in recent years and use the current mitigation measures for protected species.

Under the Status Quo Alternative, PIFSC would administer and conduct a wide range of fishery-independent and industry-associated research and survey programs, as summarized in Table 2.2-1. These surveys utilize a wide range of research equipment and fishing gear to capture fish and invertebrates for stock assessment or other research purposes, collect plankton and larval life stages of organisms to facilitate ecosystem studies, and gather oceanographic and acoustic data to characterize the marine environment. The main gear types of concern for potential interactions with protected species include pelagic trawls (surface and midwater), various hook-and-line gears, and instruments deployed on lines from vessels or moorings that may result in entanglement. In addition, the use of active acoustic instruments and the presence of researchers may lead to behavioral harassment of marine mammals. The scope of past research activities is considered as the basis for analysis of future activities under the Status Quo Alternative.

The Status Quo Alternative research activities include a suite of mitigation measures that were developed to minimize the risk of ship strikes and entanglements/captures/hookings of protected species in fishing gear (i.e., marine mammal monitoring and the "move-on" rule). The following mitigation measures have been implemented on all PIFSC surveys since at least the end of 2014, although many surveys implemented them earlier:

- Visual monitoring for protected species prior to deployment of gear;
- Use of the "move-on" rule if marine mammals are sighted from the vessel prior to deployment of trawl, longline, or any other fishing gear that may pose a risk of interactions with protected species and if the animals appear to be at risk of interaction with the gear as determined by the professional judgment of the Chief Scientist or officer on watch; and
- Short tow times and set times to reduce exposure of protected species to research gear.

However, these mitigation measures may not be sufficient to reduce the effects of PIFSC fisheries and ecosystem research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA (see Alternative 2). Other mitigation measures may be required under the MMPA and ESA processes for the specified research activities conducted by PIFSC.

Alternative 2—Preferred Alternative—Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Mitigation for MMPA and ESA Compliance

The Preferred Alternative is comprised of a combination of research activities continued from the past and additional, new research surveys and projects. The Preferred Alternative would not include several of the projects described under the Status Quo Alternative, including:

- The Northwestern Hawaiian Islands Lobster Survey
- The Northwestern Hawaiian Islands Bottomfish Survey
- Pelagic Longline Hook Trials
- Longline Gear Research Surveys
- Marlin Longline Surveys

Under the Preferred Alternative, the Cetacean Ecological Assessment surveys would include increased levels of effort relative to the Status Quo Alternative, and it would be expanded to include all four of the research areas within the Pacific Islands Region. Several new research surveys and projects that were not included in the Status Quo Alternative would occur under the Preferred Alternative, and other existing research projects would be modified; these new projects and changes in existing projects are summarized in Table 2.3-1.

In compliance with the MMPA, PIFSC would apply to NMFS Headquarters Office of Protected Resources (OPR) to promulgate regulations governing the issuance of an LOA for incidental take of marine mammals. OPR would consider these activities and mitigation measures and determine whether it should promulgate regulations and issue an LOA as appropriate to PIFSC. If regulations are promulgated and an LOA is issued, they would prescribe the permissible methods of taking; a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities; and require monitoring and reporting that will result in increased knowledge of the species and of the level of taking.

PIFSC would also conduct informal or formal ESA section 7 consultations with NMFS Pacific Islands Regional Office (PIRO), and U.S. Fish and Wildlife Service (USFWS), as appropriate, for species that are listed as threatened or endangered. If formal consultation is required, one or more Biological Opinions (BiOps) may be prepared to determine whether the federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat. BiOps would result in incidental take statements (ITSs) that include reasonable and prudent measures to minimize the impact of incidental take of ESA-listed species during PIFSC research activities. A letter requesting consultation under section 7 of the ESA for Fisheries and Ecosystem Research Conducted and Funded by NMFS' PIFSC was sent from PIFSC to PIRO Protected Resources Division (PRD) on Sept. 8, 2021.

The Preferred Alternative includes the same suite of mitigation measures as the Status Quo Alternative to reduce the risk of adverse interactions with protected species. In addition, under the Preferred Alternative, PIFSC would make changes to their gear configurations for instrument deployment, specifically altering the ratio of sinking and floating lines to reduce the risk of entanglements in lines at the surface of the water. PIFSC would also continue providing the mitigation and monitoring training program for Chief Scientists and crew responsible for implementing appropriate responses to protected species interactions. This program includes opportunities for Chief Scientists and Captains to share information on protected species avoidance practices and to help standardize such decision-making protocols. Under the Preferred Alternative, these mitigation measures would be implemented during the LOA authorization period and would be intended to reduce the effects of PIFSC fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA.

Alternative 3—Modified Research Alternative—Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Additional Mitigation

Under the Modified Research Alternative, PIFSC would conduct and fund the same scope of fisheries research as described for the Preferred Alternative and would include all of the same mitigation measures considered under the Preferred Alternative. Under this alternative, PIFSC would also apply for authorizations under the MMPA for incidental take of protected species during these research activities and initiate section 7 consultations regarding ESA-listed species. The key difference between the Modified Research Alternative and the Preferred Alternative is that the Modified Research Alternative includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on potential mitigation of commercial fisheries impacts, (2) discussions within NMFS OPR as part of the proposed rulemaking process under the MMPA, and (3) a literature review of past and current research into potential mitigation measures. These measures include changes to visual monitoring methods for protected species (e.g., dedicated Protected Species Observers and technological methods to improve detection under poor visibility conditions), operational restrictions on where and when research may be conducted, and adoption of alternative methodologies and equipment for sampling.

PIFSC periodically reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species but measures must also pass safety and practicability considerations, meet survey objectives, allow survey protocols to remain compatible with previous data sets, and be consistent with the purpose and need for PIFSC research activities. Some of the mitigation measures considered under the Modified Research Alternative (e.g., no night fishing or broad spatial/temporal restrictions on research activities) would not allow survey protocols to remain consistent with previous data sets and would essentially prevent PIFSC from collecting data required to provide for fisheries management purposes under the MSA. Some research surveys necessarily target fish species that are preyed upon by protected species with an inherent risk of interactions during these surveys. PIFSC acknowledges the inherent risk of these, and it has implemented a variety of measures to mitigate that risk. PIFSC currently has no viable alternatives to collecting the data derived from these surveys and does not propose to implement potential mitigation measures that would preclude conducting these surveys, such as the elimination of night surveys or elimination of pelagic trawl gear use. An analysis of the potential efficacy and practicability of the additional mitigation measures considered in this alternative is presented in Section 4.4.

The PEA also provides the basis for the promulgation of requested regulations and subsequent LOA under Section 101(a)(5)(A) of the MMPA, which requires NMFS to identify and evaluate a reasonable range of mitigation measures that may reduce impacts to marine mammals among other factors. As described above, some mitigation measures could prevent PIFSC from maintaining the utility of ongoing scientific research efforts, and those mitigation measures would normally be excluded from consideration in the PEA under screening criteria 3 (Section 2.1). However, such mitigation measures would likely be considered during the MMPA rulemaking process and/or ESA section 7 consultation and are therefore considered in this PEA under the Modified Research Alternative.

Alternative 4—No Research Alternative—No Fieldwork for Federal Fisheries and Ecosystem Research Conducted or Funded by PIFSC

Under the No Research Alternative PIFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this PEA in marine waters of the HARA, MARA, ASARA, and WCPRA. This moratorium on fieldwork would not extend to directed research on marine mammals and ESA-listed species that is authorized under separate research permits (i.e., MMPA section 10 permits) and NEPA documents, although these research activities may not be authorized to continue use of active acoustic equipment or fishing gears that could result in incidental takes of marine mammals. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the United States. Under this alternative, organizations that have participated in joint research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without PIFSC funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would be consistent with the time series data NMFS has collected over many years, which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by the Fishery Management Councils (FMCs or Councils), NMFS, and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

CHAPTER 3 – AFFECTED ENVIRONMENT

Chapter 3 presents baseline information on the marine environment affected by PIFSC research activities. This information is not intended to be encyclopedic but to provide a foundation for the analysis of environmental impacts of the alternatives and the cumulative effects analysis. Sources of additional information are incorporated by reference and summarized within.

The geographic areas and physical environments potentially affected by PIFSC research surveys are located throughout the Pacific Ocean. PIFSC's fisheries research activities take place in four primary research areas: the HARA, MARA, ASARA, and the WCPRA, which are described in detail in Chapter 3. PIFSC research surveys occur both inside and outside the U.S. EEZ and sometimes in foreign territorial seas. Often, the surveys span across multiple ecological, physical, and political boundaries. PIFSC research areas encompass many areas with special designations to protect various resources, serve as relatively undisturbed reference research sites, and are subject to various levels of conservation and management under a variety of authorities. Classifications of these special resource areas include EFH, and component Habitat Areas of Particular Concern (HAPCs), fisheries closure areas, and designated Marine Protected Areas (MPAs) including U.S. Marine National Monuments (MNMs), NMSs, National Parks, and National Wildlife Refuges (NWRs), as well as Department of Defense Naval Defensive Sea Areas (NDSAs), and State and Territorial MPAs.

Thousands of finfish species occur within the PIFSC research areas. Descriptions of ESA-listed species/stocks are provided, including listed Distinct Population Segments of scalloped hammerhead shark, oceanic whitetip shark, and giant manta ray. Species targeted by commercial fisheries and subject to PIFSC stock assessment research and other species caught frequently in PIFSC surveys are also described.

Marine mammal species that occur in the PIFSC research areas are listed in Table 3.2-3, including 26 species of cetaceans (whales, dolphins, and porpoise) and one pinniped (Hawaiian monk seal). All of these species are federally protected under the MMPA regardless of where they occur. Six large whale species are listed as endangered under the ESA. Information is presented on marine mammal acoustics and functional hearing ranges for several groups of marine mammals. Marine mammals rely on sound production and reception for social interactions (e.g., reproduction, communication), to find food, to navigate, and to respond to predators.

A small number of ESA-listed seabird species occur in the PIFSC research areas that may interact with PIFSC fisheries and ecosystem research (see Section 3.2.3.1), however, most ESA-listed bird species in the region would be unlikely to interact with marine research activities (see Section 4.3.5). There are many other seabird species that occur in the PIFSC fisheries research areas that may potentially interact with research vessels and gear. However, birds have never been caught incidentally in PIFSC fisheries surveys. All species likely to occur in the U.S. EEZ are protected by the MBTA.

Five species of sea turtles occur within the PIFSC research areas, all of which are listed as endangered or threatened under the ESA. Sea turtles are susceptible to damage of onshore nesting habitat, exploitation of eggs, small boat strikes, and interactions with commercial and non-commercial fisheries.

Invertebrates found within the PIFSC research areas include numerous species of cnidarians (particularly corals), crustaceans, mollusks, echinoderms, porifera (sponges), and bivalves. NMFS published a final rule in September 2014 to list 20 species of corals as threatened under the ESA (79 FR 53852, 10 September 2014). Fifteen of the 20 ESA-listed coral species may occur within PIFSC research areas. Brief descriptions are given for each of these species including habitat, distribution, and threats (see Section 3.2.5.1). Other listed coral species may also occur in these research areas but have not yet been reported so the record of species in each area may change as more reliable information becomes available.

Several components of the social and economic environment within the PIFSC research areas are described in Section 3.3. Cultural resources may be defined as historic properties, landscapes, cultural items, archaeological resources, sacred sites, traditional knowledge, or collections of materials subject to protection under federal regulations. Section 3.3 provides an overview of cultural resources found within each of the designated PIFSC research areas. Section 3.3 also provides an overview of the social and economic aspects of commercial and non-commercial fisheries, fishing communities, and the economies that would be potentially affected by fisheries and ecosystem research activities conducted or funded by PIFSC.

CHAPTER 4 – ENVIRONMENTAL EFFECTS

As indicated earlier, NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. Of the four alternatives evaluated in this PEA, three alternatives maintain an active research program (Status Quo, Preferred, and Modified Research Alternatives) that clearly enables collection and development of additional scientific information, and one alternative (No Research) does not. In NMFS' view, the inability to acquire scientific information essential to developing robust fisheries management measures that prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and restore the nation's fishery resources. The scientific information provided by fisheries and ecosystem research programs also allows NMFS to address potential effects of climate change and ocean acidification. Long-term, consistent fisheries and ecosystem research programs contribute substantially to developing effective and timely fisheries management actions and assists in meeting U.S. trust responsibilities and international treaty obligations.

The following discussion summarizes by resource component, the direct and indirect impacts associated with the alternatives evaluated in Chapter 4 of this PEA. The effects of the alternatives on each resource component were assessed using an impact assessment criteria table to distinguish between major, moderate, and minor effects within the context of each resource component. The analysis shows that the potential direct and indirect impacts on the physical and biological environments under the three research alternatives are similar and would have minor adverse effects. The three research alternatives would also have minor to moderate beneficial effects on the social and economic environment of fishing communities by providing the scientific information needed for sustainable fisheries management and by providing funding, employment, and services. The similarity of impacts among the three research alternatives is due to the fact that the research activities proposed under these alternatives are similar; the alternatives also differ in the type of mitigation measures included for protected species. The No Research Alternative, in contrast, would eliminate direct adverse effects of the research alternatives on the marine environment but would have minor to moderate adverse indirect effects on several biological resources due to increasing uncertainty in future resource management decisions caused by the loss of scientific information on the marine environment from PIFSC, as well as indirect adverse impacts from not removing marine debris from the marine environment. The No Research Alternative was also considered to have minor to moderate adverse effects on the social and economic environment of fishing communities through impacts on various communities as well as long-term and widespread adverse impacts on sustainable fisheries management. Table ES-1 provides a summary of impact determinations for each resource component by alternative.

Table ES-1 Summary of Environmental Effect Conclusions (Direct and Indirect Effects) for Each Alternative

Resource Component	Alternative 1 (Status Quo)	Alternative 2 (Preferred)	Alternative 3 (Modified Research)	Alternative 4 (No Research)
Physical Environment	Minor adverse	Minor adverse	Minor adverse	Minor adverse
Special Resource Areas and EFH	Minor adverse	Minor adverse	Minor adverse	Minor adverse
Fish	Minor adverse	Minor adverse	Minor adverse	Moderate adverse

Marine Mammals	Minor adverse	Minor adverse	Minor adverse	Minor adverse
Birds	Minor adverse	Minor adverse	Minor adverse	Minor adverse
Sea Turtles	Minor adverse	Minor adverse	Minor adverse	Minor adverse
Invertebrates	Minor adverse	Minor adverse	Minor adverse	Moderate adverse
Social and Economic Environment	Minor to moderate beneficial	Minor to moderate beneficial	Minor to moderate beneficial	Minor to moderate adverse

Physical Environment

Under the three research alternatives, direct impacts to benthic habitats would occur through the use of several types of bottom-contact equipment. Bottom-contact fishing gear used in PIFSC fishery research activities under the three research alternatives would include bottomfishing bottom traps, stereo-video recording instruments [Bottom Camera (BotCam), Modular Optical Underwater Survey System (MOUSS), Baited Remote Underwater Video Systems (BRUVS)] that rest or anchor directly on the seafloor, as well as Autonomous Reef Monitoring Structures (ARMS), Acoustic Doppler Current Profilers (ADCPs), Bioerosion Monitoring Units (BMUs), Calcium Acidification Units (CAUs), Sea Bird Electronics SBE56 Surface Temperature Recorders (STRs), water sampling devices (Programmable Underwater Collection Units [PUCs] and Remote Access Samplers [RAS]), pH/pCO_2 instruments (SEAFET/SAMI), High-frequency Acoustic Recording Packages (HARPs), and Ecological Acoustic Recorders (EARs) that are either fixed or anchored to the benthic substrate (Table 2.2-1; also see Appendix A for description of these and other gear types used by PIFSC). Due to the small areas affected by stationary bottom-contact fishing gear, the geographic extent of impacts would be limited to much less than 1 percent of the project area and would therefore be considered localized according to the criteria for determining effects levels, provided in Table 4.1-1. PIFSC does not use bottom trawl or dredge equipment for any of its research programs, and therefore, the impacts to physical habitat that could result from the use of bottom trawl or dredge equipment would not occur in the PIFSC research areas as a result of activities proposed under any of the research alternatives.

Most disturbances to benthic habitats would be expected to recover within several months due to the action of ocean currents, depositional processes, and natural growth. Water quality could be affected through disturbance of bottom sediments, causing temporary and localized increases in turbidity. The potential for accidental fuel spills or other contamination from research vessels is considered small and any incidents would be rare due to the training and spill response equipment required for work on all research vessels, and adherence to U.S. Coast Guard (USCG) regulations regarding safety and pollution prevention, and the experience of NOAA Corps and charter captains and crew. The overall effects on benthic habitat and water quality are considered minor to moderate in magnitude, small areas of impact (much less than one percent of each research area) would be impacted, and the areas of impact would be dispersed over a large geographic area. Low intensity impacts resulting from the disturbance of organisms that produce structure could persist for months, however impacts resulting in measurable changes to the physical environment would be temporary. In general, any measurable alterations to benthic habitat would recover within several months through the action of water currents, depositional processes, and natural growth. Overall impacts would therefore be considered minor adverse under all three of the research alternatives, as they would all have similar impacts on the physical environment.

Under the No Research Alternative, there would be no direct impacts on the physical environment from PIFSC-affiliated fisheries and ecological research. However, the loss of scientific information generated by PIFSC research would contribute to greater uncertainty about the effects of climate change, ocean acidification, commercial fisheries impacts, and other external factors on benthic ecosystems. Indirect effects could occur through less scientifically informed decisions by resource management agencies and persistence of marine debris that otherwise would have been removed. The loss of information from PIFSC would likely affect a large geographic area but would be minor in magnitude given other potential sources of scientific research data. Impacts to the physical environment would therefore be considered minor adverse under the No Research Alternative.

Special Resource Areas and EFH

Under the three research alternatives, PIFSC would conduct some fisheries and ecosystem research activities in monuments, sanctuaries, refuges, and EFH; however, the research activities would be minimally invasive, and extractive sampling would be limited. The potential effects on special resource areas and EFH from PIFSC research under the Status Quo Alternative are similar or the same as those discussed for physical, biological, and socioeconomic resources elsewhere in this PEA. These effects primarily involve potential adverse impacts to wildlife, and the risk of accidental spills or contamination from vessel operation. Near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment could result in temporary impacts to pelagic habitat within special resource areas and EFH. Presence of pelagic sampling equipment may result in short-term disturbance or displacement of pelagic species but the duration of impacts to pelagic habitats within special resource areas and EFH would generally not extend beyond the duration of the research activity. While survey activities may occur within special resource areas, these activities would have *de minimus* impacts on benthic habitats within sanctuaries, EFH, or other special resource areas because they would be small in magnitude, short-term in duration, and localized in geographic scope. PIFSC does not use bottom-contact trawl equipment or other mobile bottom-contact research equipment for any fisheries and ecosystem research programs proposed under the three research alternatives. Stationary bottom-contact equipment that could potentially influence benthic habitat and EFH within special resource areas is described in section 4.2.1, Physical Environment Impacts.

One PIFSC survey likely to be conducted within the special resource areas and EFH would include the Reef Assessment and Monitoring Program (RAMP) surveys in nearshore areas using non-invasive survey techniques. RAMP survey locations are selected randomly and can potentially occur within MPAs and other special resource areas. Under all of the three research alternatives such activities would be minimally extractive and would occur infrequently. Any research activities occurring within special resource areas and EFH would meet established conservation measures and restrictions for the location.

Impacts to special resource areas and EFH under the Preferred Alternative would be very similar to the impacts under the Status Quo Alternative. The Modified Research Alternative includes the potential for spatial/temporal restrictions on PIFSC fisheries research as a means to reduce impacts on protected species. This provision may reduce impacts on certain areas if such closures were determined to be effective mitigation measures. However, specific determinations about potential research restrictions have not been made and it is assumed that impacts to special resource areas and EFH would be similar under all three research alternatives.

Under the No Research Alternative, there would be no direct impacts on special resource areas and EFH from PIFSC fisheries or ecosystem research activities. However, the indirect effects on resource management agencies and conservation plans for protected areas due to the loss of scientific information would be similar to that described for the physical environment and would be considered minor adverse.

Fish

Under all of the three research alternatives, potential effects of research vessels, survey gear, and other associated equipment on fish species found in the research areas would include mortality from fisheries and ecosystem research activities, contamination from discharges, and potential disturbance and changes in behavior due to sound sources. Fish species in the project area listed as threatened or endangered under the ESA include the scalloped hammerhead shark, oceanic whitetip shark and giant manta ray. Historically, only four scalloped hammerhead sharks have been captured as a result of PIFSC fisheries and ecosystem research, all of which belonged to the non ESA-listed Central Pacific Distinct Population Segment (DPS). Furthermore, all four of these captures were released alive with no resulting mortality. Even though there is a lack of historical takes of ESA-listed shark and ray species, tagging efforts for scalloped hammerheads, oceanic white tip and giant manta rays are likely to result in minor adverse effects on individually tagged animals in the short term. For most species targeted by commercial fisheries and managed under Fishery Management Plans (FMPs), mortality due to research surveys and projects is much less than one percent of annual catch limits (ACLs) or commercial harvest and is considered to be minor in magnitude for all species' populations. For species which exceed one percent of ACLs or commercial harvest, catch is still small relative to the population of each species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. Disturbance of fish from research activities would be temporary and minor in magnitude for all species. As described in Section 4.2.3.6, the potential for accidental contamination of fish habitat is considered minor in magnitude and temporary or short-term in duration. The overall effects of any of the three research alternatives on target fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse.

In contrast to these adverse effects, PIFSC research also provides long-term beneficial effects on managed fish species throughout the Pacific Islands Region through its contribution to sustainable fisheries management. Data from PIFSC fisheries and ecosystem research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by PIFSC research programs are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries and ecosystem research, provide the basis for monitoring changes to the marine environment important to fish populations.

Under the No Research Alternative, there would be no direct effects of PIFSC research on fish because PIFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research.

The lack of at-sea research activities would eliminate the risk of mortality from fisheries research activities, disturbance, and changes in behavior due to the presence of vessels and research gear, and potential contamination from vessel discharges. However, the loss of scientific information about fish populations and their habitats, especially commercially valuable species (e.g., bottomfish, reef fish, tuna, billfishes), would make it increasingly difficult for fisheries managers to effectively monitor stock status, set commercial harvest limits, or develop fishery regulations to recover depleted stocks or protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable. For non-commercial species, the absence of new fieldwork conducted and funded by PIFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular fish species is unknown. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on fish stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact of the No Research Alternative on commercially important fish stocks would be considered moderate adverse for the areas surveyed by PIFSC.

Marine Mammals

The primary direct effects of the three research alternatives on ESA-listed and non-listed marine mammals include behavioral responses to sound produced through the use of active acoustic sources (Level B harassment under the MMPA), Level B harassment of monk seals on haulouts by the physical presence of researchers, incidental capture, entanglement, or hooking in fishing gear but released without serious injury, and incidental capture, entanglement, or hooking resulting in mortality and serious injury (M&SI). The potential for effects from ship strikes, contamination of the marine environment, and removal of marine mammal prey species was considered minor for all alternatives and research areas. The MMPA requires applicants for a LOA to estimate the number of each species of marine mammal that may be incidentally taken by harassment or M&SI during the proposed action. The PIFSC LOA application (attached to the Draft PEA as Appendix C) includes estimates of takes in all four research areas using the scope of research and mitigation measures described in the Preferred Alternative but it is assumed that these levels of take could occur under all three research alternatives.

The potential direct and indirect effects of PIFSC research activities on marine mammals have been considered for each of the four PIFSC research areas (HARA, MARA, ASARA, and WCPRA) and for all gear types used in research under each of the three research alternatives. All species may be exposed to sounds from active acoustic equipment used in PIFSC research in the four research areas, although several acoustic sources are not likely audible to many species (i.e., operated at a frequency above or below the animal's hearing range). For the marine mammals affected, acoustic effects would likely be temporary and minor changes in behavior for nearby animals as the ships pass through any given area. The potential for temporary threshold shift (TTS) in hearing is low for high-frequency cetaceans (beaked whales and dwarf and pygmy sperm whales) and very low to zero for other species. There is no potential for hearing loss or injury to any marine mammal given the type of equipment used (see Section 4.1). Because of the minor magnitude of effects and the short-term duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all species under all of the three research alternatives.

PIFSC has never caught, hooked, or had marine mammals entangled in fisheries research gear. However, incidental takes of marine mammals have occurred in commercial and non-commercial fisheries in the same areas as PIFSC research occurs and using gears similar to those used in research. While the scale of commercial fisheries is much greater in terms of level of effort and areas fished, PIFSC has used information on these analogous fisheries to make estimates of marine mammals that may be incidentally taken during future fisheries and ecosystem research. The estimated M&SI takes include one ESA-listed species (sperm whale) and 15 non-listed cetacean species or DPSs, primarily by research using longline gear but also including research with midwater trawl gear and instrument deployments (potential entanglement in mooring lines or other lines). For almost all species and stocks with determined Potential Biological Removal (PBR) values, the requested takes, if they occurred, would represent less than ten percent of PBR and would be considered minor in magnitude. The exception is for spinner dolphins. In the unlikely event all of the requested takes for spinner dolphin occurred on the O‘ahu/“4-Islands Region” stock, the takes would be 12.1 percent of PBR for this stock and would be considered moderate in magnitude. Given the mitigation measures implemented under the Status Quo Alternative, the relatively small amount of fishing effort involved in PIFSC research, and the lack of takes in the past, PIFSC does not anticipate that the level of requested takes will actually occur in the future. The overall impact of the potential takes of these species, if they occurred, would be considered minor to moderate adverse according to the criteria described in Table 4.1-1.

PIFSC also uses other hook-and-line gear, bongo nets, baited traps, Self-Contained Underwater Breathing Apparatus (SCUBA) gear, and other scientific instruments in the course of conducting fisheries and ecosystem research (Table 2.2-1) that are not considered to present reasonable risks of incidental takes of marine mammals and for which no take requests have been made.

In addition to Level B harassment takes for many species through acoustic disturbance, PIFSC is requesting Level B harassment takes for Hawaiian monk seals due to the physical presence of researchers in nearshore waters and along beaches. Given the protocols for monitoring and avoiding interactions with monk seals, these potential takes would likely result in only temporary disturbance of small numbers of monk seals and adverse impacts would be minor. Given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse for all research areas under each of the three research alternatives. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse for all three research alternatives.

The overall impacts to marine mammals would be similar among the three research alternatives, and would be minor to moderate in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

Under the No Research Alternative, PIFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the HARA, MARA, ASARA, or WCPRA. Directed-take research by PIFSC on protected species would continue under the existing respective ESA and MMPA directed-take research permits but the use of gear or instruments not expressly permitted under those authorizations would not be conducted under the No Research Alternative (e.g., the sampling of prey species using a midwater trawl net by the Cetacean Research Program). This would eliminate the potential for direct and indirect effects on marine mammals through disturbance, entanglement in gear, changes to prey availability, and contamination of the marine environment in all four research areas and for all species of marine mammals. However, many of the PIFSC projects that would be eliminated under this alternative include opportunistic observations made from the deck of the vessels (transects while vessels are underway) which provide information on the abundance and distribution of marine mammals in these four research areas. Oceanographic and fisheries data collected by PIFSC are also important for monitoring the ecological status of the environment important to marine mammals. While there would be no direct effects on marine mammals due to adverse interactions with ships and scientific gear, the loss of observational and ecological information important to marine mammals would indirectly affect resource management decisions concerning the conservation of marine mammals.

There are too many unknown variables to estimate the magnitude of effects this lack of information would mean to any particular stock of marine mammal but they would likely be minor in the near future. The overall impact to marine mammals would be adverse and minor for all four PIFSC research areas under the No Research Alternative.

Birds

All three of the research alternatives include the use of fishing gear (e.g., trawls, longlines) that have had substantial incidental catch of seabirds in commercial fisheries. However, research gear is generally smaller than commercial gear in both scope and scale, and research protocols are quite different than commercial fishing practices. In particular, fisheries research uses shorter duration sets and less effort than commercial fisheries and no bait or offal is thrown overboard while research gear is in the water, thereby greatly reducing the attraction of seabirds to research vessels. Based on the historical lack of interactions between seabirds and research gear used for PIFSC fisheries and ecosystem research, incidental take of seabirds in research gear is unlikely. This PEA also considers the potential for fisheries and ecosystem research to affect the habitat quality of seabirds through removal of prey and contamination of seabird habitat and, as described above for marine mammals, concludes that these effects would be minor adverse for all species. The overall effects on seabirds are therefore considered minor adverse under all three research alternatives. Under the Preferred Alternative and the Modified Research Alternative, if necessary to reduce potential interactions with seabirds, PIFSC would deploy tori lines (streamer lines) on longline gear to reduce the risk of catching seabirds. For example, if seabird interactions with longline gear are documented in the future, PIFSC would evaluate whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and changes to research protocols that might affect time-series data.

Some PIFSC surveys sometimes take bird biologists on board when there is bunk space available to conduct transect surveys for bird distribution and abundance in the PIFSC research areas. This information is used by NMFS, the USFWS, and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on birds.

Under the No Research Alternative, the risk of direct adverse effects on seabirds from PIFSC research would be eliminated but there could be potential long-term minor adverse indirect impacts to seabirds because resource management authorities would lose ecological information about the marine environment important to seabird conservation.

Sea Turtles

The PEA analyzes the same direct and indirect effects of PIFSC fisheries research on sea turtles as described for marine mammals. The potential for ship or small boat strikes, removal of prey, entanglement in line used during research activities, entanglement in derelict fishing gear, and contamination of marine habitat would be similar to the risks described for marine mammals; these effects are considered minor adverse for all sea turtle species under all three research alternatives. Sea turtles' hearing range is apparently well below the frequencies of acoustic instruments used in fisheries research so turtles are unlikely to detect these sounds or be affected by them. PIFSC has no history of interactions with sea turtles in research gear and the potential for injury or mortality under all of the research alternatives is very small. The overall effects of the research alternatives would therefore be considered minor adverse on all species of sea turtles considering the extent of research (in terms of area) is relatively small across the four research areas.

As with marine mammals and seabirds, the No Research Alternative would eliminate the risk of direct adverse effects on sea turtles from PIFSC research. However, there could be minor adverse indirect impacts due to the loss of PIFSC-affiliated research on bycatch reduction, the removal of marine debris, and ecological information important to sea turtle conservation.

Invertebrates

PIFSC fisheries and ecosystem research conducted under the three research alternatives could have direct and indirect effects on many invertebrate species through physical damage to infauna and epifauna, collection in midwater and surface trawl nets, incidental and directed take of coral specimens, mortality, changes in species composition, and contamination or degradation of habitat.

For all invertebrate species targeted by commercial fisheries and managed under Fishery Management Plans, mortality due to PIFSC fisheries and ecosystem research surveys and projects is less than two percent of commercial and non-commercial harvest and is considered to be minor in magnitude for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities and the risk of altering benthic community structure would be minimal. Disturbance of invertebrates and benthic habitats from research activities would be temporary and minor in magnitude for all species. The overall direct and indirect effects of the Status Quo Alternative on invertebrates would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse. However, under Status Quo and the Preferred Alternative, a small number of samples of ESA-listed corals would be collected in order to conduct research aimed at conservation of the species. Therefore, minor adverse effects on ESA-listed coral species could occur although the amount of samples collected is not likely to cause population-level effects on any species.

Under the Preferred Alternative, the Northwestern Hawaiian Islands Lobster Survey is not carried forward. The elimination of this survey would substantially reduce the total mortality of lobsters from PIFSC research activities. Modified surveys include a midwater trawl added to the Cetacean

Ecology Assessment Survey and increased geographic scope of the Insular Fish Abundance Estimation Comparison Surveys (deploys a BotCam, BRUVS, and MOUSS) to include the MARA, ASARA, and WCPRA. These stationary bottom-contact gears have very small footprints and therefore the potential to crush, bury, remove, or expose invertebrates is also very small. In addition, the Ecosystem Sciences Division (ESD) may conduct Structure-from-Motion (SfM) surveys consisting of marking off plots on the seafloor (1-3 m depth) with cable ties or stainless steel pins, collecting photographs of the plots and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images. The overall effects of the Preferred Alternative on invertebrates would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse.

The Modified Research Alternative includes potential spatial and temporal restrictions on where and when PIFSC research could occur. Spatial and temporal restrictions may reduce impacts on invertebrates in certain areas such as MPAs if such closures were determined to be effective mitigation measures. Such restrictions could also reduce overall research fishing effort in important habitats and limit the ability of PIFSC to sample invertebrate species as prescribed in their research plans. However, specific determinations about potential research restrictions have not been made and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Preferred Alternative. Overall effects on invertebrates would therefore be similar even if research was conducted in somewhat different places and times. Thus, overall impacts to invertebrates under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse.

In addition to these minor adverse effects, each of the three research alternatives would contribute to long-term beneficial effects on invertebrate species throughout the Pacific Islands Region through the contribution of PIFSC fisheries research. Specifically, the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing, and planning conservation strategies, and detecting ecosystem shifts.

Under the No Research Alternative, there would be no direct effects of PIFSC fisheries and ecosystem research on invertebrates through physical damage, directed take of coral, mortality, changes in species composition, and contamination. However, the loss of scientific information about invertebrates would impede the ability of fisheries managers to effectively assess and monitor stocks, set harvest limits, or develop necessary regulations to protect vulnerable stocks. For non-commercial species (e.g., various corals), the absence of new fieldwork conducted and funded by PIFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers. Although other data are available to support resource management decisions, the interruption or cessation of long-term data series on commercially valuable invertebrate stocks could lead to increased uncertainty and changes in some management scenarios. Management authorities would lose important information needed to establish sustainable harvest limits and help conserve and restore benthic habitats. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on invertebrate stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact of the No Research Alternative on commercially important invertebrate stocks would be considered moderate adverse.

Social and Economic Environment

The effects of PIFSC fisheries and ecosystem research on the social and economic environment are expected to be very similar under all three research alternatives. All three research alternatives include avoidance of known historic cultural resource sites, such as shipwrecks, burial sites, fishponds, and locations where contemporary cultural resources are known to occur. Each of these alternatives would include important scientific contributions to sustainable fisheries management for some of the most diverse and important commercial and non-commercial fisheries throughout the Pacific Island Region, which benefits the fisheries and the communities that support them. These industries have regionally large economic footprints, generate millions of dollars' worth of sales and thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. Millions of non-commercial fishers also participate and support fishing service industries. PIFSC fisheries research activities would also have minor to moderate beneficial impacts to the economies of fishing communities through direct employment, purchase of fuel, vessel charters, and supplies. Continued PIFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers. PIFSC fisheries research also informs management decisions which help to sustain traditional, cultural, and subsistence fishing communities. The overall effects of PIFSC-affiliated research would be long-term, distributed widely across the Pacific Island Region, and would be considered minor to moderately beneficial to the social and economic environment for all three research alternatives.

The impacts of the No Research Alternative would be the inverse of the three research alternatives. It would likely have minor to moderate adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas (i.e., underutilized stocks and lost opportunity) or an increased risk of overfishing, followed by reductions in commercial and recreational fisheries harvests. The lack of scientific information would also compromise efforts to rebuild overfished stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would adversely affect the ability of NMFS to comply with its obligations under the MSA. It would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No Research Alternative would also have long-term adverse impacts on the scientific information PIFSC contributes to meet U.S. obligations for living marine resource management under international treaties.

CHAPTER 5 – CUMULATIVE EFFECTS

Cumulative effects are the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions on the human environment over time. An individual action may have only minor or moderate impacts but the cumulative effects of all actions may be major. NEPA requires an analysis of cumulative effects in order to alert decision makers to the full environmental consequences of a proposed action and its alternatives on resource areas of concern. This analysis looks at the overall cumulative impact and the contribution of PIFSC fisheries and ecosystem research activities to the overall cumulative impact.

In terms of fisheries, understanding how the cumulative impacts from human activities and trends in the natural environment have influenced the marine environment over time is key to understanding the importance of NMFS role in fisheries management. The need for scientific information from PIFSC research activities is in large part the result of past actions that contributed to major adverse impacts on fish stocks from overfishing, pollution of coastal and ocean areas from accidental and intentional discharges, runoff of agricultural and industrial waste, and degradation of habitat. Federal efforts within the last 40 years to reduce pollution, restore degraded habitats, and effectively manage commercial and recreational fishery harvests have reversed some of these trends. A number of important fish stocks have been restored to healthy levels and others are in the rebuilding process.

Similarly, cumulative impacts from human activities and trends in the natural environment over time have contributed major adverse impacts to some populations of marine mammals, sea turtles, and other marine species. As a result, the MMPA and ESA were enacted to help address specific conservation concerns and many human activities are subject to federal management measures to protect marine species and promote recovery of impacted populations.

Climate change and ocean acidification have the potential to impact populations and distributions of many marine species. Fisheries and ecosystem research activities make a minimal contribution to these long-term, global environmental processes through the burning of fossil fuels. However, long-term, systematic marine research provides important scientific information on the changes and trends in marine ecosystems brought about by climate change and ocean acidification.

In addition to PIFSC research efforts, there are many current and reasonably foreseeable activities that may contribute to cumulative impacts on the marine environment, including: conservation efforts, commercial shipping, commercial and recreational fisheries, energy development, military activities, coastal development projects, marine research activities by other agencies and institutions, and other human activities that contribute to global climate change. These actions can produce both adverse and beneficial impacts that directly and indirectly affect ocean resources managed by NMFS and the social and economic environment of fishing communities that rely on them.

This PEA generally considers the contribution of the three research alternatives to the cumulative effects on given resources to be very similar and they are often discussed together. The contribution of the No Research Alternative to the cumulative effects on resources is quite different and is discussed separately.

As described in the Chapter 4 summary above, PIFSC research activities would have minor adverse effects on the various resource components of the physical and biological environments. Because PIFSC research activities involve such a small number of vessels compared to other vessel traffic and collect relatively small amounts of biomass compared to commercial and non-commercial fisheries, the contribution of the three research alternatives to cumulative adverse effects on fish, marine mammal, and other species and resource areas would be small. PIFSC scientific research activities will also have beneficial contributions to the cumulative effects on physical, biological, and socioeconomic resources. The research alternatives contribute substantially to the science that feeds into federal fishery management measures aimed at rebuilding and managing fish stocks in a sustainable manner. It also contributes to understanding the nature of changes in the marine environment and adjusting resource management plans accordingly, and it helps meet co-management and international treaty research obligations. The research activities under the three research alternatives help alleviate adverse cumulative impacts on the biological and socioeconomic environments, resulting in long-term beneficial contributions to cumulative effects.

The No Research Alternative would not contribute to direct adverse effects on the marine environment (e.g., research catch of fish and incidental take of marine mammals) but would contribute indirect adverse effects on both the physical, biological and socioeconomic environments based on the lack of scientific information to inform future resource management decisions and the lost opportunity to remove marine debris. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on the physical, biological and socioeconomic environments would be minor to moderate depending on how well other agencies would be able to compensate for the loss of PIFSC research.

OTHER SECTIONS

In addition to the chapters summarized above, the PEA includes a description of the laws applicable to PIFSC research activities in Chapter 6, cited references in Chapter 7, and a list of persons and agencies consulted during development of the PEA in Chapter 8. Appendix A provides a description of the fishing gear, other scientific instruments, and vessels used during PIFSC research activities. Appendix B includes tables and figures showing the spatial distribution of research effort within the PIFSC research areas. Appendix C contains the consultation letters from cooperating consulting agencies.

CONCLUSION

Based on the analysis in this PEA, NMFS has not identified any potential adverse environmental impacts that would rise to the level of “significant” under NEPA, which would trigger the requirement for an Environmental Impact Statement (EIS). A final determination on whether potential impacts of the proposed action are significant will be made and documented in the Finding of No Significant Impact (FONSI), which will be noticed in the *Federal Register* and made available to the public.

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1.1 NOAA'S RESOURCE RESPONSIBILITIES AND ROLE IN FISHERIES RESEARCH

The Federal government has a responsibility to protect living marine resources in waters of the United States, also referred to as federal waters. These waters generally lie 3 to 200 nm from the shoreline and comprise the EEZ. The U.S. government has also entered into a number of international agreements and treaties related to the management of living marine resources in international waters outside of the U.S. EEZ. To carry out its responsibilities over federal and international waters, Congress has enacted several statutes authorizing certain federal agencies to administer programs to manage and protect living marine resources. Among these federal agencies, NOAA has the primary responsibility for protecting marine finfish and shellfish species and their habitats. Within NOAA, NMFS has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources.

Within the area covered by this PEA, NMFS manages fisheries for finfish, shellfish, corals, catch of non-target, associated, and dependent species, fishery ecosystems, and habitats, under the provisions of several major statutes, including the MSA[6], the Tuna Conventions Act, the MMPA, the ESA, and the MBTA. Fulfilling the requirements of these statutes requires the close interaction of numerous entities in a sometimes complex fishery management process. In the NMFS Pacific Islands Region, the entities involved include the PIFSC, the University of Hawai‘i and NOAA's Joint Institute for Marine and Atmospheric Research (JIMAR, a cooperative institute between the University of Hawai'i and PIFSC), PIRO, the West Coast Regional Office, the Western Pacific Regional Fisheries Management Council (WPRFMC), state and territorial fisheries agencies, the USFWS, and a number of international fisheries management organizations and commissions (see Section 1.1.3).

1.1.1 Fisheries Science Centers

Six regional FSCs[7] direct and coordinate the collection of scientific information on living marine resources and their ecosystems to assist resource managers in making sound decisions that build sustainable fisheries, facilitate the protection and recovery of threatened and endangered species, and sustain healthy ecosystems. Each FSC is a distinct entity and provides the primary scientific support for a particular NMFS fisheries region (Figure 1.1-1).

PIFSC conducts research and provides scientific advice to managers of fisheries and protected resources for the State of Hawai‘i, Territory of American Samoa, Territory of Guam, the CNMI and the Pacific Remote Island Areas. This PEA assesses the impacts of research activities conducted by PIFSC in four different research areas (Figure 1.1-2): 1) HARA; 2) MARA; 3) ASARA; and 4) WCPRA. These research areas and related LMEs are described in detail in Section 3.1.1.

[6] 16 U.S.C. §§ 1801-1884, (MSA 2007).
[7] The NMFS FSCs are: 1) Northeast, 2) Southeast, 3) Southwest, 4) Northwest, 5) Alaska, and 6) Pacific Islands.

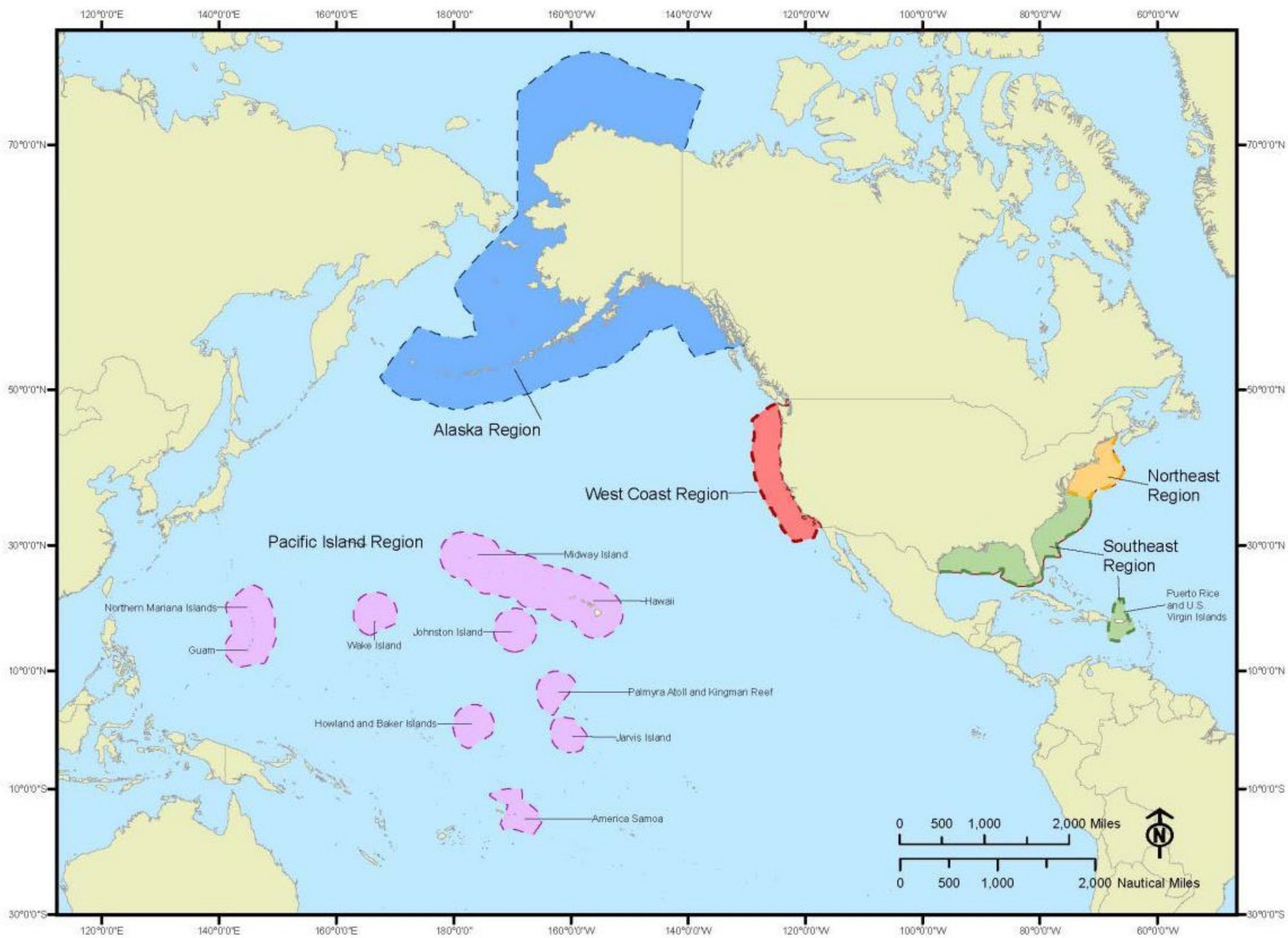

Figure 1.1-1 NMFS Fisheries Regions

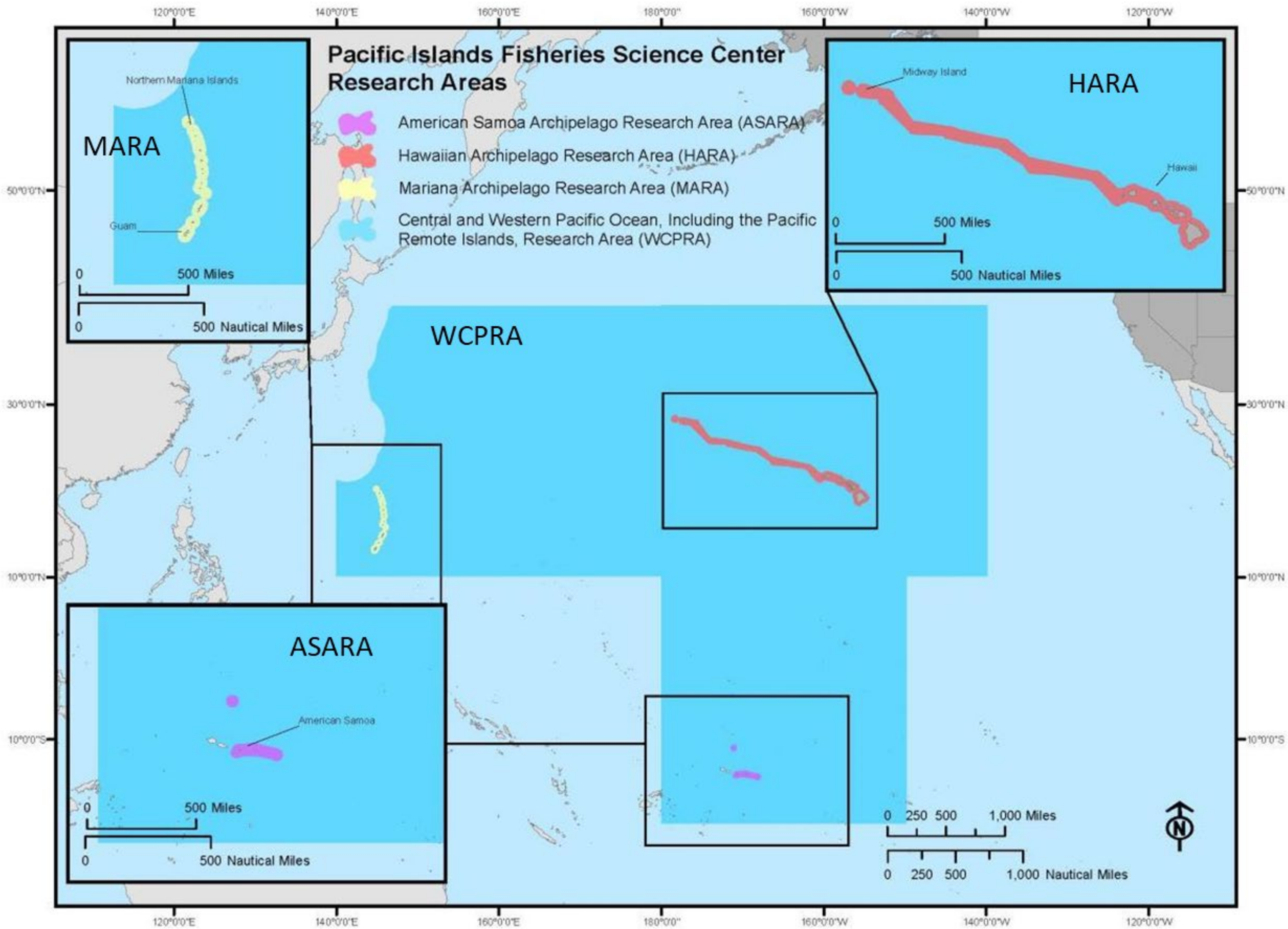

Figure 1.1-2 PIFSC Research Areas

1.1.2 Fisheries Management Councils

The MSA established eight Regional FMCs, consisting of fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others. The Councils provide resource users and managers the ability to participate in the fisheries management process through the development of FMPs—or Fishery Ecosystem Plans (FEPs) in the case of the WPRFMC—for the fisheries occurring within the EEZ. The WPRFMC covers federal waters across the central and western Pacific Ocean including the Hawaiian Archipelago, Samoa Archipelago, the Mariana Archipelago, and U.S. Pacific Remote Islands (including Johnston Atoll, Kingman Reef, Palmyra Atoll, Jarvis Island, Howland Island, Baker Island, and Wake Atoll).

The Councils include fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others, and are designed to provide all resource users and managers a voice in the fisheries management process. Data collected by FSCs are often used to inform FMPs, as well as to inform other policies and decisions promulgated by the Councils. Such policies and decisions sometimes affect areas that span the jurisdictions of several FMCs and make use of data provided by multiple FSCs.

1.1.3 International Fisheries Management Organizations

In addition to providing information to domestic fisheries management councils, PIFSC provides scientific advice to support numerous international fisheries councils, commissions, and conventions, which are discussed in detail below.

The need for international cooperation in fisheries management is driven by the trans-boundary distribution and movements of many of the targeted and bycatch species and the exploitation of common resources outside areas of national jurisdiction, on the high seas.

Pelagic species, such as tuna and billfishes, have a wide geographic distribution, both on the high seas and inside the EEZ of many nations and undertake trans-boundary movements of significant but variable distances. Pelagic species are harvested by domestic and foreign fishing fleets; however, the United States accounts for a relatively small fraction of the pelagic species caught in the western and central Pacific Ocean (Secretariat of the Pacific Community 2013). The primary international regional fisheries management organization (RFMO) for pelagic species in this region is the Western and Central Pacific Fisheries Commission (WCPFC).

1.1.3.1 Western and Central Pacific Fisheries Commission

The WCPFC is an international organization that aims to ensure the long-term conservation and sustainable use of pelagic fish stocks (i.e., tunas, billfishes, and associated species) in the western and central Pacific Ocean. The WCPFC was established by the Convention for the Conservation and Management of Pelagic Fish Stocks in the western and central Pacific Ocean (WCPFC Convention) which was enacted in 2004. The WCPFC is made up of 26 member nations (including the European Union), plus several participating territories and cooperating non-member nations, who have an interest in the management of high seas fisheries in the western Pacific Ocean. The Convention applies to waters of the Pacific Ocean including areas around Hawai‘i, Territory of American Samoa, Territory of Guam, the CNMI, and U.S. Pacific remote island areas, and therefore encompasses much of the operational area of significant U.S. purse seine, longline, and distant-water albacore troll fisheries, as well as local small-scale fisheries for pelagic species

Figure 1.1-3. Through the WCPFC, the United States is directly engaged in the development of fisheries management measures to manage and conserve bigeye, yellowfin, albacore, other tunas, billfishes, and sharks, and to minimize impacts on other species, including sea turtles and seabirds. PIFSC scientists lead or serve on, and provide scientific advice to, the WCPFC Science Committee and its Scientific Working Groups.

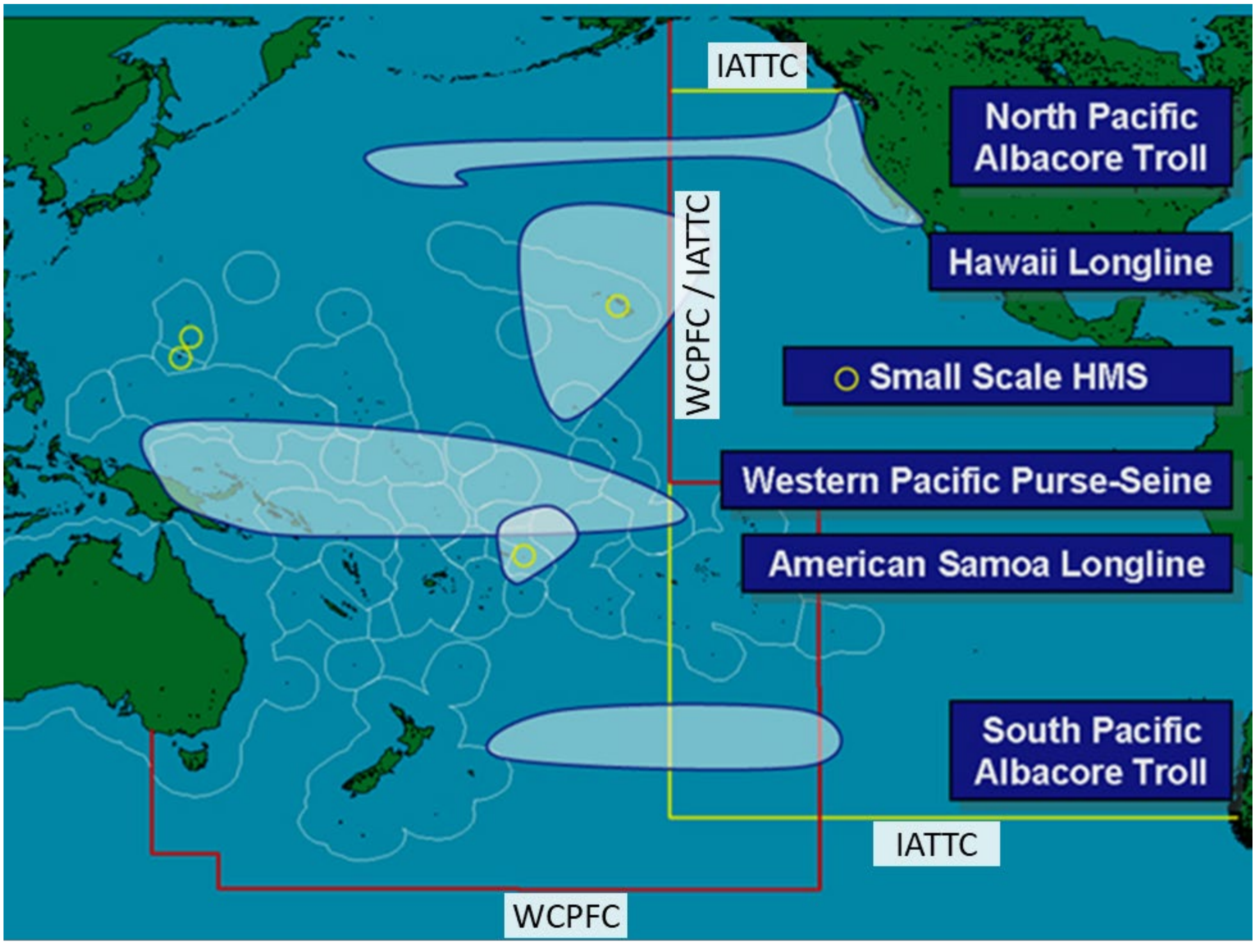

Figure 1.1-3 U.S. Western and Central Pacific Fisheries in relation to the WCPFC Area (red boundary) and the Inter-American Tropical Tuna Commission Area (yellow boundary, overlapping the red boundary in the central Pacific, see IATTC, below)

1.1.3.2 International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean

The primary source of scientific advice to the Northern Committee of the WCPFC is the International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC). The ISC was established in 1995 to develop better information on stocks of tuna and tuna-like species in the North Pacific Ocean in cooperation with relevant fisheries organizations, to enhance scientific knowledge of these stocks throughout their entire range. The organization has seven voting members and a variety of non-voting members and cooperating non-members. PIFSC scientists serve as the Chair of the ISC Plenary, chair several of its Working Groups, provide fisheries data and scientific advice, and collaborate extensively in conducting stock assessments (ISC 2014).

1.1.3.3 South Pacific Tuna Treaty

The South Pacific Tuna Treaty (SPTT) is a Multilateral Fisheries Treaty which is a vital component of the political and economic relationship between the United States and the Pacific Island Parties (Figure 1.1-4). The SPTT was entered into force in 1987 for an initial period of 5 years and since that time; it has been extended twice, most recently through 2013. The Treaty sets the operational terms and conditions for the U.S. tuna purse seine fleet to fish, primarily for skipjack and yellowfin tunas, in a vast portion of the WCPFC Area. Other measures related to conservation and management of this fishery, including non-target, associated and dependent species are also developed and implemented by the WCPFC. Under an Economic Assistance Agreement related to the SPTT, the United States provides economic assistance to the Pacific Island Parties to support public education, health care programs, responsible utilization of natural resources, and general economic and social welfare in the Pacific Islands (Department of State [DOS] 2012).

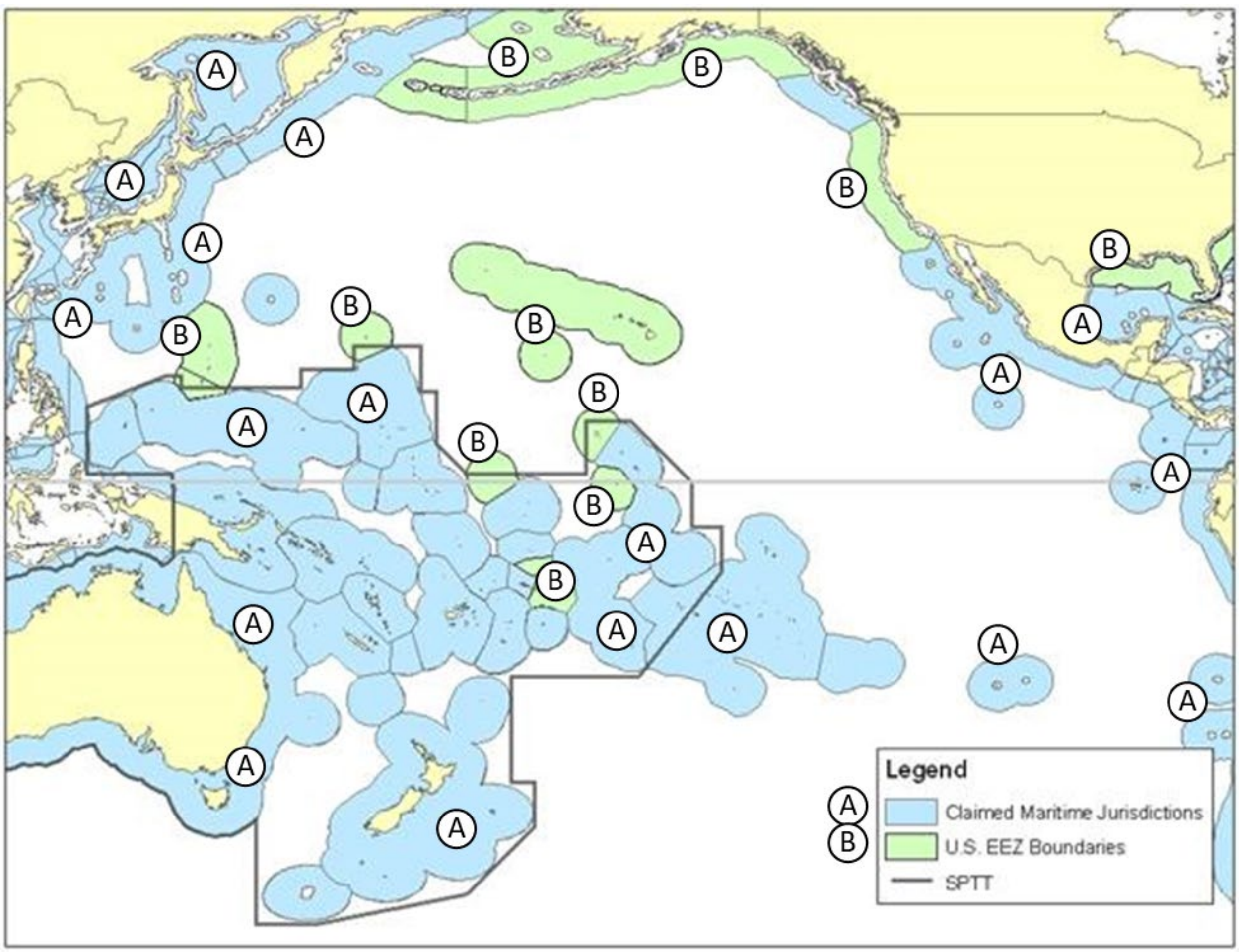

Figure 1.1-4 South Pacific Tuna Treaty Boundary

1.1.3.4 South Pacific Regional Fisheries Management Organization

Overfishing and habitat damage particularly from deep-sea trawling on high seas seamounts is prompting the initiation of multilateral agreements to address this problem in the North and South Pacific Ocean. The South Pacific Regional Fisheries Management Organization (SPRFMO) was created to manage resources in the South Pacific and adopted the Convention on the Conservation and Management of the High Seas Fishery Resources of the South Pacific Ocean in Auckland, New Zealand (SPRFMO 2014; Figure 1.1-5).

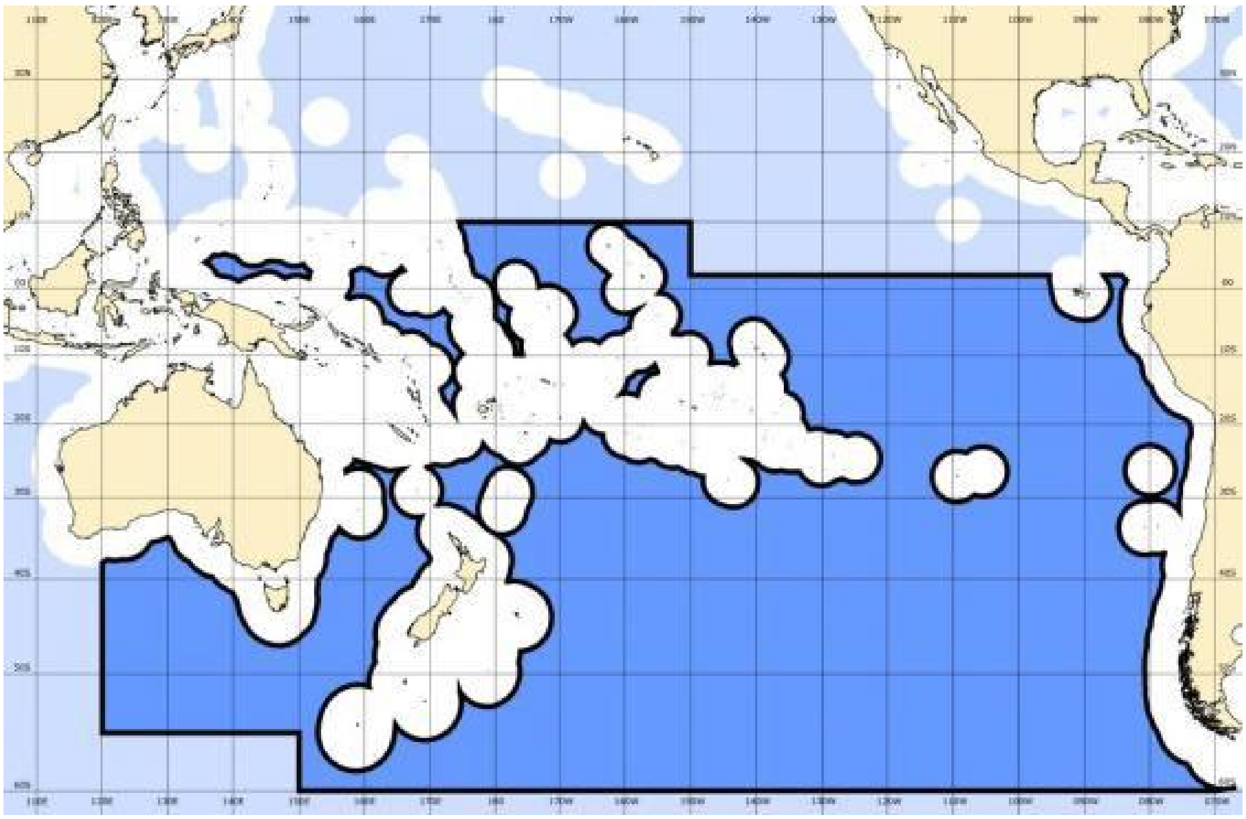

Figure 1.1-5 South Pacific Regional Fisheries Management Organization boundary map

1.1.3.5 Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean

In response to a growing concern of the international community over possible negative impacts of bottom fisheries activities on vulnerable marine ecosystems (VMEs) in the high seas, Japan, the Republic of Korea, the Russian Federation, and the United States began discussions regarding the management of the northwestern Pacific Ocean high seas bottom trawl fisheries. This area includes the Emperor Seamounts and Northern Hawaiian Ridge, which are proven fishing grounds for seamount groundfish (North Pacific Fisheries Commission [NPFC] 2012; Figure 1.1-6).

In 2009, revised interim measures of the northwest Pacific Ocean were adopted. The objectives of the interim measures are the sustainable management of fish stocks and the protection of vulnerable marine ecosystems. While working on a long-term agreement to achieve the identified objectives the parties decided to limit fishing effort to the existing level and not to expand bottomfish fisheries into new areas (NPFC 2012).

In 2011, the 10th multilateral meeting to discuss the long-term agreement included Canada, China, Japan, Korea, Russia, the United States, and Chinese Taipei. The meeting resulted in the adoption of interim management measures for the northeast Pacific Ocean and a completed draft of the English text of the Convention on the Conservation and Management of High Seas Fisheries Resources in the North Pacific Ocean (NPFC 2012).

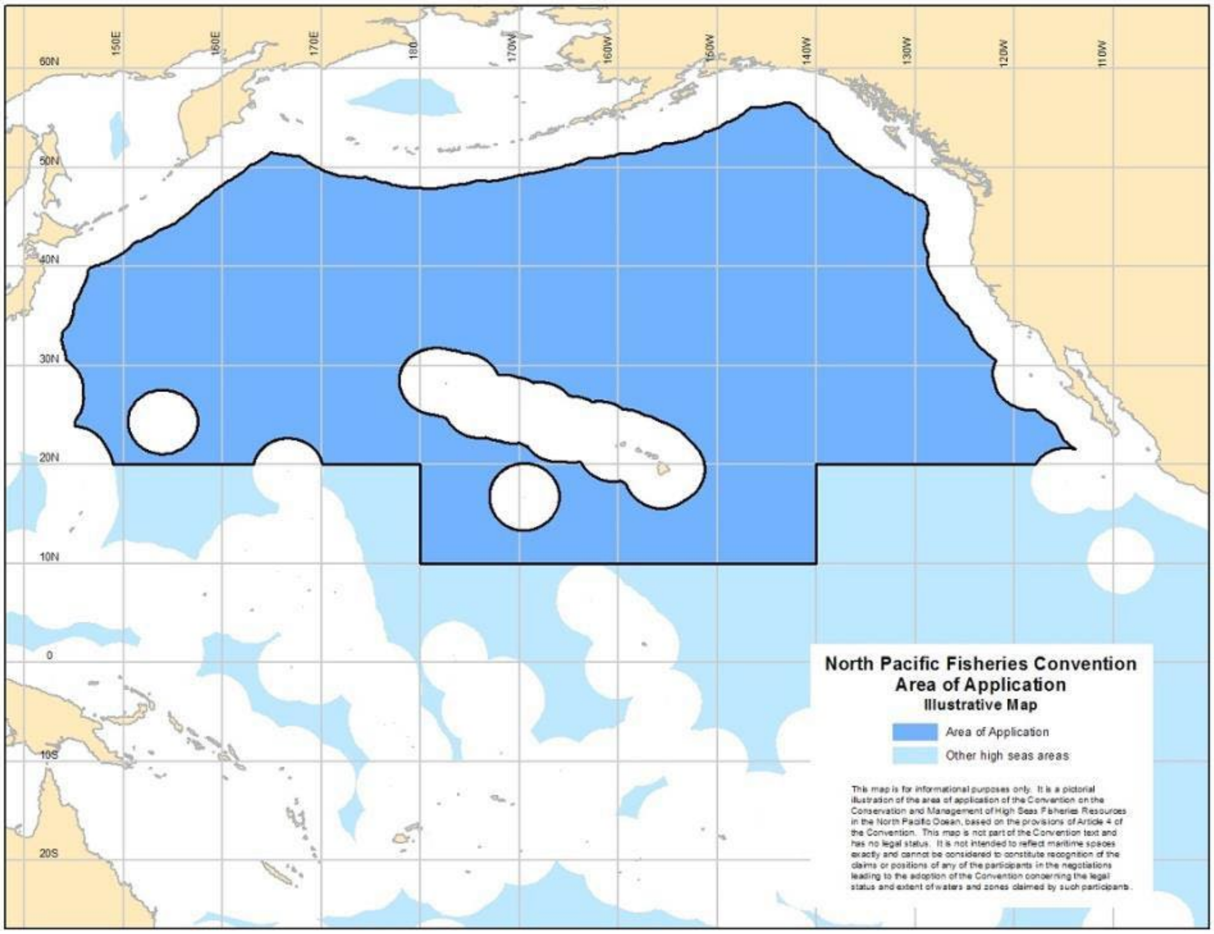

Figure 1.1-6 North Pacific Fisheries Convention boundary map

1.1.3.6 Inter-American Convention for the Protection and Conservation of Sea Turtles

The Inter-American Convention (IAC) for the Protection and Conservation of Sea Turtles is an intergovernmental treaty that provides the legal framework for countries in the Americas and the Caribbean to take actions for the benefit of sea turtles.

The IAC was entered into force in May of 2001 and promotes the protection, conservation and recovery of sea turtles and those habitats on which they depend, on the basis of the best available data and taking into consideration the environmental, socioeconomic, and cultural characteristics of the Parties (NOAA 2012a).

The Convention represents a binding commitment by these parties to implement domestic measures to reduce threats to sea turtles. These measures include:

- Prohibition of deliberate take of sea turtles or their eggs
- Compliance with the Convention on International Trade in Endangered Species (CITES)
- Implementation of appropriate fishing practices and gear technology to reduce incidental take (bycatch) of turtles in all relevant fisheries
- Use of Turtle Excluder Devices (TEDs) on shrimp trawl vessels
- Designation of protected areas for critical turtle habitat
- Restriction of human activities that could harm turtles
- Promotion of sea turtle research and education

The treaty applies to all territorial waters of the contracting parties, encompassing the Pacific and Atlantic Oceans, including the Caribbean Sea and Gulf of Mexico. Of the six sea turtle species protected under the IAC, five occur in the Pacific Islands Region: Green turtle (Chelonia mydas), Hawksbill turtle (Eretmochelys imbricata), Leatherback turtle (Dermochelys coriacea), Loggerhead turtle (Caretta caretta), and the olive ridley turtle (Lepidochelys olivacea) (NOAA 2012a).

1.1.3.7 Inter-American Tropical Tuna Commission (IATTC)

The IATTC is an international organization that seeks to ensure the long-term conservation and sustainable use of all stocks of tunas and tuna-like species and other species of fish taken by vessels fishing for tunas and tuna-like species in the IATTC Area. The IATTC was first established under a 1949 Convention, and in 2003 a new Convention—the Convention for the Strengthening of the Inter-American Tropical Tuna Commission (commonly known as the "Antigua Convention")—was adopted by the parties to the IATTC, entering into force in 2010, to reflect modern developments in fisheries management including the United Nations Fish Stocks Agreement. The IATTC includes 20 nations (including the European Union), plus several cooperating non-parties. Its area includes most of the Pacific Ocean east of 150° W Longitude (Figure 1.1-7), including waters off the west coast states of California, Oregon, and Washington, and encompasses significant U.S. fisheries, such as the troll fishery targeting albacore, and the Hawai‘i-based longline fishery which expends a portion of its effort within this Area. Through the IATTC, the United States is directly engaged in the development of management arrangements for the fisheries for which the IATTC is responsible, including measures to manage and conserve bigeye tuna and albacore. Through the West Coast Regional Office, PIFSC provides the ISC with data and advice on U.S. fisheries in the IATTC area, including catch of target, non-target, associated, and dependent species (NMFS 2012).

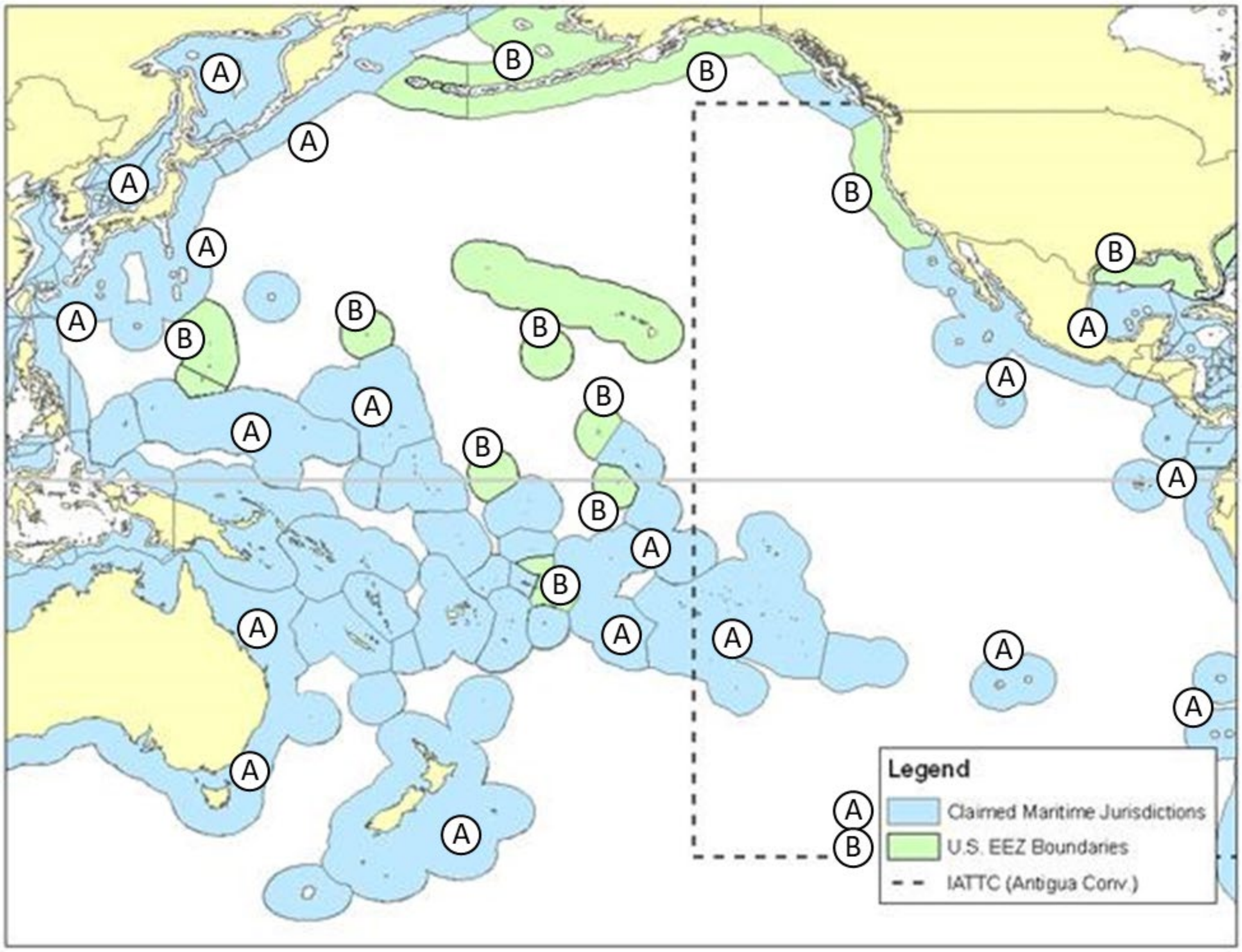

Figure 1.1-7 IATTC map

1.1.4 Role of Fisheries Research in Federal Fisheries Management

Domestic fisheries managers use a variety of techniques to manage fishery resources, a principal method being the development of FMPs or FEPs. These plans articulate fishery goals as well as the methods that will be used to achieve those goals, and their development is specifically mandated under the MSA. PIFSC provides scientific information and advice to assist with the development of FMPs or FEPs prepared by the WPRFMC, North Pacific Fisheries Management Council (NPFMC), Pacific Fisheries Management Council (PFMC), and other agencies.

Through its regional FSCs, NMFS conducts research on the status of living marine resources and associated habitats. More than most Science Centers, PIFSC conducts a great deal of fishery-dependent research and evaluation of fishery-dependent data to provide analyses of fishery dynamics and to understand factors affecting catch of non-target, associated, and dependent species (e.g., bycatch and take of protected species). PIFSC also conducts fisheries-independent research designed and conducted independent of commercial fishing activity to meet specific research goals, including research directed by PIFSC scientists and conducted on board NOAA-owned and operated vessels or NOAA-chartered vessels. PIFSC also collaborates on fisheries-independent research with cooperating agencies and scientists conducted on board non-NOAA vessels.

PIFSC fisheries-dependent research includes research conducted on-board commercial or contracted fishing vessels during their fishing operations (e.g., cooperative research with the bottomfish fishery). Fishery-independent research activities by PIFSC on commercial or contracted fishing vessels, which are not part of a FMP, FEP, or Exempted Fishing Permit (EFP) whereby marine mammal and ESA-listed species take has been exempted or that complies with MMPA section 118 or an ESA incidental take statement, are evaluated within this PEA (see Section 1.4).

Fishery-dependent research activities occurring on U.S. commercial fishing vessels associated with a fishery that has a valid FMP or EFP whereby marine mammal and ESA-listed species take has been exempted or that complies with MMPA section 118 or an ESA ITS, as applicable, are not evaluated within this PEA.

1.2 PIFSC FISHERIES RESEARCH AREAS AND FACILITIES

PIFSC is the research arm of NMFS in the Pacific Islands Region. Headquartered in Honolulu, Hawai‘i, PIFSC has taken a leading role in marine research on ecosystems, both in the insular and pelagic environments. Originally called the Honolulu Laboratory and part of the Southwest FSC for over 40 years, PIFSC became its own science center when the NMFS Pacific Islands Region was established in 2003. PIFSC implements a multidisciplinary research strategy including scientific analysis and an ecosystem observation system to support an ecosystem-based approach to the conservation management, and restoration of living marine resources. PIFSC conducts a wide range of activities including resource surveys and stock assessments, fisheries monitoring, oceanographic research and monitoring, critical habitat evaluation, life history and ecology studies, advanced oceanographic and ecosystem modeling and simulations, and economic and sociological studies. The Center’s work includes the following main focus areas.

1.2.1 Ecosystem Science Division

The Ecosystem Science Division (ESD) conducts multidisciplinary research, monitoring, and analysis of integrated environmental and living resource systems in coastal and offshore waters of the Pacific Ocean. Field research activities cover from near-shore island-associated ecosystems such as coral reefs, to open ocean ecosystems on the high seas. Research focus includes: oceanography, coral reef ecosystem assessment and monitoring, benthic habitat mapping, and marine debris research and removal. Analysis of the current structure and dynamics of marine environments, as well as examination of potential projections of future conditions such as those resulting from climate change impacts are assessed with use of numerical ecosystem models. Because humans are a key part of the ecosystem, the ESD includes research of the social and economic aspects of fishery and resource management decisions. The ESD also provides scientific and capacity building support to international organizations.

1.2.2 Fisheries Research and Monitoring Division

The Fisheries Research and Monitoring Division (FRMD) provides fisheries research and monitoring science to support fisheries management in the Pacific Islands Region. The FRMD’s fisheries research activities include, investigations into target fish species' life history, production of assessments of population size and characteristics for target and non-target species; and research into methods to reduce bycatch of non-target species, including modifications to fishing gear and use of deterrent devices. The FRMD also monitors fishing activity in federal fisheries via logbook and compiles reports of these data, as well as works with State of Hawaiʻi and Pacific Territorial agencies to enhance their fisheries monitoring efforts. The FRMD provides information about and findings from its fisheries research and monitoring activities to a variety of stakeholders, including the WPRFMC, RFMOs, and participates in collaborations and fishing gear technology transfer with foreign nations and with non-governmental organizations.

1.2.3 Protected Species Division

The Protected Species Division (PSD) conducts scientific investigations which serve a basis for management decisions and actions to enhance the conservation and recovery of endangered Hawaiian monk seals, endangered and threatened sea turtles, whales, and dolphins. The PSD is comprised of three programs: the Hawaiian Monk Seal Research Program, the Turtle Research Program, and the Cetacean Research Program. Research objectives for all three programs address species-specific topics designed to assess and monitor population trends, characterize biology and natural history, understand foraging ecology and movement patterns at sea, identify and investigate impediments to population growth, and build research capacities with other stakeholders. The PSD also conducts community outreach and education activities to share information with stakeholders and promote the stewardship of protected species.

1.2.4 Science Operations Division

The Science Operations Division (SOD) provides support and logistical services for the Center's research activities to ensure their safety and success. SOD oversees all research resources and activities aboard NOAA ships, NOAA small boats, and charters, ensuring they are permitted and comply with federal, state, and local regulations. SOD field liaisons work closely with research and management partners located in Guam, American Samoa, and the CNMI. SOD editors also review staff research products to ensure high-quality technical reports, scholarly articles, web content and educational materials.

1.2.5 Operations, Management, and Information Division

The Operations, Management, and Information Division (OMID) provides support for strategic and annual operations planning; budget allocation and execution; full-time equivalent (FTE) and human resources management (including Equal Employment Opportunity and diversity); administrative processes, data and information management information technology, e-mail and telecommunications systems; environmental compliance, safety, and facilities management. Other functions include travel services, acquisition and grants, and all other administrative services in support of PIFSC scientists.

1.3 PURPOSE AND NEED

This PEA evaluates the proposed implementation of PIFSC fisheries and ecosystem research activities for the next 5 years (as described above and in Section 2.2), or longer if the activities continue to be implemented as described in this document and the analysis of the environmental effects remains consistent with and applicable to those activities. The purpose of this action is to produce scientific information necessary for the management and conservation of domestic and international living marine resources in a manner that promotes both the recovery and long-term sustainability of certain species and generates social and economic benefits from their use. The information derived from these research activities is necessary for the development of a broad array of management actions for fisheries, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities.

The intent of PIFSC fisheries and ecosystem research activities is to inform management of the region's fisheries to ensure that the exploited marine fish and invertebrate populations, and the associated fish, protected species, habitats, and ecosystems, remain sustainable and healthy. Through this research PIFSC generates the scientific information necessary for the conservation and management of the region’s living marine resources.

This PEA also serves as the basis for evaluating the act of promulgating regulations and issuing LOA under Section 101(a)(5)(A) of the MMPA of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 et seq.) that would govern the unintentional taking of small numbers of marine mammals incidental to PIFSC’s research activities.

Under the MMPA, any activities resulting in the take of marine mammals must be authorized by NMFS; this includes research programs conducted by the NMFS science centers. Because PIFSC’s research activities have the potential to take marine mammals by Level B harassment or M&SI, PIFSC is applying to NMFS for an incidental take authorization (ITA) for its research programs.

Section 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce (Secretary) to allow, upon request, the incidental but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review. Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth.

Take, under the MMPA is defined as, “To harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.” The MMPA defines harassment as, “Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].”

The purpose of issuing an ITA is to provide an exemption to the take prohibition in the MMPA and to ensure that the action complies with the MMPA and NMFS implementing regulations. ITAs may be issued as either: (1) regulations and associated LOA under Section 101(a)(5)(A) of the MMPA; or (2) Incidental Harassment Authorizations (IHAs) under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for M&SI or where any such potential can be negated through required mitigation measures. In this specific action, because there is a potential for lethal takes and takes that may result in serious injury that could lead to mortality, PIFSC is requesting rulemaking and the issuance of a LOA for this action.

Pursuant to Section 101(a)(5)(A) of the MMPA, NMFS, upon application from PIFSC, may propose regulations to govern the unintentional taking of marine mammals incidental to the proposed fisheries research activities by PIFSC in the Pacific Island Region for the next 5 years. Because the issuance of MMPA incidental take regulations and associated LOA to PIFSC are federal actions, NMFS is required to analyze the effects of the actions on the human environment pursuant to NEPA and NMFS NEPA procedures. As a result, one branch of NMFS (the OPR, Permits and Conservation Division [NMFS PR1]) will evaluate the effects of issuing regulations and an ITA to another branch of NMFS (i.e., PIFSC).

This PEA analyzes the environmental impacts associated with the requested authorization of the take of marine mammals, incidental to PIFSC's conduct of fisheries research activities in the Pacific Islands Region. It also analyzes a reasonable range of mitigation measures that may be required if NMFS issues an MMPA authorization. The analysis of mitigation measures includes a consideration of benefits to the affected species or stocks and their habitat, and an analysis of the practicability and efficacy of each measure. This analysis of mitigation measures could potentially be used to support requirements pertaining to mitigation, monitoring, and reporting specified in MMPA regulations and subsequent LOA, if issued.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA[8], this PEA evaluates potential impacts to ESA-listed species that may result from either the primary or secondary action. Likewise, because the proposed research activities occur partially within the boundaries of NMSs, and within areas identified as EFH, this PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the NMSA and section 305(b)(2) of the MSA. PIFSC intends to use this PEA as the basis for consultations with the appropriate offices and agencies in compliance with these and other applicable laws (see Table 1.6-1).

1.4 Scope and Organization of this PEA

In considering the proposed action, NMFS is responsible for complying with a number of federal statutes, regulations, and EOs, including NEPA. As such, the purpose of the PEA is to provide an environmental analysis to support the NMFS proposal to continue the research activities under the requirements of a LOA and to encourage and facilitate public involvement in the environmental review process.

Under NEPA, an EA is prepared to describe the impacts that are likely to be caused by a proposed action on the human environment. If no potentially significant impacts are identified during preparation of the EA, a FONSI is prepared to document the decision maker's determination and to approve the proposed action. The FONSI provides the decision maker's rationale with regard to the significance of those impacts.

This PEA provides a programmatic-level assessment of the potential impacts on the biological and human environments associated with the proposed PIFSC research programs and provides a baseline for future management actions. The intent of this PEA is to describe each of PIFSC project-specific fisheries and fisheries-related ecosystem research activities (i.e., surveys) for the next 5 years.

The chapters that follow describe the proposed research activities and potential alternatives considered (Chapter 2), the affected environment as it currently exists (Chapter 3), the probable direct and indirect consequences on the human environment that may result from the

[8] 16 U.S.C. §1531 *et seq.*

implementation of the proposed research activities and their alternatives (Chapter 4), and the potential contribution to cumulative impacts from the proposed activities and their alternatives (Chapter 5).

The scope of this PEA covers research activities conducted by PIFSC or its partners that:

- Contribute to fishery management and ecosystem management responsibilities of NMFS under U.S. law and international agreements.
- Take place in marine waters in the HARA, the MARA, the ASARA and the WCPRA (see Figure 1.1-2).
- Involve the transiting of these waters in research vessels, observational surveys made from the deck of those vessels (e.g., marine mammal and seabird transects), the deployment of fishing gear and scientific instruments into the water in order to sample, collect specimens, and monitor living marine resources and their environmental conditions, or use active acoustic devices for navigation or remote sensing purposes.
- Have the potential to interact adversely with marine mammals and protected species of fish, sea turtles, birds, and invertebrates. However, the research activities covered under this PEA involve only incidental interactions with protected species, not intentional interactions with those species.
- The primary focus of this PEA is on fisheries research but also includes fisheries-related ecosystem research (i.e., collection of data necessary to understand the habitats and ecosystem processes that affect fisheries). These other types of surveys are also included because they deploy gear and instruments similar to those used in fisheries research, from similar research platforms (e.g., vessels), and in the same areas.

This PEA does NOT cover:

- Directed research on marine mammals, such as studies involving tagging and tissue sampling, which require directed scientific research permits. Directed research on marine mammals is covered by other environmental review processes and consultations under applicable regulations. However, this PEA does include some research activities that have ESA section 10 permits for research involving ESA-listed species including certain sharks, rays, and coral species. ESA Section 10 directed research permits may not cover unintentional effects on marine mammals, therefore, this PEA addresses incidental harassment of marine mammals associated with those directed research permits as described in Table 2.3-1.
- The potential effects of research conducted by scientists in other NMFS FSCs.
- Other activities of PIFSC that do not involve the deployment of vessels or gear in marine waters, such as evaluations of socioeconomic impacts related to fisheries management decisions, taxonomic research in laboratories, fisheries enhancements such as hatchery programs, and educational outreach programs.
- Other fisheries research programs conducted and funded by other agencies, academic institutions, non-governmental organizations, and commercial fishing industry research groups without material support from PIFSC.

In the future, additional research activities may propose to use methods that were not considered in the evaluation of impacts in this PEA. Some of these proposed projects may require further environmental impact assessment or satisfaction of other consultation, approval, or permitting requirements before being allowed to proceed (see also Section 2.3.2). In particular, proposed projects that may impact protected species and require permits under the ESA or the MMPA may require individual NEPA analyses and decisions tiered off this PEA. Under NEPA, tiering refers to development of subsequent NEPA analyses that incorporate by reference and build on prior NEPA analyses. A programmatic NEPA approach is especially conducive to NEPA tiering. As the details of any such studies are presently unavailable, they cannot be assessed here. After new projects are sufficiently well defined and their potential environmental consequences are better understood, specific impacts will be evaluated as necessary. If the proposed new research activities are not within or similar to the range of alternatives addressed in the programmatic document and may have adverse environmental impacts that are not within the scope of the analysis in this PEA, additional NEPA review would be required.

The proposed PIFSC research activities are not expected to result in impacts to public health or safety because the research activities would be conducted in accordance with NOAA safe work environment standards (29 Code of Federal Regulations [CFR] 1960). These issues are not considered further in this assessment.

1.5 PUBLIC REVIEW

Public participation is a cornerstone of the NEPA process. In preparing EAs, federal agencies must involve environmental agencies, applicants, and the public to the extent practicable (40 CFR Sec. 1501.4 [b]). Following guidance for public review of EAs in the Companion Manual for NAO 216-6A titled "Policy and Procedures for Compliance with the National Environmental Policy Act and Related Authorities", this PEA and the associated LOA application were available for public review on the PIFSC web site[9] in November 2015, when a notice of the availability of the DPEA was published in the *Federal Register*. Public and agency comments received on the draft PEA have been considered in this Final PEA.

One public comment letter was received from the Humane Society of the United States (HSUS). Agency comment letters were received from the State of Hawai‘i, Department of Land and Natural Resources (DLNR) and from USFWS, Pacific Islands Fish and Wildlife Office. Substantive comments were considered by PIFSC and, if necessary, addressed in the PEA.

The HSUS comments focused on Alternatives 1-3. They commented that the alternatives provided in the DPEA were inappropriately narrow, and believed that NMFS should choose a modified Alternative 2 that incorporates the additional feasible mitigation measures in Alternative 3. HSUS also requested to include Level A takes for humpback whales due to entanglement in trawl gear and for bottlenose dolphins due to hook and line gear. HSUS stated that the cumulative effects analysis covered too broad of an action area and minimized the effects of acoustic harassment.

Comments from the DLNR focused on where and to what extent Essential Fish Habitat (EFH) exists, reviewing and refining methods for calculating Potential Biological Removal (PBR) to

[9] https://www.fisheries.noaa.gov/action/incidental-take-authorization-noaa-fisheries-pifsc-fisheries-and-ecosystem-research

produce a number that is more accurate and effective, reviewing and refining critical habitat determinations, and including a description of albacore and bluefin tuna in Chapter 3.

Comments from USFWS focused on questions about gear and the use of Unmanned Aerial Systems (UAS), attraction of birds to research vessels at night, and missing descriptions and impact analyses of ESA-listed birds.

Additional review occurred through required consultations for the Coastal Zone Management Act (CZMA) and National Historic Preserviation Act (NHPA). In November and December of 2019, PIFSC initiated consultation with the Hawai‘i, Guam, CNMI, and American Samoa Coastal Management Programs as required under the CZMA. As part of the consultation process the State of Hawaii Office of Planning issued a public notice in January 2020 requesting public comments on the proposed action[10] and no comments were received.

Also, in November 2021, in order to comply with the NHPA, PIFSC sent follow-up letters to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (Native Hawaiian Organizations listed in the U.S. Department of Interior Native Hawaiian Organization Notification List and identified as organizations with interests in natural resource management and conservation) to review the draft PEA (dated October 2021) and PIFSC's determination that the proposed action would not have the potential to cause effects on historic properties. The Guam Historic Preservation Office provided comments on December 12, 2021, requesting more information including a map of the Area of Potential Effects (APE) for Guam. On February 11, 2022, PIFSC provided a map showing the APE for Guam and submitted all additional information requested, and no additional questions were received from the Guam Historic Preservation Office. No other historic preservation office or interested parties commented on PIFSC's follow up letter.

1.6 REGULATORY REQUIREMENTS

NMFS is the lead federal agency for the proposed research activities evaluated in this PEA. These activities trigger a broad range of regulatory compliance processes because they may cause both adverse impacts to public resources regulated by various statutes, and contribute to reducing impacts caused by other activities, such as fishing, that are also regulated by those same statutes. Chapters 4 and 5 assess the impacts of the research activities on protected species and habitat. Because the research activities are essential for NMFS to carry out its regulatory mandates, Chapters 4 and 5 also describe potential impacts to NMFS' ability to effectively monitor and manage fishery resources under the alternatives evaluated. Descriptions of the relevant statutory requirements are provided in Chapter 6, "Applicable Laws." Notably, PIFSC has initiated discussions with Native Hawaiian Organizations (NHOs) and the State Historic Preservation Offices (SHPOs) in Hawai‘i, Guam, American Samoa, and CNMI in order to identify historic sites that may be affected by the proposed fisheries research activities (see Appendix C [copy of letter requesting to initiate discussions]).

Table 1.6-1, below, presents a brief summary of some of these laws. This information is provided to aid the reader in understanding the material presented later in the PEA and is not intended to be a complete listing of all applicable statues, orders, or regulations applicable to the proposed action and alternatives.

[10] https://files.hawaii.gov/dbedt/erp/The_Environmental_Notice/2020-01-08-TEN.pdf

Table 1.6-1 Applicable Laws, Treaties, Executive Orders and Regulatory Organizations

Law	Description
National Environmental Policy Act (NEPA)	Requires federal agencies to evaluate potential environmental effects of any major planned federal action and promotes public awareness of potential impacts by requiring federal agencies to prepare an environmental evaluation for any major federal action affecting the human environment.
Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Authorizes the U.S. to manage fishery resources in an area from a state's territorial sea (extending 3 nm from shore) to 200 nm off its coast (termed as the EEZ). Includes 10 national standards to promote domestic commercial and recreational fishing under sound conservation and management principles, and provides for the preparation and implementation of FMPs.
Marine Mammal Protection Act (MMPA)	Prohibits the take of marine mammals in U.S waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S. Allows, upon request, the "incidental," but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing).
International Dolphin Conservation Program Act (IDCPA)	The IDCPA was a 1997 amendment to the U.S. MMPA. It provides for the U.S. implementation of the international Agreement on the International Dolphin Conservation Program (IDCP), to which the U.S. is a signatory.
Endangered Species Act (ESA)	Provides for the conservation of endangered and threatened species of fish, wildlife, and plants throughout all or a significant portion of their range, and the conservation of the ecosystems upon which they depend. Administered jointly by NMFS and the USFWS.
Migratory Bird Treaty Act (MBTA)	Protects approximately 836 species of migratory birds from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations.
Fish and Wildlife Coordination Act (FWCA)	Requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies.
National Marine Sanctuaries Act (NMSA)	Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as NMS. Section 304(d) of the NMSA requires interagency consultation between the NOAA Office of National Marine Sanctuaries (ONMS) and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource."
Tuna Conventions Act Of 1950	Provides for U.S. representation on the IATTC. The principal duties of the IATTC are (1) to study the biology of the tropical tunas, tuna baitfish, and other kinds of fish taken by tuna vessels in the eastern Pacific Ocean and the effects of fishing and natural factors upon them, and (2) to recommend appropriate conservation measures, when necessary, so that these stocks of fish can be maintained at levels which will afford the maximum sustained catches.
National Historic Preservation Act (NHPA)	Section 106 requires federal agencies to take into account the effects of their undertakings, which could include any project funded, licensed, permitted, or assisted by the federal government, on historic properties..
Executive Order (EO) 12989, Environmental Justice	Directs federal agencies to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.
Coastal Zone Management Act (CZMA)	Encourages and assists states in developing coastal management programs. Requires any federal activity affecting the land or water use or natural resources of a state's coastal zone to be consistent with that state's approved coastal management program.
Convention on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean	The convention establishes an international commission for the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific Ocean, now more commonly referred to as the WCPFC. A noteworthy aspect of the convention is the fact that it will exercise management control into the high seas zones outside national EEZs in contrast to some other regional fishery management organizations.

Law	Description
High Seas Fishing Compliance Act (HSFCA)	The United Nations Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas establishes the responsibility of each nation for the actions of vessels fishing under that nation's flag on the high seas. The HSFCA is the domestic legislation enacted in 1995 to provide authority to the Secretary of Commerce to implement this agreement.
South Pacific Tuna Treaty (SPTT)	The 1987 Multilateral Fisheries Treaty with the U.S. in the Forum Fisheries Agency is a vital component of the political and economic relationship between the U.S. and the Pacific Island Parties. The treaty entered into force in 1987 for an initial period of five years. It has since been extended twice; the most recent extension is for 2003 through 2013. The treaty sets the operational terms and conditions for the U.S. tuna purse seine fleet to fish in a vast area of the central and western Pacific Ocean, including waters under the jurisdiction of the Pacific Island Parties.
The Antiquities Act of 1906	The Antiquities Act of 1906 authorizes the President to proclaim national monuments on federal lands that contain "historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest." The President is to reserve "the smallest area compatible with the proper care and management of the objects to be protected." (16 U.S.C. § 43)
Executive Order (EO) 12114, Environmental Effects Abroad of Major Federal Actions	EO 12114, Environmental Effects Abroad of Major Federal Actions, requires federal agencies to assess whether federal actions have the potential to "significantly affect" the environment of the global commons or the environment of a foreign nation not participating with the United States or "otherwise involved in the action."
Western and Central Pacific Fisheries Commission (WCPFC)	The WCPFC is an international organization that aims to ensure the long-term conservation and sustainable use of highly migratory fish stocks (i.e., tunas, billfishes, and associated species) in the western and central Pacific Ocean. The WCPFC Convention seeks to address problems in the management of high seas fisheries resulting from unregulated fishing, over-capitalization, excessive fleet capacity, vessel re-flagging to escape controls, insufficiently selective gear, unreliable databases, and insufficient multilateral cooperation in respect to conservation and management of highly migratory fish stocks.
International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC)	The ISC was established in 1995 to develop better information on stocks of tuna and tuna-like species in the North Pacific Ocean in cooperation with relevant fisheries organizations, to enhance scientific knowledge of these stocks throughout their entire range.
South Pacific Regional Fisheries Management Organization (SPRFMO)	The SPRFMO is an inter-governmental organization that is committed to the long-term conservation and sustainable use of the fishery resources of the South Pacific Ocean and in so doing safeguarding the marine ecosystems in which the resources occur.
Inter-American Convention (IAC) for the Protection and Conservation of Sea Turtles	The IAC for the Protection and Conservation of Sea Turtles is an intergovernmental treaty that provides the legal framework for countries in the Americas and the Caribbean to take actions for the benefit of sea turtles. The IAC was entered into force in May of 2001 and promotes the protection, conservation and recovery of sea turtles and those habitats on which they depend, on the basis of the best available data and taking into consideration the environmental, socioeconomic, and cultural characteristics of the Parties.

2.1 INTRODUCTION

CEQ is responsible for the development and oversight of regulations and procedures implementing NEPA. The CEQ regulations provide guidance for federal agencies regarding NEPA's requirements (40 CFR Part 1500). NOAA has also prepared environmental review procedures for implementing NEPA, NAO 216-6A. In the Companion Manual for NAO 216-6A it explains that an Environmental Assessment (EA) must consider and analyze the impacts of a reasonable range of alternatives, including (and at times may be limited to) the preferred action and the no action alternative. To warrant detailed evaluation by the NMFS, an alternative must be reasonable[11] and meet the purpose and need (see Section 1.3). Screening criteria are used to determine whether an alternative is reasonable and should be considered further or whether it is not reasonable to consider in detail in the EA. Section 2.6 describes potential alternatives that were considered but rejected because they do not meet the purpose and need of the proposed action.

Screening Criteria – To be considered 'reasonable' for the purposes of this PEA, an alternative must meet the following criteria:

1. The action must not violate any federal statute or regulation.
2. The action must be consistent with reasonably foreseeable funding levels.
3. The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts or consider no federal funding availability for fisheries research.

To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research should fulfill the following requirements:

1. Methods and techniques must provide standardized, objective, and unbiased data consistent with past data sets (time series) in order to facilitate long-term trend analyses.
2. Collected data must adequately characterize living marine resource and fishery populations and the health of their habitats.
3. The surveys must enable assessment of population status and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
4. Research on new methodologies to collect fisheries and ecosystem information (e.g., active and passive acoustic instruments and video surveys of benthic habitats in lieu of dredge gear or bottom trawls), and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies must be conducted with experimental controls sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria and requirements. Based on this evaluation, the No-Action/Status Quo alternative and two other action alternatives were identified as reasonable and are carried forward for more detailed evaluation in this PEA. NMFS also

[11] "Section 1502.14 (NEPA) requires the EIS to examine all reasonable alternatives to the proposal. In determining the scope of alternatives to be considered, the emphasis is on what is 'reasonable' rather than on whether the proponent or applicant likes or is itself capable of carrying out a particular alternative. Reasonable alternatives include those that are *practical or feasible from the technical and economic standpoint and using common sense*, rather than simply desirable from the standpoint of the applicant." (40 Questions) (emphasis added) While this regulatory requirement is specific to EISs, it is broadly applied to EAs by convention and because an EA is an assessment of whether an EIS is necessary.

evaluates a second type of no-action alternative that considers no federal funding for fisheries research activities. This alternative is called the No Research Alternative to distinguish it from the No-Action/Status Quo alternative.

The No-Action/Status Quo Alternative is used as the baseline for comparison of the other alternatives. Three of the alternatives include fisheries and ecosystem research projects conducted or funded by the PIFSC as the primary federal action. These three alternatives also include suites of mitigation measures intended to avoid and minimize potentially adverse interactions with protected species. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the MBTA.

The three alternatives involving research activities in the marine environment trigger marine mammal protection requirements under the MMPA. For this reason, NMFS must evaluate the alternatives to ensure that they would fulfill the purpose and need of NMFS issuing regulations and subsequent LOA under Section 101(a)(5)(A) of the MMPA to PIFSC. The LOA, if issued, would provide an exception to PIFSC from the take prohibitions for marine mammals under the MMPA, incidental to the conduct of PIFSC's research activities, namely: (1) the issuance of an LOA for the take of marine mammals by Level B harassment, and M&SI incidental to the PIFSC's conduct of research activities for a five-year-long period of time; and (2) compliance with the MMPA which sets forth specific findings (e.g., no unmitigable adverse impact on the availability of a species or stock for subsistence uses, negligible impact on a species or stock, reporting, monitoring, and mitigation requirements) that must be made in order for NMFS to issue an LOA. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals to the level of least practicable adverse impact. This range of mitigation measures has been incorporated as part of the identified alternatives in order to evaluate their ability to minimize potential adverse environmental impacts. The efficacy and practicability of all potential mitigation measures are assessed in Chapter 4.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA, this PEA evaluates potential impacts to ESA-listed species. Likewise, because the proposed research activities occur partially within the boundaries of NMSs, and within areas identified as EFH, this PEA evaluates potential impacts to sanctuary resources and EFH as required under section 304(d) of the NMSA and section 305(b)(2) of the MSA, respectively.

Additionally, PIFSC research activities include several international fisheries technology research programs, including bycatch reduction research projects, that take place outside of U.S. jurisdiction, in foreign territorial seas. Under EO 12114 Environmental Effects Abroad of Major Federal Actions and DAO 216-12, NMFS is required to consider the environmental effects of federal action outside of the United States. Because these international fisheries technology research programs, including bycatch reduction research projects, are not being evaluated under NEPA, they will be considered separately from the NEPA alternatives in this PEA, and are described in Section 2.7 at the end of this chapter. In compliance with EO 12114, this PEA will describe and analyze the potential effects of the proposed action and alternatives on the environment outside of the U.S. Federal actions may be exempt from this EO if the action will not have a significant effect on the environment outside of the United States as determined by the agency (EO 12114, Section 2-5), or if the action is carried out with participation from the foreign nation (EO 12114, Section 2-3(b)).

2.2 ALTERNATIVE 1 – NO-ACTION/STATUS QUO ALTERNATIVE—CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH WITH SCOPE AND PROTOCOLS SIMILAR TO PAST EFFORT

As discussed in Chapter 1, PIFSC collects a wide array of research data necessary to evaluate the status of fishery resources and the marine environment. PIFSC scientists conduct fishery-independent research onboard NOAA owned and operated vessels or on chartered vessels in four geographic research areas. The HARA, the MARA, and the ASARA extend approximately 24 nm from the baseline of the respective archipelagos (i.e., to approximately the outer limit of the contiguous zone[12]). The fourth research area, the WCPRA, includes the remainder of the archipelagic U.S. EEZs, the central and western Pacific Ocean between the archipelagos and certain political boundaries (e.g., regional fisheries management organizations), and the waters around the Pacific remote islands. Figure 1.1-2 shows the latitude and longitude boundaries of these research areas.

PIFSC also designs and executes a limited number of surveys onboard commercial fishing vessels (activities occurring on U.S. commercial fishing vessels associated with a fishery that has a valid FMP or EFP whereby marine mammal and ESA-listed species take has been exempted or that comply with MMPA section 118 or an ESA ITS, as applicable, would be outside the scope of this PEA). In those instances, PIFSC scientists contract commercial vessels to conduct a research project in the context of the existing fishery. Under the Status Quo Alternative, PIFSC would administer and conduct the survey programs over the next five-year period that are described in Table 2.2-1. Unless specifically noted under the survey descriptions in Table 2.2-1, the status quo research described below is also included in the Preferred Alternative (Table 2.3-1).

Table 2.2-1 is a summary of regularly occurring PIFSC surveys conducted on NOAA, University of Hawai‘i, and chartered vessels. These surveys are likely to continue during the next 5 years, although not necessarily every year. The Pacific Islands Region is a vast geographic area, several times the size of the continental U.S. Consequently, it is impossible to carry-out all research surveys in all of the research areas every year. As a result, research surveys are generally focused on one research area every year and that research area is visited every second, third, or fourth year. Over the course of 5 years, this research cycle could be presented as HARA-ASARA-MARA-WCPRA-HARA. This cycle inherently includes some overlap of any one research area (e.g., Wake Atoll in the WCPRA is usually visited when the ship is transiting to MARA because it is on the way and makes for the most cost-efficient model). Furthermore, a specific survey may be prioritized every year, for several years in a row, in one research area because of a defined management need. Because the ships and headquarters for PIFSC are based in Hawai‘i, the HARA is visited more frequently than the other research areas. In addition, for any particular year, only some of the surveys are funded and carried out. The sum of all the proposed Days-at-Sea (DAS) for the surveys listed in Table 2.2-1 is over 700 days. The projected DAS numbers in the table represent a best-case scenario and are often carried out in fewer days. Furthermore, many of these surveys are overlapping (e.g., RAMP and Benthic Habitat Mapping can occur at the same time on the same ship), are specific to one research area (e.g., Mariana Resource Survey) and therefore carried out every third year, alternate with another survey (e.g., West Hawai‘i Integrated

[12] Presidential Proclamation 7219 extended the U.S. contiguous zone from 12 to 24 nm on September 2, 1999.

Ecosystem Assessment [IEA] survey and Pelagic Oceanographic Survey), and can occur independent of the NOAA white ships (e.g., small boat-based surveys that launch from land). Additionaly, every survey is subject to available funding. In recent years the DAS was funded at approximately 150 DAS for the *Oscar Elton Sette* and 130 DAS for the *Hi'ialakai*[13]. These DAS numbers include transit times and gear testing, which are not days in which research surveys are usually conducted.

[13] NOAA Ship Hi'ialakai was decommissioned (April 2019)

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Table 2.2-1 Summary Description of PIFSC Research Activities Conducted or Funded under the Status Quo Alternative

See Appendix A for descriptions of the different gear types and vessels used. Equivalent research vessels may be used in the future for specific research activities depending on availability. Appendix B includes figures showing the spatial coverage of each survey by season. Mitigation measures are described in Section 2.2.1. Units of measurement are presented in the format data was collected.

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
Sampling Pelagic Stages of Insular Fish Species	Results of sampling inform life history and stock structure studies for pelagic larval and juvenile stage specimens of insular fish. Additional habitat information is also collected. Target species are snapper, grouper, and coral reef fish species within the 0-175 meter (m) depth range. Pelagic stages sampling is conducted both at midwater depths using a "Stauffer" modified Cobb trawl (Cobb trawl) or a 10-foot (ft) Isaacs-Kidd trawl, and at the surface using a 6-ft Isaacs-Kidd trawl. Surveys may occur every year in the HARA but approximately once every 3 years in the MARA, ASARA, and WCPRA.	HARA MARA ASARA WCPRA 3-200 nm from shore	Year-round HARA: up to 20 DAS MARA, ASARA, WCPRA: up to 30 DAS approximately once in research area every 3 years Midwater Research trawls are conducted at night, Surface trawls are conducted day and night	NOAA Ships such as *Oscar Elton Sette* or equivalent vessel	Cobb trawl (midwater trawl) with OES Netmind or Isaacs-Kidd 10-ft midwater trawl	Tow speed: 2.5-3.5 knots (kts) Duration: 60-240 minutes (min) Depth: Deployed at various depths during same tow to target fish at different water depths, usually to 250 m	40 tows per survey per year
					Isaacs-Kidd 6-ft trawl (surface trawl) Dip net (surface)	Tow speed: 2.5-3.5 kts Duration: 60 min Depth: Surface	40 tows per survey per year
Spawning Dynamics of Highly Migratory Species	Early life history studies provide larval stages for population genetic studies and include the characterization of habitat for early life stages of pelagic species. Egg and larval collections are taken in surface waters using a variety of plankton gear, primarily Isaacs-Kidd 6-ft surface trawl but also sometimes including 1-m ring net and surface neuston net.	HARA MARA ASARA WCPRA 1-25 nm from shore	Year-round HARA: up to 25 DAS MARA, ASARA, WCPRA: up to 25 DAS approximately once in research area every 3 years Surface trawls are conducted day and night	NOAA Ships such as *Oscar Elton Sette* or equivalent vessel, Small boats	Isaacs-Kidd 6-ft (surface)	Tow speed: 2.5-3.5 kts Duration: 60 min Depth: Surface	140 tows per survey per year
					Neuston tows (surface) 1-m ring net (surface)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min Depth: 0-3 m	140 tows per survey per year
Cetacean Ecology Assessment *(Under the Preferred Alternative this survey would include midwater trawling with the Cobb net)*	Survey transects conducted in conjunction with cetacean visual and acoustic surveys within the Hawai'i EEZ to develop ecosystem models for cetaceans. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.	HARA MARA ASARA WCPRA	Variable timing, depending on ship availability, up to 90 DAS Usually conducted in non-winter months Midwater trawls are conducted at night, Surface trawls are conducted day and night All other gear and instruments are conducted day and night	NOAA Ships such as *Oscar Elton Sette*, small boats, contract fishing vessels	Small-mesh towed net (surface trawl)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min	180 tows total per year
					Active acoustics (splitbeam Simrad EK60)	38-200 kilohertz (kHz)	Intermittent continuous during surveys
					Acoustic Doppler Current Profiler (ADCP) (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
					Conductivity, temperature, depth (CTD) profiler	90 min Profiles from surface down to 1000 m depth	Up to 180 per survey per year)
					Expendable bathythermograph (XBT)	10 min duration. Profiles from surface down to1000 m depth	Maximum 900 per survey per year
	<u>*Passive Acoustics Calibration*</u> – Transmit sound (synthetic pings, dolphin whistles or echolocation clicks, etc.) to passive acoustic recording devices for purposes of in-situ calibration, needed to understand detection distances and received level or frequency-dependent variation in the device performance.	HARA MARA ASARA WCPRA			Underwater sound playback system (Lubell LL916 piezoelectric underwater speaker)	Includes underwater projector and amplifier suspended from small boat or ship. Projection depth may vary from near surface to 100 m.	Intermittent

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
Cetation Ecology Assessment, cont'd.	Stationary Passive Acoustic Recording – Placement of long-term acoustic listening devices for the purposes of recording cetacean occurrence and distribution, ambient and anthropogenic noise levels, and presence of other natural sounds. Recorders are typically deployed and retrieved once or twice per year at each monitoring location.	HARA MARA ASARA WCPRA			High-frequency acoustic recording package (HARP), ecological acoustic recorder (EAR), or similar device	Deployed in seafloor package or mooring configuration consisting of recorder, acoustic releases, anchor, and flotation	Up to ten long-term monitoring sites
	Passive Acoustic Monitoring – Deployment of passive acoustic monitoring devices in conjunction with other sampling measures, such as on fishing gear or free-floating.	HARA MARA ASARA WCPRA			Miniature HARPs, sonobuoys, or similar platforms	Autonomous recorder package modified for attachment to longline gear, oceanographic mooring, or free-floating. Various configurations may have surface buoys with recorder up to 1000 ft below, or they may have smaller form factor with entire package not exceeding 1m length.	Continuous
	Passive Acoustic or Oceanographic Gliders – Autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle provide measure of cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide oceanographic measures over several months duration.	HARA MARA ASARA WCPRA			Seaglider; WaveGlider; or similar platform	Autonomous underwater vehicle. Buoyancy driven glider profile from surface to pilot-controlled depth (up to 1000 m), Inertial vehicles driven by wave-action have surface float with solar panels and communication antennas with sub-surface sled carrying sensors 5-20 m below surface.	Continuous
Marine Debris Research and Removal *(Preferred Alternative expanded to include net tows and UAS gear, and to include all research areas)*	These surveys: (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. Team members systematically survey reefs using shoreline walks, swim surveys, and towed-diver surveys to locate submerged derelict fishing gear in shallow water. Debris type, size, fouling level, water depth, GPS coordinates, and substrate of the adjacent habitat are recorded. Nets are evaluated before removal actions to determine appropriate removal strategies. Attempts to remove marine debris encountered at sea are variable and can be unfeasible because of operational, vessel, or safety constraints. However, by attaching a satellite-tracked marker to debris, it will be possible to locate that debris in the future and to track and analyze its drifting patterns.	HARA ASARA	HARA: annually or on an as needed basis, up to 30 DAS ASARA: Occurred once in 2009 after a tsunami Surface trawls are conducted day and night UAS are conducted during the day or night In-water and beach activities are conducted during the day	NOAA Ships *such as Oscar Elton Sette*, or equivalent vessel Small boats	Knives, lift bags, scissors, shovels, cargo nets Helicopters (Main Hawaiian Islands [MHI] only)	Gear used to a depth of 30 m in around islands and atolls.	HARA: average of 48 metric tons (mt) per survey per year 1996–2013 ASARA: 4 mt per survey per year
Coral Reef Benthic Habitat Mapping	Produces comprehensive digital maps of coral reef ecosystems using multibeam sonar surveys and optical validation data collected using towed vehicles and autonomous underwater vehicles (AUVs).	HARA MARA ASARA WCPRA	Year-round, up to 30 DAS Day and night	NOAA Ships such as *Oscar Elton Sette* or equivalent vessel Small boats	Active acoustics (will vary by vessel): Multibeam Simrad EM3002 D and EM300, multibeam Reson 8101 ER, Imagenex 837 DeltaT, split-beam Simrad EK60	38-300 kilohertz (kHz)	Continuous

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
Deep Coral and Sponge Research	Research includes opportunistic surveys on distribution, life history, ecology, abundance, and size structure of deep corals and sponges using ROV, divers, and submersibles. Besides visual surveys, sampling protocols include collection of coral and sponges for genetic, growth and reproductive work and an array of data loggers (temperature, currents, particulate load) placed on the bottom for recovery in future years. No ESA listed species are sampled during this work.	HARA MARA ASARA WCPRA	Opportunistically, depending on ship availability Year-round, 50 DAS	NOAA Ships such as *Okeanos Explorer*, *Oscar Elton Sette*, University of Hawaiʻi research vessel *Ka'imikai-o-Kanaloa*, or equivalent vessel	Remotely operated vessel (ROV), divers, submersibles, AUV, landers, instrument packages, Ship-based multibeam echosounders (SeaBeam 3012 multibeam, EK-60 18kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz)	ROVs include the Super Phantom S2 ROV system operated by the Undersea Vehicles Program at the University of North Carolina at Wilmington. Subs include Pisces V and Pisces IV and similar Human occupied vehicles (HOV) AUV includes Seabed and other unmanned systems Hull-mounted 3.5-30 kHz multibeam	HARA: 200 MARA: 200 ASARA: 200 WCPRA: 200 DNA specimens N=100, mean weight (wt) = 10 grams (g) Voucher specimens N=60 wt = 10-500 g Paleo-specimens N=40, wt=500-2000 g
Insular Fish Life History Survey and Studies	Provide size ranges of deepwater eteline snappers, groupers, and large carangids to determine sex-specific length-at-age growth curves, longevity estimates, length and age at 50% reproductive maturity within the Bottomfish Management Unit Species (BMUS) in Hawaiʻi and the other Pacific Islands Regions. Specimens are collected in the field and sampled at markets.	HARA: (0.2 -5 nm from shore) every year. MARA ASARA WCPRA	HARA: July-September, up to 15 DAS/yr. Other areas: Year-round, up to 30 DAS for each research area once 3 three years Day and night	NOAA Ships such as *Oscar Elton Sette* or equivalent vessel, Contracted fishing vessels, small boats	Hook-and-line	Hand line, Electric or hydraulic Reel: Each operation involves 1-3 lines with.4-6 hooks per line; soaked 1-30 min. Squid bait on circle hooks (typically 10/0 to 12/0).	HARA: 350 operations per survey per year Other areas: 240 operations per survey per year for each research area
Pacific Reef Assessment and Monitoring Program (RAMP) *(Preferred Alternative to include additional gear and fish collections)*	Ecosystem surveys that include rapid ecological assessments; towed-diver surveys; coral disease, invertebrates, fish, and algae surveys; and oceanographic characterization of coral reef ecosystems. Surveys also include training to conduct surveys which occur between 0-3nm from shore, year-round, using small boats, SCUBA or closed-circuit rebreathers (CCR) diver surveys, sampling, and deployment of various equipment. Samples and specimens collected in the field would be analyzed in the laboratory.	HARA MARA ASARA WCPRA; 0-20 nm from shore	Year-round; Annual (each research area is surveyed triennially) 30-120 DAS depending on which area is surveyed In-water activities with divers are conducted during the day, all other activities are conducted day and night	NOAA Ships such as *Oscar Elton Sette*, Small boats	Hand gear used by SCUBA and free divers	Spear gun, slurp gun (a clear plastic tube designed to catch small fish by sliding a plunger backwards out of the tube), hand net, including small boat operations with SCUBA Hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, core-punch, hand snipping Temporary transect line, surface marker buoy, 1 m long plastic spacer pole with camera	MARA: Ad hoc fish collections from 2009, less than 20 specimens. Up to but no more than 500 samples per year including corals, coral products, algae, and algal products, and sessile invertebrates (size range from fragments to entire individuals/colonies, although the smallest possible sample will be taken—typically 2 cm by 2 cm. Some of these may be ESA-listed species. X transects per year with 30 pole contacts on the substrate for each photo-transect site
					Pneumatic/hydraulic drill for coral coring	Approximately 4-centimeter (cm) diameter and ≤ 100 cm long masonry drill bit used to extract a 2.5 x 5-70 cm coral sample	30 coral cores per survey per year
					Active acoustics: will vary by vessel (Multi-beam: Reson8101 ER; split-beam: Simrad EK60)	38-200 kHz	Continuous
					Bioerosion monitoring units (BMUs)	1 x 2 x 5 cm pieces of relic calcium carbonate, placed next to the reef and deployed at 0-40 m	150 deployments per survey per year Deployed for approximately 1-3 years
					Autonomous reef monitoring structures (ARMS)	36 x 46 x 20 cm structure placed on pavement or rubble (secured to bottom by stainless steel stakes and weights) in proximity to coral reef structures	150 deployments for a duration of typically1-3 yr. each

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
RAMP, cont'd.					Sea Bird Electronics SBE56 temperature recorders	Instrument and mounting brackets are 10 x 5 x 30 cm, anchored to a dead portion of the reef with two coated 3 pound (lb.) dive weights and cable ties, typically deployed at 5-25 m but may reach 30 m	Typically deployed for 1-3 years
					ADCP	Nortek Aquadopp Sideseeing Profiler, 2 MHz down to 30m	Continuous during transects
					CTD profiler (shallow-water and deep-water)	Shallow-water CTDs will be conducted from small boats to a depth of 30 meters Deep-water CTDs will be conducted from larger vessels to a maximum depth of 500 m.	Hundreds to thousands of casts per survey per year
					Baited remote underwater video system (BRUVS)	35 kg system weight with 1 kilogram (kg) of bait Deployed down to100 m to the seafloor	Up to 600 deployments per survey per year Deployed for approximately 1 hour
					Calcification acidification units (CAUs)	Each CAU consists of 2 PVC plates (10 x 10 cm) separated by a 1 cm spacer and mounted on a stainless steel rod which is installed by divers into the bottom (avoiding corals) down to 30 m	150 deployments per survey per year Deployed for approximately 1-3 years
Surface Night-Light Sampling	Conducted opportunistically for decades aboard PIFSC research vessels. Sampling goals: collect larval or juvenile stages of pelagic or reef fish species that accumulate within surface slicks during daylight hours and those attracted to surface and submerged lights from research vessels at night.	HARA; primarily 1-25 nm from shore; adjacent to the Kona coast but also out to 200 nm and beyond in the WCPRA	Year-round Up to 30 DAS Along with scheduled NOAA research cruises or opportunistically aboard other vessels. Conducted during the night	NOAA Ships such as *Oscar Elton Sette* or equivalent fisheries research vessel, or other vessels.	Net (dip)	Scoop nets (0.5 m diameter sometimes attached to 3-4 m long poles) used while vessel is drifting	30 night-light operations on all vessels combined. Total catch (all species) ≤ 1500 specimens of larval or juvenile fish per year
Kona Integrated Ecosystem Assessment Cruise *(Under the Preferred Alternative hook-and-line fishing component is added)*	Survey transects conducted off the Kona coast and Kohala Shelf area to develop ecosystem models for coral reefs, socioeconomic indicators, circulation patterns, larval fish transport and settlement. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection. This survey is usually performed along with passive acoustic surveys as described under the Cetacean Ecological Surveys	HARA; 2-10 nm from shore	Variable timing, depending on ship availability, up to 10 DAS Day and night	NOAA Ships such as *Oscar Elton Sette*, or equivalent vessel	Large-mesh midwater Cobb trawl	Tow speed: 3 kts Duration: 60-240 min Depths: Deployed at various depths during same tow to target fish at different depths, usually to 200 m	15-20 tows per survey per year (these tow samples would usually be limited to either West Hawai'i Integrated Ecosystem Assessment (IEA) or Oceanography Cruise in any one year)
					Small-mesh surface and midwater trawl nets (Isaacs-Kidd 6-ft and 10-ft, neuston, ring, bongo nets, 1-m plankton drop net)	Tow speed: 3 kts Duration: up to 60 min Depth: 0-200 m	15-20 tows per survey per year (any combination of the nets described)
					Active acoustics (split-beam: Simrad EK60; trawl mounted OES Netmind; Didson 303)	Hull mounted: 38-200 kHz Surveys typically to 1000 m depth Didson is usually operated between 400 m and 700 m depth. Range is 30 m	Intermittent continuous during surveys Up to 12 Didson casts for up to 120 min per survey.
					ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
					CTD profiler	90 min/cast	50 tows per survey per year, alternating with Oceanography Cruise
Barbless Hook Donation	Donations of barbless circle hooks are made primarily at shore-based fishing tournaments or other outreach events to encourage replacement of	HARA	Year round, no DAS Conducted during the day	None	Barbless circle hooks	Hooks have the barbs crimped flat (barbs effectively removed)	Up to 35 events (days of donating hooks) per year. Up to 35,000 hooks donated per yr.

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
	barbed hooks in normal (legal) use. PIFSC has no control over the use of the hooks after the donation.						
Northwestern Hawaiian Islands Bottomfish Surveys *(Survey not continued in the Preferred Alternative)*	Conduct bottomfishing and collect biological data, including length measurements and otoliths and gonads. Genetic sampling of opakapaka and butaguchi.	HARA: Northwestern Hawaiian Islands	Year-round, Up to 16 DAS	NOAA Ships such as *Oscar Elton Sette*	Hook-and-line	Electric or hydraulic reel: each operation involves 1-3 lines with 4-6 hooks per line; soaked 1-30 min	256 operations per survey per year. 400 BMUS per year
Insular fish Abundance Estimation Comparison Surveys *(Survey to be expanded to all research areas under Preferred Alternative)*	Comparison of Fishery-Independent Methods to Survey Bottomfish Assemblages in the MHI: Coordinated research between PIFSC ESD and FRMD, State of Hawai'i Department of Land and Natural Resources, University of Hawai'i at Manoa, University of Miami. Day and night* surveys are used to develop fishery-independent methods to assess stocks of economically important insular fish. Methods include: active acoustics, stereo baited underwater video camera systems (BotCam, Modular Optical Underwater Survey System [MOUSS], BRUVS), AUV equipped with stereo video cameras, towed optical assessment device (TOAD), and hook-and-line fishing. * night surveys were conducted only once in 2011	MHI; 2-10 nm from shore	Variable, up to 30 DAS	NOAA Ships such as *Oscar Elton Sette* or equivalent vessel, Contracted research vessels	Hook-and-line	Hand, electric, and/or hydraulic reels. Each vessel fishes 2 lines per operation. Each line is baited with 4 hooks. Soak time ≤30 min per fishing operation. .	≤ 540 operations (each ≤30 min soak time) per survey per year
					Active acoustics (split multi-beam: Reson8101 ER; deep water: Simrad EK60; trawl mounted OES Netmind), various fish finder devices	38-240 kHz	Intermittent continuous during surveys
					Underwater Video Camera (BotCam)	Duration: deployed 30-60 min. Depth: 350m	380 deployments per survey per year
					AUV	Speed: 0.5 kts Duration: 3 hours/deployment	40 deployments per survey per year
					ROV	Duration: 1 hr	40 deployments per survey per year
					TOAD	Tow speed: 6 kts Duration: 1 hr	40 tows per survey per year
Gear and Instrument Development and Field Trials	Field trials to test the functionality of the gear prior to the field season, or to test new gear or instruments described elsewhere in this table but outside the geographic scope specified for other surveys.	HARA (Primarily in the waters south of Pearl Harbor on the Island of O'ahu)	Year-round, up to 15 DAS Day and night	NOAA Ships such as *Oscar Elton Sette*, or equivalent vessel Small boats	Nets, lines, instruments Calibration of Simrad EK60	38-200 kHz	Intermittent for 24-48 hours
Northwestern Hawaiian Islands (NWHI) Lobster Surveys *(Survey not continued in the Preferred Alternative)*	Collect data on abundance and species composition, length-frequency data of trap-captured lobsters at two banks in the Northwestern Hawaiian Islands (NWHI) to compare with results of previously collected data. Record and release any tagged lobsters.	HARA	Year-round, up to 30 DAS	*Oscar Elton Sette* or equivalent, contract fishing vessel(s)	Lobster traps	One string per site, 8 or 20 traps per string, separated by 20 fathoms of ground line; two depth regimes: 10-20 or 20-35 fathoms. Up to 15 sites (15 strings) per night	Up to 360 strings set per survey per year Total catch ≤ 5,500 spiny lobsters and ≤ 6,500 slipper lobsters per year
Mariana Resource Survey	Sampling activity to quantify baseline bottomfish and reef fish resources in the MARA. Various artificial habitat designs will be developed, enclosed in mesh to retain captures, and evaluated. Cobb trawl and Isaacs-Kidd trawls will collect pelagic-stage specimens of reef fish and bottomfish species. Large fish traps (1m x 1m x 2m) will be deployed overnight to assess bottomfish composition relative to hook-and-line	MARA 0-25 nm from shore	May–August Up to 102 DAS (once every 3 years) Midwater trawls are conducted at night, surface trawls are conducted day and night In-water activities are conducted during the day	*Oscar Elton Sette*	Large-mesh midwater Cobb trawl	Tow speed: 3 kts Duration: 60-240 min trawls; 2 tows per night Depth(s): Deployed at various depths during same tow to target fish at different water depths, usually between 100 m and 200 m	15-20 tows per survey per year
					Small-mesh surface and midwater trawl nets (Isaacs-Kidd, neuston, ring, bongo nets)	Tow speed: 3 kts Duration: up to 60 min Depth: 0-200 m	15-20 tows (any combination of the nets described) per survey per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
	fishing and the quality of each habitat for recent recruits. Traps will be set along or perpendicular to the bottom contour primarily in mesophotic habitats (50-200 m depths) and in deep-slope bottomfish habitats (200-500 m depths).		All other activities are day or night		Bottom Traps (Kona crab, enclosure)	Kona crab nets are nylon, with meshing spaced 2 1/2 inches apart attached to a wire ring with squid or fish bait set in the middle. Up to ten nets can be tied together with a buoy on the end net for retrieval. They are left for approximately 20 min. Enclosure traps are Fathoms Plus shellfish "lobster" traps or similar. These traps are dome-shaped, single-chambered, two entrance cones (with dimensions of 980 millimeter (mm) x 770mm x 295mm, with inside mesh dimensions of 45mm x 45mm). The traps are weighted and baited with the remains of life history samples from trolling and bottomfishing operations and are attached to two surface floats. Two strings of six traps each would be deployed at night on sand, rubble, and pavement (i.e., not coral) substrate, and retrieved the next morning. Up to 20 traps per string, separated by 20 fathoms of ground line; two depths 10-35 fathoms. Up to 2 strings per DAS. Bottom trap dimensions up to 1m high, 1 m wide, and 2 m long. Traps have outer mesh covering from 0.5-3.0 inch mesh and 1-2 funnel entrances. Bottom trap is baited with fish using an inside baiter. Bottom trap door swings open to retrieve catch and baiter.	25 gear sets per cruise Up to 400 strings set per survey per year
					Simrad split-beam EK60, OES Netmind	38-200 kHz	Intermittent continuous during surveys
				Small boats	Hook-and-line	Electric or hydraulic reel: Each operation involves 1-3 lines, with squid lures, soaked 10-60 min at depths between 200 m to 600 m.	1000 sets per survey per year
					Divers (spear)	Speargun	1000 reef fish
Pelagic Longline Hook Trials *(Survey not continued in the Preferred Alternative)*	Investigate effectiveness of various types of circle and tuna hooks at reducing the bycatch of non-target species in longline fisheries. Fishery observers or NOAA scientists conduct on-board documentation of catch and survival. Data collected on catch efficacy, fish size, species selectivity, and survival upon haul-back as based on hook type (e.g., J, tuna, circle hooks). Opportunistic trolling may also be conducted to collect pelagic fish specimens for genetic, physiological, and ecological studies.	HARA, WCPRA outside prohibited longline fishing areas and up to 500 nm from shore	Variable 0-130 DAS	Contracted longline fishing vessels or fishery research vessels.	Pelagic longline and trolling	Mainline length: up to 60 miles Number of hooks: 600-3500 Gangion length (up to 30+ m, and spacing (up to 70+ m) are as required by regulations in each area: Hook size and type: size 6/0 to 9/0 J hooks, size 3.2 to 3.8 Tuna hooks, size 12/0 to 18/0 Circle hooks as restricted by changing bycatch mitigation regulations. All hooks used are allowed by regulations at the time and place used. Soak time: 600-1800 min. Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook troll lures at 4-6 kts	Sum of all three surveys using longline gear (this and 2 below) total up to 130 longline operations per year with up to 130 trolling operations between longline operations.
Longline Gear Research *(Survey not continued in the Preferred Alternative)*	Research analyzes the vertical distribution of pelagic species catch rates and time of capture. Time-depth recorders (TDRs) and hook-timers on longlines deployed to document capture depth and habitat of pelagic species and time of capture. Opportunistic trolling may also be conducted to collect pelagic fish specimens for genetic, physiological, and ecological studies.	HARA, ASARA, WCPRA outside prohibited longline fishing areas and up to 500 nm from shore	Variable Opportunistic, subset of 0-130 DAS listed above under Pelagic Longline Hook Trials	NOAA Ships such as *Oscar Elton Sette* or equivalent fishery research vessel, contracted longline fishing vessels.	Pelagic longline with TDRs	Same as above	Operations are a subset of operations per yr listed above under Pelagic Longline Hook Trials

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
Marlin Longline *(Survey not continued in the Preferred Alternative)*	Uses different setting techniques in order to eliminate shallow hooks and maximize target catch of deep dwelling species such as bigeye tuna while reducing catch of marlins, sharks, and turtles. Goal: ensure shallowest hooks fish at depths of at least 100 m. Opportunistic trolling may also be conducted to collect pelagic fish specimens for genetic, physiological, and ecological studies.	HARA, ASARA, WCPRA outside prohibited longline fishing areas and up to 500 nm from shore	Variable Opportunistic, subset of 0-130 DAS listed above under Pelagic Longline Hook Trials	Contracted longline fishing vessels	Pelagic longline and trolling	Same as above	Operations are a subset operations per yr listed above under Pelagic Longline Hook Trials
Pelagic Oceanographic Cruise	Investigate physical (e.g., fronts) and biological features that define the habitats for important commercial and protected species of the North Pacific Ocean, especially tuna and billfishes, which are targeted by longline fishers. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; surface and water column oceanographic measurements and water sample collection.	Pacific Ocean; western and central tropical and subtropical Pacific 25-1000 nm from shore in any direction	Annual (season variable) Up to 30 DAS Midwater trawls are conducted at night, surface trawls are conducted day and night All other activities are conducted day and night	NOAA Ships such as *Oscar Elton Sette*, or equivalent vessel	Large-mesh midwater Cobb trawl Plankton drop net (stationary surface sampling)	Tow speed: 3 kts Duration: 60-240 min 1-meter diameter plankton drop net would be deployed down to 100 m	20 tows per year, alternating with West Hawaiʻi IEA cruise 4 liters of micronekton per tow 20 drops per year (collections would be less than one liter of plankton)
					Small-mesh surface and midwater trawl nets (Isaacs-Kidd, neuston, ring, bongo nets)	Duration: up to 60 min Depth: 0-200 m	15-20 tows (any combination of the nets described) <1 liter of organisms per tow
					Active acoustics (split multi-beam: Reson8101 ER; deep water: Simrad EK60, OES Netmind)	38-200 kHz	Intermittent continuous during surveys
					ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
					CTD profiler	45-90 min cast duration	60 casts per year, alternating with West Hawaiʻi IEA cruise 60 tows/year
Lagoon Ecosystem Characterization *(Geographic scope is expanded to include areas throughout WCPRA in the Preferred Alternative)*	Measures abundance of juvenile bumphead parrotfish in the interior lagoon at Wake Atoll over a two-week-long period by employing standardized transect and photo-quadrant techniques using SCUBA and snorkeling gear. A collection net may also be used to non-lethally sample fish species inhabiting the lagoon to determine genetic identity.	Wake Atoll lagoon	Variable in season, Up to 14 DAS Conducted during the day	Small boats	Divers with hand net	SCUBA, snorkel, 12-inch diameter small mesh hand net	10 dives per survey 10 fin clips collected for genetic analyses
		Palmyra Atoll	Variable in season, Up to 14 DAS Conducted during the day	Small boats	Hook-and-line	Standard rod and reel using lures or fish bait from shoreline or small boat	1-30 min casts 60 casts per survey

As shown in Table 2.2-1, PIFSC fisheries research surveys are conducted annually and within four primary geographic areas: the HARA, the MARA, the ASARA, and WCPRA (see Figure 1.1-2). The gear types fall into several categories: pelagic surface and midwater trawl gear used at various levels in the water column, pelagic longlines with multiple hooks, and other gear (e.g., various fine-meshed plankton nets, active and passive acoustic instruments, video recording equipment, AUV, CTD profiler).

The Status Quo Alternative consists of the research activities described in Table 2.2-1 (see also Appendices A and B), including a suite of mitigation measures that were developed by PIFSC in consultation with marine mammal scientists and other protected species experts. These mitigation measures have been phased into PIFSC surveys starting in the 2009 field seasons and refined through 2013. These mitigation measures are anticipated to be required under the LOA that would be issued under the Preferred Alternative for the specified research activities conducted by PIFSC. However, these mitigation measures may not be sufficient to reduce the effects of PIFSC activities on marine mammals and other protected species to the level of least practicable adverse impact (see the Preferred Alternative), so additional mitigation may be required under the proposed action by the LOA.

The procedures described here are based on protocols used during previous PIFSC research surveys. These procedures are the same whether the survey is conducted on board a NOAA vessel or charter vessel. PIFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluations of new mitigation measures include assessments of their effectiveness in reducing risk to protected species. Implementation of any such measures must also be subject to safety and practicability considerations, allow survey results to meet research objectives, and maintain consistency with previous data sets.

2.2.1 Mitigation Measures for Protected Species and Habitats

2.2.1.1 Midwater Trawl Surveys

Visual Monitoring Measures

- The officer on watch, Chief Scientist (or other designated member of the Scientific Party), and crew standing watch visually scan, usually with binoculars, for marine mammals, sea turtles, and other ESA-listed species (protected species) during trawl operations. Because trawling is typically conducted at night, sight distance is generally limited to no more than 20 m from the ship. If trawling is conducted during the day, the member of the crew designated to stand watch for marine mammals and sea turtles visually scans the waters surrounding the vessel with an approximately 1-km radius.

Operational Procedures

- "Move-on" Rule: If any marine mammals are sighted anywhere around the vessel in the 30 minutes before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear at the discretion of the officer on watch in consultation with the Chief Scientist. Small moves within the sampling area can be accomplished without leaving the sample station. After moving on, if marine mammals are still visible from the vessel and appear to be at risk, the officer on watch may decide, in consultation with the Chief Scientist, to move again or to skip the station. The officer on watch will first consult with the Chief Scientist or other designated scientist and other experienced crew as necessary to determine the best strategy to avoid potential takes of these species based on those encountered, their numbers and behavior, position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel might not require any move or only require a short move from the initial sampling site while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if they follow the vessel. In most cases, trawl gear is not deployed if marine mammals have been sighted from the ship in the previous 30 minutes unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the Chief Scientist and officer on watch. The efficacy of the "move-on" rule is limited during nighttime or other periods of limited visibility; although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval.

- Trawl operations are usually the first activity undertaken upon arrival at a new station in order to reduce the opportunity to attract marine mammals and other protected species to the vessel. However, in some cases, CTD casts may immediately precede trawl deployment. The order of gear deployment is determined on a case-by-case basis by the Chief Scientist based on environmental conditions and other available information at the sampling site. Other activities, such as water sampling or plankton tows, are conducted in conjunction with, or upon completion of, trawl activities.
- Once the trawl net is in the water, the officer on watch, the Chief Scientist or other designated scientist, or crew standing watch continue to monitor the waters around the vessel and maintain a lookout for marine mammal presence as far away as environmental conditions allow (as noted previously, visibility is very limited during night trawls). If these species are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. Generally, if a marine mammal is incidentally caught, it would happen during haul-back operations, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. The risk of catching an animal may be reduced if the trawling continues and the haul-back is delayed until after the marine mammal has lost interest in gear or left the area. In other situations, swift retrieval of the net or cutting the cables may be the best course of action. The appropriate course of action to minimize the risk of incidental take of protected species is determined by the professional judgment of the officer on watch and appropriate crew based on all situation variables, even if the choices compromise the value of the data collected at the station.
- If trawling operations have been delayed because of the presence of marine mammals, the vessel resumes trawl operations (when practicable) only when these species have not

been sighted within 30 minutes or else otherwise determined to no longer be at risk. This decision is at the discretion of the officer on watch and will depend upon the circumstances of the situation.

- Care is taken when emptying the trawl, including opening the cod end, as close to the deck as possible in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not protected species are present. It may be necessary to cut the net to remove the protected species.

Tow Duration

- Standard tow durations for midwater Cobb trawls are between two and four hours as target species (e.g., pelagic stage eteline snappers) are relatively rare, and longer haul times are necessary to acquire the appropriate scientific samples. However, trawl hauls will be terminated and the trawl retrieved upon the determination and professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary, that this action is warranted in order to avoid an incidental take.

Marine mammal excluder devices

- PIFSC currently uses two types of midwater trawl nets; the Cobb trawl and the Isaacs-Kidd trawl. The Cobb trawl and the Isaacs-Kidd trawl have been used throughout the Pacific Islands Region with no interactions with protected species. There are no plans to develop or install marine mammal excluder devices for these types of trawls in this region.

Speed limits and course alterations

- Vessel speeds are restricted on research cruises in part to reduce the risk of ship strikes with marine mammals. Transit speeds vary from 6 to ten kts but average 9 kts. The vessel's speed during active Cobb trawl operations and active acoustic surveys is typically 2 to 4 kts due to trawl net and sea-state constraints. Thus, these much slower speeds greatly reduce the risk of ship strikes. In addition, PIFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them.
- At any time during a survey or while in transit, any crew member that sights marine mammals that may intersect with the vessel course immediately communicates their presence to the bridge for appropriate course alteration or speed reduction as possible to avoid incidental collisions, particularly with large whales (e.g., humpback whales).

2.2.1.2 Longline Gear

Operational Procedures

Because longline research is currently conducted in conjunction with commercial fisheries, operational characteristics (e.g., branchline and floatline length; branchline diameter; hook type, size, and wire diameter; bait type; number of hooks between floats) of the longline gear in Hawai‘i, American Samoa, Guam, the CNMI, or EEZs of the Pacific Insular Areas shall adhere to the requirements on commercial longline gear based on NMFS regulations specified in 50 CFR 229, 300, 404, 600, and 665. PIFSC will adhere to the above regulations and generally follow the below procedures when setting and retrieving longline gear:

- When shallow-setting anywhere and setting longline gear from the stern:
  - Completely thawed and blue-dyed bait will be used (two 1-lb. containers of blue-dye will be kept on the boat for backup). Fish parts and spent bait with all hooks removed will be kept for strategic offal discard. Retained swordfish will be cut in half at the head; used heads and livers will also be used for strategic offal discard. Setting will only occur at night and begin 1 hour after local sunset and finish 1 hour before next sunrise, with lighting kept to a minimum.
- When deep-setting north of 23°N and setting longline gear from the stern:
  - 45 g or heavier weights will be attached within 1 m of each hook. A line shooter will be used to set the mainline. Completely thawed and blue-dyed bait will be used (two 1-lb. containers of blue-dye will be kept on the boat for backup). Fish parts and spent bait with all hooks removed will be kept for strategic offal discard. Retained swordfish will be cut in half at the head; used heads and livers will also be used for strategic offal discard.
- When shallow-setting anywhere and setting longline gear from the side:
  - Mainline will be deployed from the port or starboard side at least 1 m forward of the stern corner. If a line shooter is used, it will be mounted at least 1 m forward from the stern corner. A specified bird curtain will be used aft of the setting station during the set. Gear will be deployed so that hooks do not resurface. 45 g or heavier weights will be attached within 1 m of each hook.
- When deep-setting north of 23°N and setting longline gear from the side:
  - Mainline will be deployed from the port or starboard side at least 1 m forward of the stern corner. If a line shooter is used, it will be mounted at least 1 m forward from the stern corner. A specified bird curtain will be used aft of the setting station during the set. Gear will be deployed so that hooks do not resurface. 45 g or heavier weights will be attached within 1 m of each hook.

Operational characteristics of longline research in non-WPRFMC areas of jurisdiction adhere to the regulations of the applicable management agencies, including WCPFC and IATTC. These operational characteristics include WCPFC 2007, WCPFC 2008, ICCAT 2010, ICCAT 2011, IATTC 2007, and IATTC 2011.

The "move-on" rule may be implemented if any protected species are present near the vessel and appear to be at risk of interactions with the longline gear; longline sets are not made if marine mammals or sea turtles have been seen from the vessel within the past 30 minutes and represent a potential for interaction with the longline gear, as determined by the professional judgment of the Chief Scientist or officer on watch. Longline gear is always the first equipment or fishing gear to be deployed when the vessel arrives on station. Longline gear is set immediately upon arrival at each station provided the conditions requiring the move-on rule have not been met.

If marine mammals are detected while longline gear is in the water, the officer on watch will exercise similar judgments and discretion to avoid incidental take of these species with longline gear as described for trawl gear. The species, number, and behavior of the protected species are considered along with the status of the ship and gear, weather and sea conditions, and crew safety factors. The officer on watch uses professional judgment and discretion to minimize risk of potentially adverse interactions with protected species during all aspects of longline survey activities.

If marine mammals are detected during setting operations and are considered to be at risk, immediate retrieval or halting the setting operations may be warranted. If setting operations have been halted due to the presence of these species, setting will not resume until no marine mammals have been observed for at least 30 minutes.

If marine mammals are detected while longline gear is in the water and are considered to be at risk, haul-back will be postponed until the officer on watch determines that it is safe to proceed. Marine mammals caught during longline fishing are typically only caught during retrieval, so extra caution must be taken during this phase of sampling.

2.2.1.3 Plankton Nets, Small-mesh Towed Nets, Oceanographic Sampling Devices, Active Acoustics, Video Cameras, AUV, and ROV Deployments

PIFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises, such as plankton nets, oceanographic sampling devices, video cameras, low-power high-frequency active acoustics directed underneath the ship as a beam, AUVs and ROVs. It is not anticipated that these types of gear or equipment would interact with protected species and are therefore not subject to specific mitigation measures. However, the officer on watch and crew visually monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to protected species during deployment of all research equipment (e.g., reduced boat speed). Often these types of gear are deployed from small boats, not ships, and therefore visual monitoring is the best measure to avoid interactions with protected species.

2.2.1.4 Handling Procedures for Incidentally Captured Animals

For the Pacific Islands Region, PIFSC follows the guidance on the identification, handling, and release of protected species that has been provided by the NOAA Pacific Islands Regional Office (NOAA 2020).

<u>Marine Mammals</u>

- Based on previous PIFSC research activities, it is not anticipated that any marine mammals would be captured during the proposed research. However, if a marine mammal is captured live or injured, then it would be extracted from the research gear and returned to the water as soon as possible. Animals would be released without removing them from the water if possible. Data collection would be conducted in such a manner as not to delay release of the animal and should include species identification, sex identification if genital region is visible, estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount and description of gear remaining on the animal), and photographs. The Chief Scientist or crew should collect as much data as possible from hooked or entangled animals, considering the disposition of the animal; if it is in imminent danger of drowning, it would be released as quickly as possible. Biological specimens would not be collected from marine mammals because PIFSC currently does not have an IHA. If a large whale is alive and entangled in fishing gear, the vessel should immediately call the USCG at Very High Frequency radio Ch. 16 or the appropriate Marine Mammal Health and Stranding Response Network.

Sea Turtles

- Based on previous PIFSC research activities, it is not anticipated that any sea turtles would be captured during the proposed research. However, if a dead, injured, or stranded sea turtle was encountered, then PIFSC would follow the existing regulations (50 CFR 223.206 and 222.310) and Pacific Islands Regional Office guidance. If possible, data would be collected in such a manner as not to delay release of the animal(s) and should include species identification, sex identification if genital region is visible, estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal) and photographs. If scientific personnel onboard the vessel have the appropriate permits for sea turtle research, then they may elect to install Passive Integrated Transponder (PIT) tags in the flippers of animals that have not already been tagged. Captured turtles are quickly processed and released in accordance with established handling procedures.

Rays (including Mobuildae Rays)

- Based on previous PIFSC research activities, it is not anticipated that any rays would be captured during the proposed research. However, if a ray is incidentally captured, it would be released quickly but with care and kept in the water to the maximum extent possible. These mitigation measures are based on Carlson et al. (2018) and while specifically developed for Mobuildae species, are generally applicable to all rays.
- Mitigation Measures Applicable During Any Survey
  - Make every effort to disentangle the animal from the gear.
  - If possible to do without causing injury, use the gear (i.e., netting, line and leader, etc.) to maneuver the ray alongside the vessel to disentangle while fully submerged to keep the ray in the water.
  - Do not cut off the tail.
  - Do not gaff the animal.
  - Do not lift, drag, or carry the ray by the gill slits or cephalic lobes.
  - Do not punch holes through the body to pass hoisting cables through it or bind wire around the animal to move it.
  - Bringing a ray onboard a vessel: If it is not possible to remove the netting while the animal is in the water, carefully bring it on board without causing damage to the body by supporting at least two points of contact or preferably have two to three people carry the ray (specifically for *Mobuildae* species) by the sides of each wing.

  - To release from onboard a vessel: Have 2 or 3 people (especially for *Mobuildae* species) carry each wing and release ray over the side of the vessel.
- Trawl or Gillnet Surveys
  - Follow the steps above. Otherwise, if netting cannot be removed while the animal is in the water, carefully cut netting/mesh off the body and retain netting on board then release following the steps above.
- Purse Seine Surveys
  - Release *Mobuildae* species directly from the brailer (i.e., scoop net) if possible. Otherwise, follow the steps above.
- Longline Surveys
  - Follow the steps above plus the measures listed here. Use the line and leader to maneuver the animal alongside the vessel.
  - Do not attempt to pull hooks out until assessing whether it can be done safely. If the ray is hooked through the mount with a barbed hook, it can be safely dislodged by using a turtle dehooker or cutting the hook below the barb with bolt cutters.
  - If the hook has been swallowed, or "foul hooked" (i.e., any place but the jaw), do not try to retrieve the hook. Cut the leader as close to the hook as possible and release.
  - Animals should be released with no or little trailing line or hook.

2.2.1.5 Reef Assessment and Monitoring Program and Marine Debris Research and Removal Activities

The following measures are carried out when working in and around shallow water coral reef habitats. These measures are intended to avoid and minimize impacts to protected species and benthic habitats, as well as avoid introducing non-native invasive species. These activities generally include small boat operations and divers in the water.

<u>Small Boat and Diver Operations</u>

- Transit from the open ocean to shallow-reef survey regions (depths of < 35 m) of atolls and islands should be no more than 3 nm, dependent upon prevailing weather conditions and regulations. Each team conducts surveys and in-water operations with at least 2 divers observing for the proximity of protected species sightings, a coxswain driving the small boat, and a topside spotter working in tandem. Topside spotters may also work as coxswains, depending on team assignment and boat layout. Spotters and coxswains will be tasked with specifically looking out for divers, protected species, and environmental hazards.

  Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species. Scientists, divers, and coxswains follow the Best Management Practices (BMPs) for boat operations and diving activities. These practices include but are not limited to the following precepts:

  1. Constant vigilance shall be kept for the presence of protected species

2. When piloting vessels, vessel operators shall alter course to remain at least 100 m from marine mammals and at least 50 m from sea turtles
3. Reduce vessel speed to 10 km or less when piloting vessels in the proximity of marine mammals
4. Reduce vessel speed to 5 km or less when piloting vessels in areas of known or suspected turtle activity
5. Marine mammals and sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore
6. If approached by a marine mammal or turtle, put the engine in neutral and allow the animal to pass
7. Unless specifically covered under a separate permit that allows activity in proximity to protected species, all in-water work will be postponed until whales are within 100 yards or other protected species are within 50 yards. Activity will commence only after the animal(s) depart the area
8. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s)
9. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any protected species

<u>Protocol for Minimizing Benthic Disturbance (including coral reefs)</u>

- Research dives, using SCUBA, will focus on the goal of data collection for research and monitoring purposes. All care will be taken during anchoring small boats, with sand or rubble substrate targeted for anchorage to minimize benthic disturbance or coral damage. The operational area will be continuously monitored for protected species, with dive surveys being altered, postponed, or canceled and small boats on standby, neutral, or relocating to minimize disturbances or interactions. The anchor will be lowered rather than thrown, and a diver will check the anchor to make sure it does not drag or entangle any benthos or listed species.

<u>Protocol for Minimizing the Spread of Disease and Invasive Species</u>

The following actions are routinely required to minimize the spread of diseases to coral reef organisms and spreading invasive species on equipment and vessels.

Equipment and Gear

- Equipment (e.g., gloves, forceps, shears, transect lines, photographic spacer poles, surface marker buoys) in direct contact with potential invasive species, diseased coral tissues, or diseased organisms are soaked in a freshwater 1:32 dilution with commercial bleach for at least 10 min and only a disinfected set of equipment is used at each dive site.

- All samples of potentially invasive species, diseased coral tissues, or diseased organisms are collected and sealed in at least 2 of a combination of bags or jars underwater on-site and secured into a holding container until processing.
- Dive gear (e.g., wetsuit, mask, fins, snorkel, buoyancy compensator, regulator, weight belt, booties) is disinfected by one of the following ways: a 1:52 dilution of commercial bleach in freshwater, a 3 percent free chlorine solution, or a manufacturer's recommended disinfectant-strength dilution of a quaternary ammonium compound in "soft" (low concentration of calcium or magnesium ions) freshwater. Used dive gear is disinfected daily by performing the following steps: (1) physical removal of any organic matter and (2) submersion for a minimum of 10 min in an acceptable disinfection solution, followed by a thorough freshwater rinse and hanging to air dry. All gear in close proximity to the face or skin, such as masks, regulators, and gloves, are additionally rinsed thoroughly with potable water following disinfection.

Small Boats

- Small boats that have been deployed in the field are cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, is physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external surfaces of vessels are rinsed daily with freshwater and always rinsed between islands before transits. Vessels are allowed to dry before redeployment the following day.

<u>Sea Turtles and Hawaiian Monk Seals</u>

- To avoid interactions with listed species during surveys and operations, team members and small boat coxswains will monitor areas while in transit to and from work sites. If a listed species is sited, the vessel will alter course in the opposite direction. If unable to change course, the vessel will slow or come to a stop awaiting the animal to be clear of the boat as long as passenger safety is not compromised. Currently, there are no known strikes or incidental takes of a listed protected species from a vessel or propeller of a Pacific RAMP vessel in the NWHI, or other surveyed areas around the Pacific.
- As part of due diligence, protected species monitoring will continue throughout all dive operations by at least one team member aboard each boat and two divers working underwater. Operations will be altered and modified as previously listed.
- Mechanical equipment will also be monitored to ensure no accidental entanglements occur with protected species (e.g., with PAM, float lines, transect lines, and oceanographic equipment stabilization lines). Team members will immediately respond to an entangled animal, halting operations and providing an onsite response assessment (allowing the animal to disentangle itself, assisting with disentanglement, etc.), unless doing so would put divers, coxswains, or other staff at risk of injury or death.
- Before approaching any shoreline or exposed reef, all observers will examine the beach, shoreline, reef areas, and any other visible land areas within the line of sight for marine mammals and sea turtles. The Pacific RAMP teams typically do not participate during terrestrial surveys and operations as part of their mandate, and, therefore, minimize the potential for disturbances of resting animals along shorelines.

- Land vehicle (trucks) operations will occur in areas of marine debris where vehicle access is possible from highways or rural/dirt roads adjacent to coastal resources. Prior to initiating any marine debris removal operations, marine debris personnel (marine ecosystem specialists) will thoroughly examine the beaches and nearshore environments/waters for Hawaiian monk seals, humpback whales, green sea turtles, and hawksbill sea turtles before approaching marine debris sites and initiating removal activities. Debris will be retrieved by personnel who are knowledgeable of and act in compliance with all federal laws, rules and regulations governing wildlife in the Papahānaumokuākea MNM and Main Hawaiian Islands (MHI). This includes but is not limited to:
  - Decontamination of clothing/soft gear taken ashore by prior freezing for 48 hours, or use of new clothing/soft gear as indicated by USFWS regulations;
  - Avoidance of seabird colonies; and
  - Avoidance of marine turtles and Hawaiian monk seals, maintaining a minimum distance of 50 yards from all monk seals and turtles, and a minimum of 100 yards from female seals with pups.

<u>Shoreline Marine Debris Research and Removal Mitigation Measures to Avoid Historic Properties</u>

The following measures are carried out during marine debris removal activities to avoid impacts to historic properties. The focus of removal efforts is on derelict fishing gear (DFG), which pose a potential entanglement risk to wildlife (e.g., Hawaiian monk seals, sea turtles), and plastics.

- While in-water:
  - All DFG is evaluated by divers before any removal activities take place.
  - During this evaluation, the divers look for historic properties that may be in the immediate vicinity (e.g., shipwrecks, fishponds). If a potential historic property is located but is not attached to any DFG, the site is avoided. If a potential historic property is located and it is attached to DFG, then the DFG is treated as stable and only entanglement risks are addressed without disturbing the site. The geographic positioning system (GPS) location of any potential historic property is recorded.
- Along the shoreline:
  - Shoreline survey and removal efforts are conducted within the dynamic zone from approximately the low tide line up to the high tide line on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because the survey and removal efforts do not take place in uplands or other vegetated areas, they would avoid impacts to upland historic properties (e.g., burial mounds).
  - Most DFG (primarily fishing nets) and plastics are found at rest on the surface of the shoreline and require no excavation of the subsurface thereby avoiding impacts to buried historic properties.
  - DFG that does require excavation is usually found in the dynamic zone between the low and high tide lines where wave and tidal action deposits debris and sand. Historic

properties, or sites eligible for listing, are highly unlikely to be found in between the low and high tide lines.

If an unidentified object (e.g., hazardous materials [HAZMAT])is found during excavation, then the DFG will be left in place and only potential entanglement hazards (e.g., loops in lines) will be cut free and removed (similar operating protocols for in-water removal).

2.2.2 Mitigation Measures for Essential Fish Habitat

Some of the mitigation measures described for marine mammals and protected species under the Status Quo Alternative are also designed to protect EFH, including the following:

- Speed limits and course alterations—slower vessel speeds reduce the risk of vessel groundings and damage to EFH habitat such as coral reefs. Transit from the open ocean to shallow-reef survey regions (depths of < 35 m) of atolls and islands should be no more than 3 nm, dependent upon prevailing weather conditions and regulations.
- Small boat and diver operations – Care is taken during anchoring small boats, with sand or rubble substrate targeted for anchorage, to minimize benthic disturbance or coral damage. The anchor is lowered rather than thrown, and a diver checks the anchor to ensure it does not drag or entangle any benthos.
- Minimizing the spread of disease and invasive species – Equipment in direct contact with potential invasive species, diseased coral tissues, or diseased organisms are soaked in freshwater 1:32 dilution with commercial bleach for at least 10 minutes and only a disinfected set of equipment is used at each dive site. Small boats that have been deployed in the field are cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, is physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external surfaces of vessels are rinsed daily with freshwater and always rinsed between islands before transits. Vessels are allowed to dry before redeployment the following day.
- All oceanographic monitoring instruments would be secured to non-coral areas near reefs with stainless steel stakes, zip ties, or sand screws to ensure instruments do not break loose and damage corals.

2.2.3 Mitigation Measures for AUVs and UAS

- In order to minimize malfunction of the AUV's during operations, a pre-deployment test of all operating systems will be run to ensure that the AUV is operating correctly and there are no visually apparent physical defects in the AUV.
- All AUV deployment missions will have a deployment and retrieval plan to minimize lag time in water and ensure that the AUV is properly retrieved.
- In order to minimize the spread of invasive species, all AUVs will be inspected and cleaned of any organic material including algae and other organisms prior to deployment.
- All UAS will undergo a pre-flight test prior to deployment to ensure that the equipment is working properly and weather conditions are conducive to flying a mission.
- All UAS operations will be conducted with a pilot and a spotter to ensure that the UAS is monitored at all times.
- Should any UAS make an emergency landing in the water, small boats will be deployed immediately to retrieve the equipment to minimize potential for pollution (e.g., loss of gas or batteries into the marine environment).

- A submersible dive plan will be in place for each dive that details each mission, locations, and deployment/recovery times to minimize the potential for collision with the substrate or groundings.
- Each submersible will be inspected and cleaned of any organic material including algae and other organisms, and chemicals, oils, or other pollutants prior to deployment, in order to minimize the spread of invasive species and ensure no pollutants are released into the ocean.
- Researchers and contracted fishers will use pre-existing mapping data to avoid sensitive areas (areas of high coral cover) when conducting bottomfishing operations.

2.3 ALTERNATIVE 2—PREFERRED ALTERNATIVE—CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH MITIGATION FOR MMPA AND ESA COMPLIANCE

The Preferred Alternative is comprised of a combination of research activities continued from the past and additional, new research surveys and projects. The Preferred Alternative would not include several of the projects described in Table 2.2-1 under the Status Quo. Those surveys have been noted in Table 2.2-1 and include the following:

- Northwestern Hawaiian Islands Lobster Survey
- Northwestern Hawaiian Islands Bottomfish Survey
- Pelagic Longline Hook Trials
- Longline Gear Research Surveys
- Marlin Longline Surveys

Although these research projects would not continue under the Preferred Alternative under the auspices of PIFSC, similar research may continue to be conducted and funded by PIRO through contracts with commercial fisheries. Any incidental takes resulting from such research would be authorized under the MSA and incidental takes of protected species resulting from such research would be the result of the commercial fishery. The impacts of such surveys are included in the analysis of cumulative impacts (Chapter 5) but are not considered further in this analysis of the Preferred Alternative.

Under the Preferred Alternative, the Cetacean Ecological Assessment surveys described under the Status Quo would include increased levels of effort and would include midwater trawling with a Cobb net. Several new research surveys and projects have been added to the Preferred Alternative that were not included in the Status Quo Alternative and other existing research projects have been modified (e.g., new or updated instruments); these new projects and changes in existing projects are summarized in Table 2.3-1.

Tagging of ESA-listed oceanic whitetip sharks would occur incidental to the small boat tuna fishery in the MHI (see Table 2.3-1). It is anticipated that about 27 of these sharks would be caught as bycatch in the fishery. Fishing techniques that might interact with these sharks include: nighttime handline fishing, trolling, jigging, bottomfishing, and spearfishing. Caught oceanic whitetip sharks would either be tagged or undergo tissue sampling and returned unharmed to the water. Oceanic white-tip sharks would also be caught and tagged in the Fishing Impacts of Non-Target Species study.

The conduct of fisheries and ecosystem research by PIFSC under the Preferred Alternative would require regulations and authorizations for incidental take of marine mammals under the MMPA and incidental take of protected species under the ESA. Under this alternative, PIFSC would apply to the NMFS OPR requesting regulations governing the issuance of an LOA for incidental take of marine mammals under the MMPA. OPR would make the necessary findings, and, if appropriate, promulgate regulations and issue an LOA to PIFSC. If regulations are promulgated and an LOA is issued, they would prescribe the permissible methods of taking; a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities; and require reporting that will result in increased knowledge of the species and the level of taking.

In addition, both OPR and PIFSC engaged in ESA section 7 consultations with PIRO PRD (and USFWS as necessary) for species that are listed as threatened or endangered. On December 14, 2016, PIFSC requested concurrence and informal consultation with USFWS Pacific Islands Fish and Wildlife office based on determinations that proposed research *may affect but is not likely to adversely affect* the ESA-listed marine and terrestrial species in the action area including: Central North, Central West and Central South Pacific Distinct Population Segments (DPS) of green sea turtles; hawksbill sea turtles; leatherback sea turtles; North and South Pacific Ocean DPSs of loggerhead sea turtles; olive ridley sea turtles; Short-tailed albatross; Hawaiian petrels; Newell's shearwaters; band-rumped storm petrels; Nihoa millerbirds; Nihoa finches; Laysan finches; and Laysan ducks. On February 21, 2017, USFWS responded with a Letter of Concurrence (LOC) for these species.

On September 11, 2018, PIFSC requested informal concurrence under section 7 of the ESA for fisheries and ecosystem research stating that proposed activities *may affect but are not likely to adversely affect* ESA-listed sea turtles (Central North Pacific, Central West Pacific, and Central South Pacific DPSs of green sea turtle; hawksbill sea turtle, leatherback sea turtle, North Pacific Ocean and South Pacific Ocean DPS of loggerhead sea turtle; and olive ridley sea turtle), the Indo-West pacific DPS of scalloped hammerhead shark; the oceanic white tip shark; the giant manta ray the chambered nautilus (proposed for listing) and seven species of giant clam (also proposed for listing at the time). PIFSC also requested concurrence on findings that proposed research is *not likely to adversely affect* false killer whale or Hawaiian monk seal critical habitat. On September 13, 2018, PIRO responded with a Letter of Concurrence (LOC) for the species requested plus seven threatened Pacific coral species. In the LOC PIRO concurred with the informal determinations and provided three conservation recommendations.

Subsequently, on September 8, 2021, PIFSC re-initiated ESA section 7 consultation with PIRO based on updates to proposed research presented in the PEA and other relevant updates to ESA-listed species in the action area. A Biological Assessment (BA) dated August 31, 202,1 was prepared and provided to PIRO. The BA describes all listed species and critical habitat in the Pacific Islands Region that may be affected by fishery and ecosystem surveys over the 5-year period from 2021-2026. The formal ESA consultation process was initiated on November 22, 2021, and the Biological Opinion (BiOp) was completed on November 21, 2022. The BiOp concluded that the proposed action is not likely to adversely affect Central North Pacific, Central South Pacific, and Central West Pacific green sea turtle, hawksbill sea turtle, Leatherback sea turtle, North Pacific loggerhead sea turtle, olive ridley sea turtle, blue whale, fin whale, sei whale, sperm whale, Hawaiian monk seal, MHI insular false killer whale, North Pacific right whale, and chambered nautilus; and that the action is not likely to adversely affect critical habitats of the Hawaiian monk seal and MHI insular false killer whale, and is not likely to adversely modify or destroy proposed critical habitat of Pacific Ocean corals. Additionally, the BiOp concluded that PIFSC's fshery and ecosystem research activities is not likely to jeopardize the continued existence of the threatened giant manta ray, threatened Indo-West Pacific scalloped hammerhead shark, threatened oceanic whitetip shark, threatened *Acropora globiceps*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, and *Isopora crateriformis*.

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Table 2.3-1 Summary Description of Surveys in the Pacific Islands Region Proposed under the Preferred Alternative

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
Cetacean Ecology Assessment *(Addition of Cobb midwater trawls, addition of eDNA water sampling, and increase from 90 to 180 DAS compared to Status Quo protocols)*	Survey transects conducted in conjunction with cetacean visual and acoustic surveys within the Hawai'i EEZ to develop ecosystem models for cetaceans. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.	HARA MARA ASARA WCPRA	Variable, up to 180 DAS depending on area surveyed Midwater trawls are conducted at night, surface trawls are conducted day and night All other gear and instruments are conducted day and night	*Oscar Elton Sette,* small boats	Cobb midwater trawl	Tow speed: 3 kts Duration: 60-240 min	180 trawls per research area
					Small-mesh towed net (surface trawl)	Tow speed: 2.5-3.5 kts Duration: 30-60 min	180 tows per research area
					Active Acoustics (splitbeam Simrad EK60, OES Netmind	38-240 kHz	Intermittent continuous during surveys
					ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
					CTD profiler	90 min	2 per day
					XBT	10 min duration. Profiles from surface to up to 1000n m depth	Maximum 5 per day
	<u>*Passive Acoustics Calibration*</u> – Transmit sound (synthetic pings, dolphin whistles or echolocation clicks, etc.) to passive acoustic recording devices for purposes of in-situ calibration, needed to understand detection distances and received level or frequency-dependent variation in the device performance.	HARA MARA ASARA WCPRA	Same as above	Oscar Elton Sette, small boats	Underwater sound playback system	Includes underwater projector and amplifier suspended from small boat or ship. Projection depth may vary from near surface to 100 m.	Intermittent
	<u>*Stationary Passive Acoustic Recording*</u> – Placement of long-term acoustic listening devices for the purposes of recording cetacean occurrence and distribution, ambient and anthropogenic noise levels, and presence of other natural sounds. Recorders are typically deployed and retrieved once or twice per year at each monitoring location.	HARA MARA ASARA WCPRA	Same as above	Oscar Elton Sette, small boats	HARP, EAR, or similar device	Deployed in seafloor package or mooring configuration consisting of recorder, acoustic releases, anchor, and flotation	Up to ten long-term monitoring sites
	<u>*Passive Acoustic Monitoring*</u> – Deployment of passive acoustic monitoring devices in conjunction with other sampling measures, such as on fishing gear or free-floating.	HARA MARA ASARA WCPRA	Same as above	Oscar Elton Sette, small boats	Miniature HARPs, Drifting Acoustic Spar Buoy Recorders, Tetrahedral arrays,	Deployed in seafloor package, mooring configuration, or free-floating consisting of recorder, acoustic releases, anchor, and flotation	Continuous

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
					or similar platforms		
	Passive Acoustic or Oceanographic Gliders – Autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle measures cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide oceanographic measures over several months duration.	HARA MARA ASARA WCPRA	Same as above	Oscar Elton Sette, small boats	Seaglider; WaveGlider; or similar platform	AUV	Continuous
	Collection of eDNA samples – Shipboard eDNA samples would be collected via the ship's CTD to identify cryptic cetaceans.	HARA MARA ASARA WCPRA	Casts would generally occur during night	Oscar Elton Sette, small boats	Environmental DNA water samples (eDNA) collected via Niskin bottles on CTD frame	Water samples collected at depths ranging from 10 – 1000 m. Water would be collected in Niskin bottles and decanted into 10 L carboys for processing.	200 casts per research area
Marine Debris Research and Removal *(Expanded from Status Quo protocols to include net tows and UAS gear, Structure-from-Motion surveys, and to include all research areas)*	Surface and midwater plankton tows to quantify floating microplastic in seawater	HARA MARA ASARA WCPRA	Annually, or on an as-needed basis, up to 30 DAS Surface trawls are conducted day and night UAS are conducted during the day or night In-water and beach activities are conducted during the day	*Oscar Elton Sette,* NOAA ships or small boats	Neuston, or similar, plankton nets surface towed alongside ship and/or small boats	Tow Speed: varied Duration: < 1 hour	Up to 250 tows per survey per year
	The use of UAS platforms can aid in CRED's efficiency during survey and removal operations by directing efforts to high density areas	HARA	Same as above	Same as above	UASs (e.g., NOAA PUMA, NASA Ikhana systems, hexacopter)	Deployed from shore, small boat, or ship. Operate along shoreline or over water around atoll.	Less than 20 operations per island or atoll per year
	Adding more frequent marine debris research and removal activities to other research areas.	MARA WCPRA	Additional 30 DAS	Same as above	Same as above	Same as above	Same as above

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
	Collection and sieving of mesoplastics from beach sand located between the low and high tide lines. Plastics are removed for sampling and further study.	HARA		Same as above	Sieves	Sieving of mesoplastics (> 500 microns in size) from sand.	100 samples per atoll
	SfM surveys consist of marking off plots on the seafloor (1-3 m depth) with cable ties and/or stainless steel pins, collecting plot photos and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images.	HARA MARA ASARA WCPRA	Annually, or on an as-needed basis, up to 30 DAS.	Same as above	Cable ties, stainless steel pins, camera	Temporarily deployed on the seafloor to mark off plots, removed once photos are taken.	
Pacific RAMP *(Expanded from Status Quo protocols to include EARs, water sampling devices, carbonate sensing instruments, UAS and USVs, additional BMUs and CAUs deployments, collection of live rock, and additional DAS for reef fish surveys)*	Ecosystem and oceanographic characterization surveys of coral reef ecosystems.	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed In-water activities with divers are conducted during the day, all other activities are conducted day and night	*Oscar Elton Sette*, small boats	EARs, Water samplers (PUCs, RAS, STRs, WTRs, and hand collecting devices) Carbonate sensing instruments [SEAFET (pH), SAMI (pH), SAMI (pCO_2)] CAUs BMUs Hand gear used by SCUBA and free divers. Pneumatic/hydraulic drill for coral coring	Deployed by use of ~ 70 lb anchors guided into place by divers These CTD sized instruments are anchored to a dead portion of the reef with coated weights and cable ties, typically deployed at 5-30 m depth Approx. 4 cm masonry drill bit used to extract a 2.5 x 5-70 centimeter (cm) sample	MARA: Ad hoc fish collections from 2009, less than 20 specimens. Up to 500 samples per year including corals, coral products, algae and algal products, sessile invertebrates, fragments to individuals/colonies. Some of these may be ESA-listed species 25 EARs per year, deployed for 1-3 years 500 water samples per year, deployed 1-7 days 150 deployments per year, deployed for approximately 1-3 years Up to 500 BMUs and CAUs per year Collection of 1900 cm^3 of live rock (e.g., dead Porites sp.) to provide clean coral skeletons to generate new

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
							BMUs for measurement and study. 30 coral cores per survey per year
Pacific RAMP, cont'd.	UAS would be used to collect coral reef ecosystem mapping & monitoring data. Initially testing and field trials would be conducted using multispectral, hyperspectral, or IR sensors. Surveys would be conducted around the MHI.	HARA MARA ASARA WCPRA			UASs (e.g., NOAA PUMA, NASA Ikhana systems, hexacopter)	Deployed from shore, small boat, or ship. Operate along shoreline or over water around atoll.	Less than 20 operations per island or atoll per year
	USV	HARA MARA ASARA WCPRA Nearshore areas			Emily USV will be used to conduct nearshore sampling of surface and bottom variables, as well as ambient atmospheric conditions near the USV.		
	Visual reef fish surveys	HARA MARA ASARA WCPRA	Year-round, additional 21 DAS		SCUBA and free divers	Visual fish identification and abundance surveys, benthic photo-transect	None
	Photomosaics to collect coral community composition data.	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed.		SCUBA, digital cameras and video camera	Camera system consists of two SLR digital cameras and a single video camera mounted to a custom frame.	None

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
	Carbonate budget assessments to assess reef material production rates	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed.		SCUBA divers	Visual benthic, fish, and urchin identification, size, and abundance surveys	None
Insular fish Abundance Estimation Comparison Surveys *(Geographic scope expanded from HARA to include all research areas compared to Status Quo protocols, and addition of eDNA water sampling)*	Comparison of Fishery-Independent Methods to Survey Bottomfish Assemblages in the MHI: Coordinated research between PIFSC FRMD, State of Hawai‘i Department of Land and Natural Resources, University of Hawai‘i at Manoa, University of Miami. Day and night surveys are used to develop fishery-independent methods to assess stocks of economically important insular fish. Methods include: active acoustics, stereo baited underwater video camera systems (BotCam, MOUSS, BRUVS), AUV equipped with stereo video cameras, TOAD, and hook-and-line fishing.	HARA MARA ASARA WCPRA	Variable, up to 30 DAS per research area per year, HARA surveyed annually, ASARA, WCPRA surveyed every 3 years	*Oscar Elton Sette*, or equivalent research vessel, and contracted fishing vessels	Hook-and-line	Hand, Electric, Hydraulic reels. Each vessel fishes 2 lines. Each line is baited with 4-6 hooks. 1-30 minutes per fishing operation.	HARA: 7,680 operations per year MARA: 1.920 every 3rd year (average 640 operations per year) ASARA: 1,920 every 3rd year (average 640 per year) WCPRA: 1,920 every 3rd year (average 640 per year)
					Active acoustics (split-beam): Simrad EK60	Hull mounted: 38-200 kHz	Intermittent continuous during surveys
					Underwater Stereo-Video Camera Systems (e.g., BotCam, BRUVS, MOUSS)	Deployed from ship or small boat on a line Duration of camera drop: ≤30 min	HARA: 7,680 drops per year MARA: 1.920 every 3rd year (average 640 per year) ASARA: 1,920 every 3rd year (average 640 per year) WCPRA: 1,920 every 3rd year (average 640 per year)
					AUV	Speed: 5 kts Duration: 3 hrs	HARA: 480 deployments per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average 27 per year)

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
							WCPRA: 80 every 3rd year (average 27 per year)
					ROV	Duration: 1 hr	HARA: 480 deployments per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average27 per year) WCPRA: 80 every 3rd year (average 27 per year)
					TOAD	Tow speed: 6 kts Duration: 1 hr	HARA: 480 per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average 27 per year) WCPRA: 80 every 3rd year (average 27 per year)
					Niskin bottles attached to ship's CTD, MOUSS frame (aboard small boats), or equivalent	Bottles attached to frame would be triggered at different depths (10 – 1000 m). Water would be stored and processed upon conclusion of the cruise.	250 casts / 250 L of water per research area per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
					Ship-based multibeam echosounders (SeaBeam 3012 multibeam, EK-60 18kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz)	Hull mounted	Intermittent continuous during surveys
Gear and Instrument Development and Field Trials	Field trials to test the functionality of the gear prior to the field season, or to test new gear or instruments described elsewhere in this table but outside the geographic scope specified for other surveys.	HARA (Primarily in the waters south of Pearl Harbor on the Island of O‘ahu)	Year-round, up to 15 DAS Day and night	NOAA Ships such as *Oscar Elton Sette*, or equivalent vessel Small boats	Nets, lines, instruments Calibration of Simrad EK60	38-200 kHz	Intermittent for 24-48 hours
Pelagic Troll and Handline Sampling	Surveys would be conducted to collect life history and molecular samples from pelagic species. Other target species would be tagged-and-released. Different tags would be used depending upon the species and study but could include: passive, archival, ultrasonic, and satellite tags. Fishery observers or NOAA scientists conduct on-board documentation of catch and survival.	HARA, MARA, ASARA, 0 to 24 nm from shore (excluding any special resource areas)	Variable, up to 14 DAS Day and night	NOAA research vessels or the equivalent, or contracted fishing vessels.	Pelagic troll and handline (hook-and-line) fishing.	Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook trolling lures at 4-10 kts. Pelagic handline (hook-and-line) fishing at primarily 10-100 m midwater depths and down to bottomfish depths of 600 m, with hand, electric, or hydraulic reels. Up to 4 lines. Each line is baited with 4 hooks.	A total of up to 2 operations of any of these gear types per DAS, totaling 28 operations (all types combined) for the survey.
West Hawai‘i Integrated	Survey transects conducted off the Kona coast and Kohala Shelf area to develop ecosystem models for coral reefs, socioeconomic indicators, circulation patterns, larval fish transport and settlement. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column	HARA; 2-10 nm from shore	Variable, up to 10 DAS Day and night	*Oscar Elton Sette*	Cobb midwater trawl	Tow speed: 3 kts Duration: 60-240 min	15-20 tows/yr
					Hook-and-line	Electric or hydraulic reel: Each operation involves 1-3 lines, with squid lures, soaked 10-60 min at depths between 200m to 600m.	No more than 50 hours of effort. Approximately 10 mesopelagic squid caught per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
Ecosystem Assessment Cruise *(Adds hook-and-line fishing component to Status Quo protocols)*	oceanographic measurements and water sample collection.				Small-mesh towed net (surface trawl)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min	
					Active Acoustics Simrad split-beam EK60, trawl mounted OES Netmind, Didson 303	38-200 kHz Didson 303 is usually operated between 400m and 700m depth.	Intermittent continuous during surveys. Up to 12 Didson casts for up to 120 minutes per survey.
					ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
					CTD	45-90 min/cast	50 casts per year, alternating with Oceanography Cruise
Sampling of Juvenile-stage Bottomfish via Settlement Traps	Sampling activity to capture juvenile recruits of eteline snappers and grouper that have recently transitioned from the pelagic to demersal habitat. The specimens will provide estimates of birthdate, pelagic duration, settlement date, and pre-and post-recruitment growth rates derived from the analysis of otoliths. The target species include Deep-7 bottomfish and the settlement habitats these stages are associated with.	MHI; 0.2-5 nm from shore	July-September Up to 25 DAS Day and night	*Oscar Elton Sette* or equivalent research vessel, small boats	Trap (Settlement)	Cylindrical with dimensions up to 3 m long and 2 m diameter (maximum – typical size is 1 m by 2 m). Frame composed of semi-rigid plastic mesh of up to 5 cm mesh size. Folded plastic of up to 10 cm mesh is stuffed inside as settlement habitat, and cylinder ends are then pinched shut. Traps are clipped throughout the water column onto a vertical line anchored on bottom at up to 400 m, supported by a surface float.	10 traps per line set; up to 4 line sets soaked per day, from overnight up to 3 days. Up to 100 lines of traps set per year. Catch of 2500 juvenile stage bottomfish per year
Lagoon Ecosystem Characterization *(Increased geographic scope to include areas throughout WCPRA*	Measure the abundance and distribution of reef fish (including juvenile bumphead parrotfish) in any of the lagoons in the WCPRA over a two-week-long period by employing standardized transect and photo-quadrant techniques using SCUBA and snorkeling gear. A collection net may also be used	Throughout WCPRA	Up to 14 DAS Conducted during the day	Small boats	Divers with Hand Net or speargun	SCUBA, snorkel, 12-inch diameter small mesh hand net	10 dives per survey 10 fin clips collected for genetic analyses
					Hook-and-Line	Standard rod and reel using lures or fish bait	1-30 minute casts 60 casts per survey

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
compared to Status Quo protocols)	to non-lethally sample fish species inhabiting the lagoon to determine genetic identity. Hook-and–line and spear may also be used to lethally collect specimens.					from shoreline or small boat	
Pelagic Longline, Troll, and Handline Gear Trials	Investigate effectiveness of various types of hooks, hook guards, gear configurations, or other modified fishing practices for reducing the bycatch of non-target species and retaining or increasing target catch. Data collected on catch efficacy, fish size, species selectivity, and survival upon haul-back Investigate the vertical distribution of pelagic species catch and capture time with TDRs and hook-timers. Investigate behavior of catch and bycatch in relation to fishing operations using cameras, hydrophones, or other sensors. Catch may be tagged and released and specimens may be kept for genetic, physiological, and ecological studies. Troll and handline fishing for pelagic species may also be investigated, with tag and release of catch and collection of specimens.	Longline fishing would occur outside of: (1) all longline exclusions zones in the Hawai'i EEZ; (2) the Insular False Killer Whale range, and (3) all special resource areas. Longline fishing would occur up to approximately 500 nm from the shores of the Hawai'i Archipelago.	21 DAS Day and night	Contracted longline fishing vessels	Pelagic Longline	Gear (See Appendix A). Soak time: 600-1800 min	Up to 21 longline operation per survey per year
		25 to 500 nm from shore (excluding any special resource areas)			Trolling and handline (hook-and-line)	Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook troll lures at 4-10 kts Pelagic handline (hook-and-line) fishing at 10-100 m midwater depths, with hand, electric, or hydraulic reels. Up to 4	Up to 21 troll or handline (combined) operations per survey per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
						lines. Each line is baited with 4 hooks. Up to 4 hrs per troll or handline operation	
Fishing Impacts of Non-Target Species	Bycatch reduction research, post release survival and ecological research on sharks commonly encountered in recreational, commercial purse seine and longline fisheries in the Pacific Ocean. Research would include post-release survival studies to identify and develop best handling methods in recreational, purse seine and longline fisheries for improved post-release survival rates and ensuring crew safety. The deployment and analysis of electronic tags would generate robust post-release survival estimates which would improve the rigor of stock assessments and aid in the development of best handling practices for fisheries impacting shark populations.	HARA MARA ASARA WCPRA	Up to 60 DAS per year	*Oscar Elton Sette*, contracted fishing vessels, charter vessels	Tags (SPOT, SPAT, miniPAT, dart tags, and Coded 69 kHz acoustic transmitters (V16 Vemco)).	SPOT = up to 87 x 37 x 23 mm and 57 g fin mounted tags SPAT = 124 x 38 mm and 60 g attached by tether and anchor miniPAT = 124 x 38 mm and 60 g attached by tether and anchor Dart tags = 160 x 1.6 mm attached at base of dorsal fin Acoustic transmitters = 90 x 9 mm, surgically implanted into abdominal wall	50 sharks/year per species (Oceanic whitetip, including scalloped hammerheads) 3 mL blood samples from the same sharks
Oceanic White Tip Shark Tagging	Tagging, tracking and biological sampling of oceanic whitetip sharks (*Carcharhinus longimanus*) incidentally captured in the Hawai‘i small-boat tuna fishery. Research activities under this project would be directed by (or managed by) PIFSC and include training fishers participating in the Hawai‘i Community Tagging Program to tag, photograph, collect tissue samples and or collect interaction data from oceanic whitetip sharks captured incidentally during fishing operations targeting pelagic tuna, billfish and bottomfish teleost species. Incidentally caught sharks would be either tagged OR tissue sampled.	HARA	N/A	Small boats used in the tuna fishery	Pop-off Satellite Archival Transmitting Tags (PSATs), acoustic tags or conventional identification tags.	Fishing techniques that might interact with these sharks include: nighttime handline fishing, trolling, jigging, bottomfishing, and spearfishing.	Up to 50 individuals (~ 30 from the MHI small boat tuna fishery and ~ 20 from commercial fisheries in the central and western Pacific) may be captured and tagged in a given year
Giant Manta Ray Tagging	Tagging, tracking and biological sampling of giant manta rays incidentally caught in Pacific longline and purse seine fisheries. Research activities would be directed by PIFSC and include training fishery observers to tag, photograph, collect tissue samples	HARA MARA ASARA WCPRA	N/A	Commercial longline and purse seine fisheries	PSATs	Incidental catch in commercial longline or purse seine fisheries	Approximately 30 individuals may be captured/tagged and/or sampled in a given year

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
	and/or collect interaction data from giant manta rays captured incidentally during fishing operations in the western and central Pacific ocean						
Coastal Pelagic Ecology, Coastal Fishery Oceanography, Opelu Koas	Investigate physical and biological features that define the key habitats for important coastal pelagic species around Hawaiian Islands, especially the mackerel scad locally called opelu, *Decapterus macarellus*, which are targeted by fishers and an important forage fish for the coastal pelagic ecosystem. Sampling includes using 360-degree video cameras in the water column; scientific fishing operations; plankton nets; surface and water column oceanographic measurements; water sample collection for biogeochemical properties, physical properties, and eDNA. These surveys will be conducted in waters within and adjacent to these key habitats.	HARA	Annual (season variable) Up to 20 DAS, daytime operations	NOAA small boats and possibly charter vessels	Plankton drop net (stationary surface sampling)	1-meter diameter plankton drop net would be deployed down to 100 m	200 drops per year (collection total would be less than five liters of plankton)
				Small-mesh towed surface nets (neuston, ring, bongo nets)	Duration: up to 60 min Depth: 0-100 m	15-20 tows (any combination of the nets described) <1 liter of organisms per tow	
				CTD profiler (portable unit)	15-30 min cast duration	60 casts per year	
				360 degree video and other cameras	Less than 1 hour duration	Up to 20 deployments per year	
				Hook-and-line	Standard rod and reel using jigging lures from small boat at ~ 25 m depth	2 lines used at daytime only. 10-20 small boat trips per year. Less than one hour per trip.	
				Water sample collection	Duration: 15-30 min; Depth:0-100m; Water samples collected at depths ranging from 0 – 100 m. Water would be collected in Niskin bottles and decanted	60 casts per year	

Survey Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details (Approximated)	Total Number of Samples (Approximated)
					into 10 L carboys for processing.		

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2.3.1 Mitigation Measures for Protected Species

Under the Preferred Alternative, PIFSC would apply for authorizations under the MMPA and the ESA for incidental take of protected species while conducting the suite of research activities described above. This process requires regulations and authorizations for incidental take of marine mammals under the MMPA and incidental take of protected species under the ESA. Under this alternative, PIFSC is applying to NMFS Headquarters OPR requesting regulations governing the issuance of an LOA for incidental take of marine mammals under the MMPA. OPR would make the necessary findings and, if appropriate, promulgate regulations and issue an LOA to PIFSC. The LOA would prescribe mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals during the specified research activities.

In addition, both OPR and PIFSC would engage in ESA section 7 consultations with NMFS PIRO (and USFWS) for species that are listed as threatened or endangered (see Section 2.3). These consultations may result in the development of a BiOp that determines whether or not the federal action would be likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of any critical habitat. The BiOp could contain an ITS for ESA-listed species that includes reasonable and prudent measures along with implementing terms and conditions intended to minimize the impact of incidental take of ESA-listed species during PIFSC research activities.

Under the Preferred Alternative, PIFSC would also continue to apply for ESA section 10 directed research permits for the intentional take of ESA-listed species.

The Preferred Alternative would include the same suite of mitigation measures described in the Status Quo Alternative to reduce the risk of adverse interactions with protected species and EFH. In addition, PIFSC would implement gear modifications under the Preferred Alternative that would reduce the risk of marine mammals getting entangled in instrument deployments (Section 2.3.1.1). PIFSC would also implement a series of improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative to facilitate and improve the implementation of the mitigation measures described under the Status Quo Alternative (section 2.3.1.2).

2.3.1.1 Gear Modifications

In order to minimize the potential risk of entanglement during instrument deployment, PIFSC would modify the total line length and the relative length of floating line to sinking line used for stationary gear that is deployed from ships or small boats (e.g., stereo-video data collection). A certain amount of extra line (or scope) is needed whenever deploying gear/instruments to the seafloor to prevent currents from moving the gear/instruments off station. If the line is floating line and there is no current, then the scope will be floating on the surface. Alternatively, scope in sinking line may gather below the water surface when currents are slow or absent. Because current speeds vary, there is a need for scope every time that gear is deployed.

Line floating on the surface presents the greatest risk for marine mammal entanglement because: (1) when marine mammals (e.g., humpback whales) come to the surface to breathe, the floating line is more likely to become caught in their mouths or around their fins; and (2) humpback whales tend to spend most of their time near the surface, generally in the upper 150 m of the water column.

Currently, PIFSC uses only floating line to deploy stationary gear from ships or small boats. Floating line is used in order to maintain the vertical orientation of the line immediately above the instrument on the seafloor. The floating line also helps to keep the line off of the seafloor where it could snag or adversely affect benthic organisms or habitat features.

This mitigation measure would involve the use of sinking line for approximately the top 1/3 of the line. The other approximately lower 2/3 would still be floating line. This configuration would allow any excess scope in the line to sink to a depth where it would be below where most whales and dolphins commonly occur. Specific line lengths, and ratios of floating line to sinking line, would vary with actual depth and the total line length. This mitigation measure would not preclude the risk of whales or dolphins swimming into the submerged line but this risk is believed to be lower relative to line floating on the surface.

In addition, tori lines (streamer lines – see Appendix A) may be used for longline surveys as needed. PIFSC would deploy streamer lines before longline gear is set to mitigate the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has been proven effective in reducing seabird bycatch in several Pacific fisheries (Melvin et al. 2001).

2.3.1.2 Protected Species Training

PIFSC considers the current suite of monitoring and operational procedures to be necessary and sufficient to minimize adverse interactions with protected species while still allowing PIFSC to fulfill their scientific mission. However, many of the mitigation measures described in the Status Quo Alternative could also be considered "best practices" for safe seamanship and avoidance of hazards during fishing. PIFSC researchers are aware of the explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species. However, the specific conditions for implementing these mitigation measures in all situations have not been formalized or widely discussed among all scientific parties and vessel operators. PIFSC therefore proposes a series of improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative. PIFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described under the Status Quo Alternative. The enhanced mitigation measures included in the Preferred Alternative are anticipated to be sufficient for and required by NMFS under MMPA and ESA authorizations for the specified research activities affiliated with PIFSC.

- Some mitigation measures such as the move-on rule require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Ship captains and Chief Scientists are charged with making those judgments at sea. They are all highly experienced professionals but there may be inconsistencies across the range of research surveys conducted and funded by PIFSC in how those judgments are made. In addition, some of the mitigation measures described above could also be considered "best practices" for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species may not have been formalized and clearly communicated with all scientific parties and vessel operators. PIFSC therefore proposes a series of improvements to its protected species training, awareness, and reporting procedures. PIFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described above.

- PIFSC will initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted above, there are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal interactions before and during the time research gear is in the water. The intent of this mitigation measure would be to draw on the collective experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. PIFSC would coordinate not only among its staff and vessel captains but also with those from other FSCs with similar experience.
- Another new element that would be required for all PIFSC research projects is the proposed development of a formalized protected species training program for all crew members that may be posted on monitoring duty or handle incidentally caught protected species. Training programs would be conducted on a regular basis and would include topics such as monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. PIFSC will work with the Pacific Islands commercial fisheries Observer Program to customize a new protected species training program for researchers and ship crew. The Observer Program currently provides protected species training (and other types of training) for NMFS-certified observers placed on board commercial fishing vessels. PIFSC Chief Scientists and appropriate members of PIFSC research crews will be trained using similar monitoring, data collection, and reporting protocols for protected species as is required by the Observer Program. All PIFSC research crew members that may be assigned to monitor for the presence of marine mammals during future surveys will be required to attend an initial training course and refresher courses annually or as necessary. The implementation of this training program would formalize and standardize the information provided to all research crew that might experience protected species interactions during research activities.
- For all PIFSC research projects and vessels, written cruise instructions and protocols for avoiding adverse interactions with protected species will be reviewed and, if found insufficient, made fully consistent with the Observer Program training materials and any guidance on decision-making that arises out of the two training opportunities described above. In addition, informational placards and reporting procedures will be reviewed and updated as necessary for consistency and accuracy. All PIFSC research cruises already include pre-sail review of protected species protocols for affected crew but PIFSC will review its briefing instructions for consistency and accuracy.
- Following the first year of implementation of the LOA, PIFSC will convene a workshop with PIRO Protected Species, PIFSC fishery scientists, NOAA research vessel personnel,

and other NMFS staff as appropriate to review data collection, marine mammal interactions, and refine data collection and mitigation protocols, as required.

- In addition, PIFSC fisheries research personnel working in nearshore or onshore locations in proximity to Hawaiian monk seals will document any disturbances to seals. Such documentation will include date, location, number and reaction of seals, type of disturbance and nature of fisheries research activity being conducted. Reports from such events will be compiled and reviewed on an annual basis for review by PIFSC leadership in order to devise alternative strategies for reducing any future take. Take events will be reported annually to OPR as required by authorization.

2.3.1.3 Operational Procedures

As discussed in Section 4.2.4.6, PIFSC carefully considered the potential risk of marine mammal interactions with its bottomfishing hook-and-line research gear. PIFSC determined that the risk was not high enough to warrant requesting takes in that gear. However, PIFSC intends to implement the following measures to reduce the risk of potential interactions and to help improve our understanding of what those risks might be for different species. These efforts will help inform the adaptive management process to determine the appropriate type of mitigation needed for research conducted with bottomfishing gear.

- Visual monitoring for marine mammals before gear is set and implementation of the "move-on" rule as described for longline gear.
- To avoid attracting any marine mammals to a bottomfishing operation, dead fish and bait will not be discarded from the vessel while actively fishing. Dead fish and bait may be discarded after gear is retrieved and immediately before the vessel leaves the sampling location for a new area.
- If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity of a bottomfishing operation, then the gear would be retrieved immediately and the vessel would move to another sampling location where marine mammals are not present.
- If a hooked fish is retrieved and it appears to the fisher that it has been damaged by a monk seal, then visual monitoring will be enhanced around the vessel for the next ten minutes. Fishing may continue during this time. If a shark is sighted, then visual monitoring would be returned to normal. If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity of a bottomfishing operation, then the gear would be retrieved immediately and the vessel would be moved to another sampling location where marine mammals are not present. Catch loss would be tallied on the data sheet, as would a "move-on" for a marine mammal.
- If bottomfishing gear is lost while fishing, then visual monitoring will be enhanced around the vessel for the next ten minutes. Fishing may continue during this time. If a shark is sighted, then visual monitoring would be returned to normal. If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity, it would be observed until a determination can be made of whether gear is sighted attached to the animal, gear is suspected to be on the animal (e.g., it demonstrates uncharacteristic behavior such as thrashing), or gear is not observed on the animal and it behaves normally. If a cetacean or monk seal is sighted with the gear attached or suspected to be attached, then the

procedures and actions for incidental takes would be initiated. Gear loss would be tallied on the data sheet, as would a "move-on" because of a marine mammal.

2.3.2 Unknown Future PIFSC Research Activities

In addition to the activities identified above, PIFSC may propose additional surveys or modify existing research activities within the timeframe covered by MMPA authorization. For example, over the next 5 years advancements in technology may lead to new and better sampling instruments and gear, such as video equipment and UAS. Because of the annual cycle under which decisions to fund or conduct research are made, PIFSC cannot identify in advance all the potential future activities that may take place over the next 5 years. For purposes of this programmatic analysis, NMFS has examined the research activities that have occurred in the past 5 years and used this information as a proxy for future proposed research activities that may occur through the five-year MMPA authorization period. Taken together these activities comprise the actions evaluated within this PEA under the Preferred Alternative.

Over the next 5 years, as future congressional appropriations and NMFS fisheries research budgets are established, PIFSC will examine the proposed future research to determine if the activities are consistent with the scope of actions considered under the Preferred Alternative. To be considered 'within scope' under this PEA, future proposals for specific research projects must be consistent with the gear types, spatial and temporal distribution of research activities, and types of effects analyzed within this document. If future research projects are not consistent with the type or scope of fisheries research activities analyzed in this PEA, they may be subject to additional NEPA, ESA, and MMPA evaluations.

More specifically, the basic methodology used to evaluate any proposed future research activity will be as follows:

1. Evaluate the activity to determine if it would be conducted within the geographic scope of the region evaluated in the PEA. The evaluation described in Chapter 4 of this PEA is based on the historic spatial distribution of research surveys. Any future research activities proposed within the geographic areas described in Chapter 4 would pass this step of the evaluation. The geographic scope of this PEA is extensive but some areas (e.g., areas with permanent exclusions) have not been subject to research surveys and are not necessarily included in this evaluation. Any proposed research in those areas may require additional evaluation.
2. Evaluate the seasonal distribution of the activity. The activities evaluated in this PEA are conducted throughout the year but certain surveys are only conducted in specific time frames or seasons. If a program was proposed that was similar in methodology to past surveys but drastically shifted the timing of research activities from what was analyzed in this PEA, additional evaluation may be required.
3. Evaluate the gear types proposed. The gear types that were included in the analysis are described in Appendix A. If the proposed future research activity use the same or similar gear in the same manner analyzed in this PEA, then the research activity would likely fall within the analysis conducted. The research activity would not have to exactly match the descriptions in this PEA, because the same impacts would be expected from similar gear types and activities. For example, if a new side-scan sonar were deployed and the signal

strength and frequency were within the ranges evaluated for bottom sounding sonar evaluated in this PEA, then the impacts would be similar because only the area swept by the sonar would be changing. If a new type of gear were deployed, or if a gear type was to be used in substantially different ways than described, and if environmental impacts not considered in this PEA could result, then additional NEPA analysis would be required.

To reiterate, any proposed action 1) conducted in regional areas described in this PEA, 2) during times of the year considered, and 3) using gear types and methods generally equivalent to the methods evaluated, would likely be considered covered by the scope of analysis and conclusions drawn in this PEA. If future proposed research activities, projects, or programs are not consistent with the type or scope of fisheries research activities analyzed in this PEA, they would not be covered under this PEA.

2.4 ALTERNATIVE 3—MODIFIED RESEARCH ALTERNATIVE—CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH ADDITIONAL MITIGATION

Under the Modified Research Alternative, PIFSC would continue fisheries research as described in Section 2.3 and Appendix A and would apply for authorizations of incidental take of protected species under the MMPA and the ESA. The Modified Research Alternative would include all of the same mitigation measures required by the MMPA and ESA authorization procedures as described for the Preferred Alternative. The difference between the Modified Research Alternative and the Preferred Alternative is that the Modified Research Alternative includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on similar fisheries actions, (2) discussions within NMFS as a part of the proposed rulemaking process, and (3) a literature review of past and current research into potential mitigation measures. The new suite of research activities is a combination of past research and additional, new research, as described for the Preferred Alternative.

As described in the Preferred Alternative, PIFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species but measures must also: pass safety and practicability considerations, meet survey objectives, allow survey results to remain consistent with previous data sets, and be consistent with the purpose and need for PIFSC research activities (Section 1.3). Some of the mitigation measures considered in this alternative (e.g., no night fishing, or broad spatial and/or temporal restrictions) would essentially prevent PIFSC from collecting data required to provide for fisheries management purposes under the MSA. Some research surveys necessarily target fish species that are preyed upon by marine mammals with an inherent risk of interactions with marine mammals during these surveys. PIFSC acknowledges the inherent risk of these, and it has implemented a variety of measures to mitigate that risk. PIFSC currently has no viable alternatives to collecting the data derived from these surveys and does not propose to implement potential mitigation measures that would preclude conducting these surveys, such as the elimination of night surveys or elimination of pelagic trawl gear use. An analysis of the potential efficacy and practicability of the additional mitigation measures considered in this alternative is presented in Section 4.4.

The PEA also serves as the basis for an application for the issuance of regulations and subsequent LOA under Section 101(a)(5)(A) of the MMPA that would regulate the unintentional taking of small numbers of marine mammals incidental to PIFSC's research activities. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate mitigation measures to minimize impacts to marine mammals to the level of "least practicable adverse impact." As described above, some mitigation measures could prevent PIFSC from maintaining the utility of ongoing scientific research efforts, and those mitigation measures would normally be excluded from consideration in the PEA under screening criteria 3 (Section 2.1). However, such mitigation measures would likely be considered during the MMPA ITA process and/or ESA section 7 consultation and are therefore considered under the Modified Research Alternative in this PEA.

2.4.1 Additional Mitigation Measures for Protected Species

2.4.1.1 Trawl Surveys

1. Monitoring methods

   Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist or other designated scientist, and crew standing watch, are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

   - Visual surveillance by dedicated protected species observers. This measure would require PIFSC to use trained protected species observers whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel. This dedicated observer position would be different than having marine mammal or bird biologists on board whose job is to conduct abundance and distribution surveys. Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.
   - Use of a camera or underwater video system to monitor any interactions of protected species with the trawl gear. Underwater video technology may allow PIFSC to determine the frequency of interactions with the trawl gear and to evaluate the effectiveness of a measure's ability to mitigate injurious or lethal interactions.
   - Use of passive acoustic monitoring for marine mammal vocalizations to aid in the detection of marine mammals present in the survey area and to implement appropriate modifications of trawl operations.
   - Use of aircraft, unmanned aerial vehicles, or autonomous underwater gliders to provide additional detection capabilities.
   - Use of infrared (IR) technologies to detect marine mammals.
   - Use of night-vision devices to detect marine mammals.

2. Operational restrictions
   - This measure would require PIFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with marine mammals that would be difficult to detect by visual monitoring.
   - Video sampling with an open codend.

3. Acoustic and visual deterrents
   - This measure would require PIFSC to use deterrents, such as recordings of predator vocalizations to deter interactions with trawl gear, or use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear.

4. Temporal or geographic restrictions
   - Spatial or temporal restrictions are one of the most direct means of reducing adverse impacts to protected species. By reducing the overlap in time and space of the survey's footprint with known concentrations of protected species, PIFSC may reduce the amount of incidental take of such species. This measure would require PIFSC to identify areas and times that are most likely to result in adverse interactions with protected species (e.g., areas of peak abundance such as humpback whale wintering in the MHI) and to avoid, postpone, or limit research activities to minimize the risk of such interactions with protected species as long as such spatial or temporal restrictions do not conflict with the ability of PIFSC to conduct scientifically valid surveys and to provide the best scientific information available for purposes of managing commercial fisheries. This may include limits on specific locations, physical or oceanographic features, biologically important times, or gear types.
   - Avoidance of certain federal and state MPAs. This measure would restrict PIFSC trawl surveys in certain federal or state MPAs (Section 3.1.2.4).

2.4.1.2 Longline Gear

1. Monitoring methods
   - Visual surveillance by independent protected species observers. This measure would require PIFSC to use trained, independent, protected species observers on each longline survey to detect the presence of marine mammals and other protected species within the survey area. Considerations include the use of independent observers for all surveys or during longline surveys of particular concern. Monitoring may take place during setting, soaking, and/or hauling.
2. Operational procedures
   - Tori or streamer lines. Under this measure, PIFSC would deploy streamer lines before longline gear is set to mitigate the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has been proven effective in reducing seabird bycatch in several Pacific fisheries (Melvin et al. 2001).
3. Acoustic deterrents
   - This measure would require PIFSC to use deterrents such as acoustic pingers or recordings of predator vocalizations (e.g., killer whale) to deter interactions with longline gear.
4. Visual deterrents
   - This measure would require the crew to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope, marked lines) to make the longline gear more detectable thereby potentially reducing the likelihood of hooking or entangling a marine mammal. Note that lights and light sticks are prohibited for use on longline gear in some Pacific fisheries as they may contribute to increased turtle bycatch.

2.5 Alternative 4 – No Research Alternative—No Fieldwork for Fisheries and Ecosystem Research Conducted or Funded by PIFSC

Under the No Research Alternative PIFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this PEA in marine waters of the HARA, the MARA, the ASRA, and WCPRA. This moratorium on fieldwork would not extend to research that is not in scope of this PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the United States Under this alternative, organizations that have participated in joint research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would be consistent with the time series data NMFS has collected over many years, which is the core information supporting NMFS' science and management missions and vital to fishery management decisions made by the FMCs, NMFS, and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

Currently, fisheries and marine ecological research is also being conducted by state and territorial agencies, international agencies, and research institutes in the four PIFSC research areas, sometimes with funding support from PIFSC. However, this research is limited in scale and generally confined to state and territorial waters, as well as near-shore ocean areas and does not cover many of the fisheries topics currently investigated by PIFSC. Under the No Research Alternative, it is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by PIFSC. No agencies or other entities would likely conduct marine research to replace the research abandoned by PIFSC in the four research areas under the No Research Alternative. Additionally, under this alternative there would be no need for a MMPA LOA; and, therefore, one would not be issued.

2.6 ALTERNATIVES CONSIDERED BUT REJECTED FROM FURTHER ANALYSIS

As stated previously, the alternatives evaluated in an EA must achieve the purpose and need of the proposed action, in part or in full, without violating any of the applicable laws and regulations described in Chapter 6 and summarized in Section 1.6. Other potential alternatives that do not satisfy the agency's purpose and need, or would not meet minimum environmental standards, are not considered reasonable and need not be carried forward for evaluation in an EA. The following alternatives were considered but rejected because they do not meet the purpose and need as stated in Section 1.3 or the screening criteria described in Section 2.1.

2.6.1 Sole Reliance on Commercial Fishery Data

One alternative that NMFS considered was to rely solely on commercial fisheries data such as Catch Per Unit Effort (CPUE), seasonal and geographic distribution of harvests, and other harvest data to assess the status of commercially important stocks. This alternative was rejected from further analysis because it would not provide sufficient information on the age and size class structure of exploited fish stocks and would be insufficient to track fish population dynamics or provide other types of predictive capabilities required to manage the fisheries. Although several large commercial fisheries in the region are assessed using almost exclusively fishery-dependent data (e.g., Hawai‘i shallow-set longline (SSLL) and deep-set longline (DSLL), American Samoa longline and purse seine), sole reliance on commercial fishery data would preclude the collection of complimentary ecosystem data needed to inform long-term decision making by fisheries and ecosystem management organizations. For example, PIFSC provides managers with oceanographic, life history, and community structure data not collected by the commercial or recreational fisheries. In addition, sole reliance on commercial fishery data would not meet the need to maintain a standardized, objective, and unbiased sampling approach provided by independent surveys.

Conclusion: This alternative does not meet screening criteria 1 or 3. It would not meet statutory obligations because directed research activities would not be conducted. It would not maintain scientific integrity of research programs because the results would not provide the holistic and complementary datasets (oceanographic, life history, and abundance data) for the vast geographic areas within the Pacific Islands Region. For these reasons this alternative is not carried forward for detailed evaluation.

2.6.2 New Methodologies

Another alternative considered was to adopt other types of survey methodologies or develop new methodologies based primarily on their potential to eliminate or greatly reduce interactions with protected species or effects on habitat, as opposed to adopting new methods and gear for fisheries research purposes. Although NMFS continues to place a high priority on avoiding adverse interactions with protected species and is continually reviewing potential mitigation measures for research activities, the purpose and need for conducting fisheries research requires future sampling methodologies be consistent with past data sets to maintain long-term trend analyses for commercially fished and ecologically important species. NMFS is currently evaluating alternative sampling methods for fisheries and marine ecosystem research, some of which may reduce the potential for incidental takes of protected species or effects on benthic habitats. However, these new methodologies will be evaluated primarily for consistency with the purpose and need for fisheries and marine ecosystem research and whether they provide information that can build on and supplement past data sets.

Conclusion: This alternative did not meet screening criterion 3. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. Therefore, this alternative is not carried forward for detailed evaluation.

2.6.3 Alternative Research Program Design

In this alternative the types of research conducted would be revised to determine if alternative levels of particular research activities would result in different levels of impacts. This alternative would emphasize minimizing potential adverse environmental impacts when designing research activities. Other factors, such as maximizing efficient use of scientific research funding and maintaining the integrity of long-term data sets, would not be considered in this approach.

Conclusion: This alternative was rejected because it would not meet screening criterion 3 and would intrude on inherently technical and scientific decisions. Therefore, this alternative is not carried forward for detailed evaluation.

2.7 INTERNATIONAL BYCATCH REDUCTION RESEARCH PROJECTS IN FOREIGN TERRITORIAL SEAS: EO 12114 COMPLIANCE

In coordination and collaboration with non-governmental organizations and foreign governments, PIFSC participates in several fisheries technology development and ecosystem monitoring capacity-building projects in foreign territorial seas that include bycatch reduction, electronic monitoring (EM), coral reef research and monitoring, and other fishing technology research projects. These projects take place within 12 nm of the foreign country's baseline. These projects collect data necessary to evaluate the efficacy of various fisheries technologies. For example, bycatch reduction projects are designed to develop and refine gear technologies that have shown potential to reduce bycatch interactions in fisheries (e.g., net, trawl, seine, longline, handline, hook-and-line fisheries). By collaborating with local (in-country) fishers, international scientists and managers, non-governmental organizations (NGOs), universities, and government fishery scientists, PIFSC contributes to such fisheries research in a manner that is conducted under typical fishing operations and without increasing fishing effort in the fishery. Depending upon the project and the location, the respective foreign governments or fishery agencies may participate directly or indirectly in these research activities (e.g., research partnerships, approved permit, agreements).

PIFSC proposes to administer, collaborate, and participate in the following projects in foreign territorial waters over the next 5 years:

- Coral Triangle Initiative. This program occurs year-round in the nearshore waters around the Philippines, Malaysia, Indonesia, Timor-Leste, Papua New Guinea, Solomon Islands, Vietnam, and other participant nations in the region. It provides technical assistance to develop and institutionalize ecosystem approaches to fisheries management planning for the Arafura Sea ecosystem. It includes governance framework-development and capacity-building, ecosystem approaches to fisheries management and LEAD Training for Core National/Regional Universities in the Philippines. Foreign partners include U.S. Agency for International Development, technical assistance and capacity building on sustainable fisheries management and conservation with local agencies. The protocols for fieldwork include the use of hand gear by SCUBA divers, including a spear gun, slurp gun, and hand net. Protocols also include deployment of ARMs, CAUs, BMUs, and BRUVs. Additional protocols include the use of various multi-frequency active acoustics (38-240 kHz). These protocols are based on the RAMP surveys and activities described in the Status Quo and Preferred Alternatives.
- Development of innovative **Bycatch Reduction Technologies** (BRTs). These are projects that occur throughout the year in the waters of the Eastern Tropical Pacific (Mexico, Guatemala, Honduras, Costa Rica, Panama, El Salvador, Nicaragua, Columbia, Ecuador, Peru, and Chile), the South Atlantic (Brazil, Uruguay, and Argentina), the South China Sea, the Coral Triangle (Indonesia, Vietnam, and Philippines), and the Mediterranean Sea (Spain, Italy, Cyprus, and Israel). These projects aim to develop and refine fisheries technologies that reduce incidental bycatch while still catching target fishes, increase fishing efficiencies and fisheries monitoring, and improve fisheries management. Partners include the Ocean Discovery Institute and World Wildlife Fund-USA (United States), Comisión Nacional de Áreas Naturales Protegidas (Mexico), Grupo Tortuguero (Mexico), Instituto Nacional de Pesca (Mexico), ProDelphinus (Peru),

Instituto del Mar Del Peru (Peru), Pacifico Laud (Chile), Subscretaria de Recursos Pesqueros (Ecuador), TAMAR (Brazil), World Wildlife Foundation—Indonesia (Indonesia), Ministry of Marine Affairs and Fisheries (Indonesia), Kai Soluciones Avanzades (Spain), International Council on Animal Protection (United States, El Salvador, Nicaragua, Honduras), Birdlife International, and Conservation of Marine Biodiversity (SUBMON Spain). These projects use contracted fishery observers on coastal gillnet fisheries, pelagic longlines, bottom set longline, and fish trap fisheries. Fishery observers monitor the fishermen's use of net illumination technology, visual alerts, electropositive metals, acoustic deterrent devices, modified hooks to test and develop new mitigation measures to reduce bycatch (e.g., bycatch such as finfish, elasmobranchs, sea turtles, sea birds, marine mammals), as well as place satellite telemetry tags on incidentally caught species (e.g., sea turtles, sharks, etc.) to better understand post interaction mortalities, and also help test the use of EM devices to better increase observed fishery activities.

- Testing of BRTs in East Asian Fisheries. This project occurs near Japan, Taiwan, and China. It seeks to understand bycatch interactions and test BRTs in Japanese fisheries. Emphasis is placed on testing BRTs in fisheries that interact with Northern Pacific loggerhead sea turtles. Foreign partners include the Sea Turtle Association of Japan, Tokyo University of Marine Technology, Japan Fisheries Agency, and Suma Aqualife Park. The protocols for fieldwork include the use of aerial surveys, fishery observers, behavioral studies in aquaria, and satellite telemetry. Fishery observers use pound net escape devices, net illumination, visual alerts, electropositive metals, acoustic deterrents, and modified hooks to develop new mitigation measures for bycatch reduction.
- Testing BRTs in Western and Central Pacific Ocean. This project occurs near Fiji and evaluates the effectiveness of various types of circle and tuna hooks at reducing the bycatch of non-target species in longline fisheries. It also collects data in collaboration with local fishers, NGOs, and governmental organizations on catch efficacy, fish size, species selectivity, and survival upon haul-back as based on hook type. Fishery observers conduct on-board documentation of catch and survival data on foreign flag vessels. Fishery observers monitor the fishermen's use of net illumination technology, visual alerts, electropositive metals, acoustic deterrent devices, modified hooks to test and develop new mitigation measures to reduce bycatch, as well as place satellite telemetry tags on incidentally caught species (e.g., sea turtles, sharks) to better understand post interaction mortalities, and also help test the use of EM devices to better increase observed fishery activities.

3.1 PHYSICAL ENVIRONMENT

The geographic areas and physical environments potentially affected by the PIFSCs research surveys are located throughout the Pacific Ocean. These areas include the waters around the Hawaiian, American Samoan, and Mariana Archipelagos as well as the high seas in between these island chains, including the Pacific Remote Island Areas. PIFSC research surveys occur both inside and outside the U.S. EEZ and sometimes in foreign territorial seas. Often, the surveys span across multiple ecological, physical, and political boundaries.

3.1.1 Large Marine Ecosystems

LMEs are large areas of coastal ocean space. LMEs generally include greater than 200,000 square kilometers (km^2) of ocean surface area and are located in coastal waters where primary productivity is generally higher than in open ocean areas. LME physical boundaries are based on four ecological criteria: bathymetry, hydrography, productivity, and trophic relationships. Based on these four criteria, 10 LMEs have been delineated for the coastal marine waters of the U.S., and a total of 64 distinct LMEs have been delineated around the coastal margins of the Atlantic, Pacific and Indian Oceans (Sherman et al. 2004). Figure 3.1-1 shows the world's LMEs. Each color represents a distinct LME.

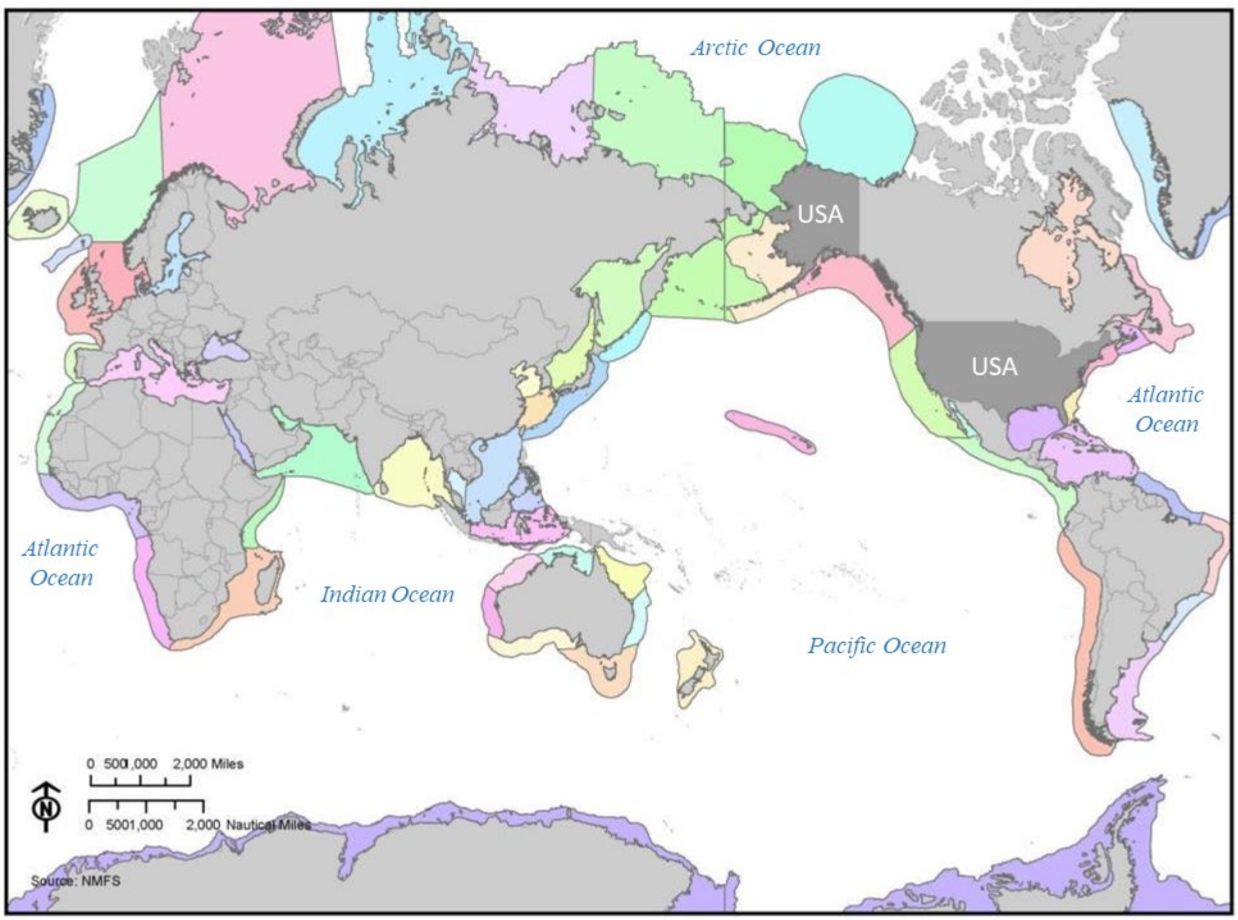


Figure 3.1-1 Large Marine Ecosystems of the World

Globally, LMEs are the source of 80 to 95 percent of the world's marine fish harvest and are centers of economic activity for oil and gas, shipping, and tourism industries. The LME concept provides a practical framework for the application of ecosystem-based approaches to fisheries assessment and management, habitat restoration, and research on pollution and ecosystem health.

NOAA and NMFS have implemented a management approach designed to improve the long-term sustainability of LMEs and their resources by using practices that focus on ensuring the sustainability of the productive potential for ecosystem goods and services. For more detailed information on the LME management concept and trends in ecosystem health, see The UNEP [United Nations Environmental Program] Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas (Sherman and Hempel 2008).

PIFSC's fisheries research activities take place in four primary research areas: HARA, MARA, ASARA, and the WCPRA, which are described in detail in the following sections (Figure 3.1-2). The HARA includes the Insular Pacific-Hawaiian LME. Additionally, a substantial amount of the PIFSC fisheries research activities are conducted in offshore areas that lie outside of the coastal LME boundaries. LMEs within close proximity to offshore research include the Indonesian Sea LME, Sulu-Celebes Sea LME, Kuroshio Current LME, and the Oyashio Current LME.

3.1.1.1 Hawaiian Archipelago Research Area

The HARA includes waters surrounding the Hawaiian Islands to a seaward extent of approximately 24 nm. PIFSC conducts research surveys in the HARA, primarily inside the Insular Pacific-Hawaiian LME boundary. The Insular Pacific-Hawaiian LME has a surface area of approximately one million km², extending 1,500 miles from the MHI to the outer northwest islands, including a range of islands, atolls, islets, reefs, and banks (WPRFMC 2009a). Within the Pacific basin are underwater plate boundaries that define long mountainous chains, submerged volcanoes, islands and archipelagos as well as various other bathymetric features that influence the movement of water and the distribution of marine organisms. The Hawaiian Islands were created during successive periods of volcanic activity and are surrounded by coral reefs. This area contains about 1 percent of the coral reefs and sea mounts in the world and four major estuaries (Aquarone and Adams 2008).

The HARA experiences relatively uniform and tropical meteorological and oceanographic conditions. Sea surface temperatures generally average between 24.5 and 25.3 degrees Celsius (°C) and range from 21 to 29 °C throughout the HARA. The circulation of ocean water in the HARA and throughout the Pacific Ocean is a complex system primarily driven by solar radiation that results in wind being produced from the heating and cooling of ocean water and the evaporation and precipitation of atmospheric water (WPRFMC 2009a). Unique oceanographic systems including the North Hawaiian Ridge Current, Pacific Ocean-Atmosphere system, cyclonic eddies, and wind-driven ocean circulation drives much of the regional ocean productivity around the HARA (Qiu et al. 1997; Xie et al. 2001; Seki et al. 2001; Chavanne et al. 2002). Figure 3.1-2 shows the major surface currents of the Pacific Ocean.

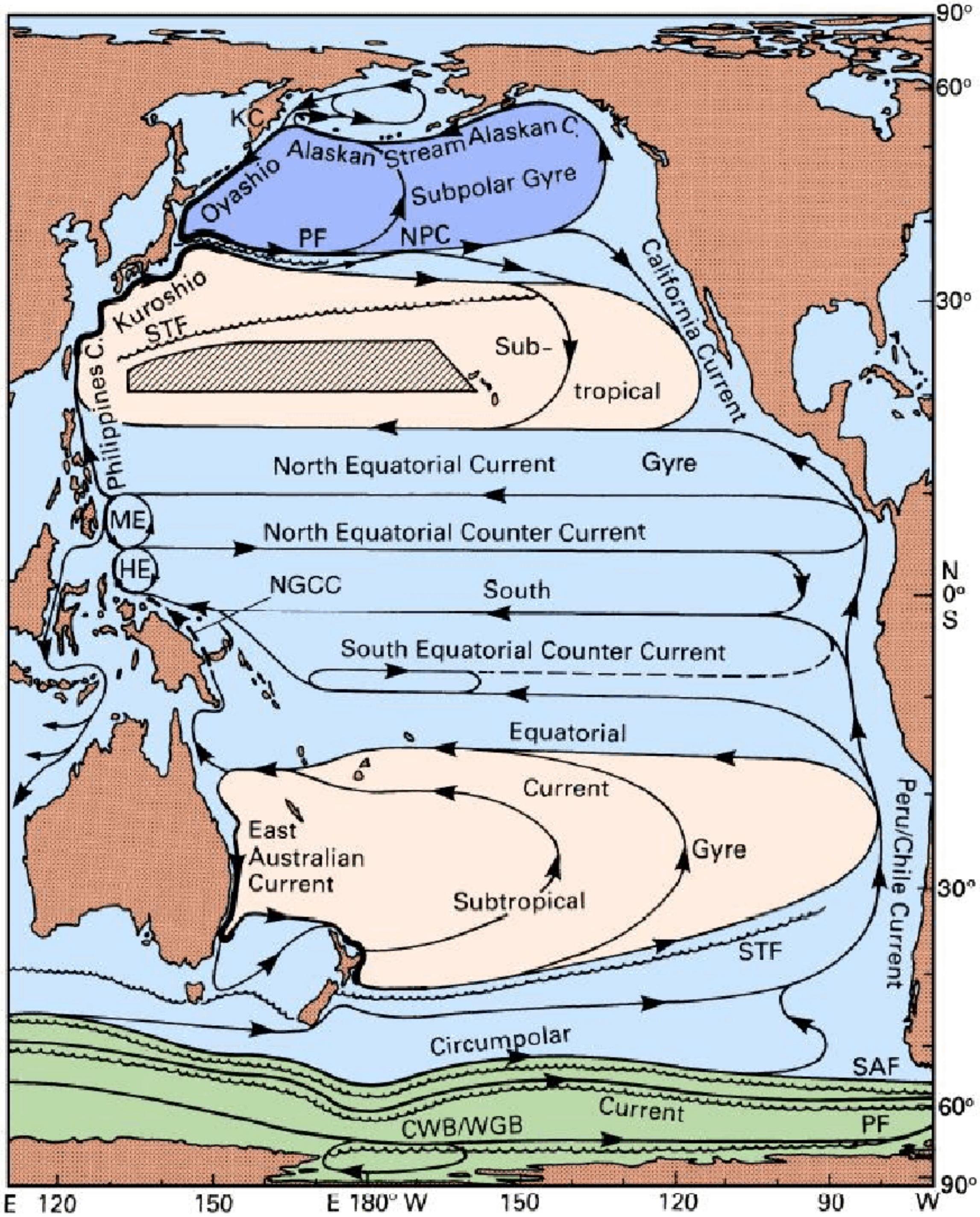


Figure 3.1-2 Major Surface Currents of the Pacific Ocean

Source: Tomczak and Godfrey 2003

Note: Abbreviations are used for the Mindanao Eddy (ME), the Halmahera Eddy (HE), the New Guinea Coastal Current (NGCC), the North Pacific Current (NPC), and the Kamchatka Current (KC). Other abbreviations refer to fronts: NPC (North Pacific Current), STF (Subtropical Front), SAF (Subantarctic Front), PF (Polar Front), and CWB/WGB (Continental Water Boundary/Weddell Gyre Boundary). The shaded region indicates banded structure (Subtropical Countercurrents). In the western South Pacific Ocean, the currents are shown for April–November when the dominant winds are the trades. During December–March, the region is under the influence of the northwest monsoon, flow along the Australian coast north of 18° S and along New Guinea reverses, the Halmahera Eddy changes its sense of rotation, and the South Equatorial Current joins the North Equatorial Countercurrent east of the eddy (WPRFMC 2009a).

The HARA is seasonally influenced by the Subtropical Front (STF), which corresponds to a shallow subtropical countercurrent that transects the LME in winter and summer (Kobashi et al. 2006). The STF plays an important role in the regional ecology of the HARA, defining a major trans-ocean migration path and feeding grounds for many species. Additionally, the HARA 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, and may break off coral, move underwater boulders, and shift large volumes of sand and erode islands (WPRFMC 2009a).

Breaking waves from surf generated by Pacific storms influences the structures of exposed reef communities; extreme wave events are believed to play fundamental roles in forming and maintaining the spatial and vertical distributions of corals, algae, and fishes in coral reef ecosystems throughout the HARA (WPRFMC 2009a).

3.1.1.2 Mariana Archipelago Research Area

The MARA includes waters surrounding the CNMI and the Territory of Guam to a seaward extent of approximately 24 nm. The Mariana Islands cover approximately 396 square miles. They are composed of 15 volcanic islands that are part of a submerged mountain chain that spans from Guam to Japan. Politically, the islands are split into the Territory of Guam and the CNMI but are combined for the purposes of defining the MARA. The islands are oriented along a north-south axis, with Guam being the southernmost island in the archipelago. Additionally, there is a chain of submerged seamounts located approximately 120 nm west of the Mariana Islands, also in a north-south pattern, reaching southwest of Guam. Seamounts are mountains rising from the ocean seafloor that do not reach the water’s surface. Species richness is greater near seamounts than nearshore or oceanic areas, creating hotspots of pelagic biodiversity (Morato et al. 2010). The islands and seamounts were formed approximately 43 million years ago by the subduction of the Pacific tectonic plate under the Philippine plate. The Mariana Trench is a unique feature created at this subduction zone. Also running in a north-south pattern located east of the island chain, the Mariana Trench is the deepest location on earth with its deepest point, the Challenger Deep, at 11,000 m, which is located just outside of the U.S. EEZ.

Since their formation, the islands have undergone complex changes including periods of volcanism, submarine and subaerial uplift, subsidence, and rifting, all of which have contributed to its heterogeneous surface composition and primarily flat uplifted limestone plateaus (WPRFMC 2009b). Habitats included in this area include coral reefs with wide diversity, deep reef slopes, banks and seamounts, and the deep ocean floor (WPRFMC 2009b). Coral reefs appear to have developed differently throughout the Mariana Archipelago based on the age and geology of the islands. Geological faulting of large areas in the older southern portion has created large, oblique shallow-water surfaces that have supported extensive reef growth and the development of reef flats and lagoons over time. In contrast, the islands in the north are younger with more vertical profiles that do not provide the basis for extensive reef development. Oceanic islands generally lack an extensive shelf area of relatively shallow water extending beyond the shoreline. Instead, most often have a deep reef slope, angled between 45 and 90 degrees toward the ocean floor. Species compositions along deep reef slopes, banks, and seamounts all can vary widely based on depth, light, temperature, and substrate. As a result, this spectrum of physical conditions creates a suite of different habitats that in turn support a variety of biological communities. At the end of the slope lies the deep ocean floor. While most of this dark and cold area is homogenous and low in productivity, there are hot spots where thermal vents spew hot water with relatively high concentrations of various metals and dissolved sulfide. Specialized bacteria found around such thermal vents can make energy from the sulfide and provide a nutrition source for a variety of other species (WPRFMC 2009b).

The primary surface current affecting CNMI and Guam is the North Equatorial Current (see Figure 3.1-2), which flows westward through the islands; however, the Subtropical Counter Current also influences the Northern Mariana Islands and generally flows in a easterly direction. Depending on the season, sea surface temperatures near the Northern Mariana Islands vary between 27.2 –29.4 °C and the mixed layer extends to depths of 300–400 ft (Eldredge 1983).

3.1.1.3 American Samoa Archipelago Research Area

The ASARA includes waters surrounding the American Samoa archipelago to a seaward extent of approximately 24 nm. The Samoa archipelago is located northeast of Tonga and consists of seven major volcanic islands, several small islets, and two coral atolls. The two largest islands in this chain, Upolu and Savaiʻi, are governed by the Independent State of Samoa and are not included in the ASARA. The five major inhabited islands of American Samoa are Tutuila, Aunuʻu, Ofu, Olosega, and Taʻu. The total land mass of American Samoa is about 200 km2 and surrounded by an EEZ of approximately 390,000 km2. The largest island, Tutuila, is nearly bisected by Pago Pago Harbor, the deepest and one of the most sheltered embayments in the South Pacific.

The region was believed to be relatively geologically inactive with few seamounts or guyots in comparison to other Polynesian states. New anecdotal evidence indicates that the region is volcanically active. The majority of islands rise from deep (4,000 m) oceanic depths (WPRFMC 2009c). In 2005, NOAA and the University of Hawaiʻi conducted research on undersea volcanoes and associated ecosystems between Hawaiʻi and New Zealand (WPRFMC 2009c). Using deep-sea submersibles scientists visited the volcanic hotspot at the Vailuluʻu Seamount located in American Samoa near Tutuila. The Vailuluʻu Seamount had been previously bathymetrically mapped; however, in the 6 years since the most recent mapping a 330-m tall volcanic cone, known as Nafanua, had grown in the seamount's crater. Scientists speculate this growth will continue and will breach the sea surface within decades forming a new island in the Samoan island group. The seamount cone has several different types of hydrothermal vents which provide habitat for an unusual group of organisms ranging from microbial mats to a species of polychaete worm and at the summit of Nafanua, a thriving population of eels (Dysommina rugosa) surviving on crustaceans imported to the system from the water column above (WPRFMC 2009c).

The primary surface current affecting ASARA is the Equatorial Current (see Figure 3.1-2), which flows westward through the islands. The ASARA experiences southeast trade winds that result in frequent rains and a warm tropical climate. The year-round air temperatures range from 70° to 90 degrees Fahrenheit (°F). Humidity averages 80 percent during most of the year. The average rainfall at Pago Pago International Airport is 130 inches per year, while Pago Pago Harbor, only 4.5 miles away, receives an average of 200 inches of rainfall per year (TPC/Dept. of Commerce, 2000). The effects of prominent meteorological features on the ecosystems and marine resources of the American Samoa Archipelago are unclear (WPRFMC 2009c).

3.1.1.4 Western Central Pacific Including the Pacific Remote Islands Research Area (WCPRA)

The WCPRA includes part of the high seas (i.e., international ocean waters) considered under the jurisdiction of the WCFPC. The WCPRA also includes the Pacific Remote Islands Area (PRIA) comprised of Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Atoll, and Palmyra Atoll. This large area essentially captures all past, present, and future PIFSC high seas research surveys (e.g., oceanography, longline gear research) that occur outside of the HARA, MARA, and ASARA, while also approximately aligning with various RFMOs and other geopolitical boundaries.

Baker Island is located approximately 13 miles north of the equator and approximately 1,600 nm to the southwest of Honolulu, Hawai‘i. It is a coral-topped seamount surrounded by a narrow-fringing reef that drops steeply close to shore and has an emergent land area of 1.4 km2. Howland Island is located approximately 48 miles north of the equator and 36 nm north of Baker Island. The island is an emergent top of a seamount, fringed by a relatively flat coral reef that drops off sharply, and has an emergent land area of 1.6 km2. Jarvis Island is approximately 1,300 miles south of Honolulu and 1,000 miles east of Baker Island. It is a relatively flat, sandy coral island with a total land area of 4.5 km2. Johnston Atoll is approximately 720 nm southwest of Honolulu. It is an egg-shaped coral reef and lagoon complex on a relatively flat, shallow platform of 205 km2. Kingman Reef is approximately 33 nm northwest of Palmyra Atoll. It consists of a series of fringing reefs around a central lagoon that does not have any emergent land to support vegetation. Wake Atoll is approximately 2,100 miles west of Hawai‘i and has a total land area of 6.5 km2 between three different islets. Palmyra Atoll is approximately 1,056 nm south of Honolulu and consists of 52 islets surrounding three central lagoons (WPRFMC 2009d).

Along with the above major islands and atolls, the Pacific Ocean contains nearly 25,000 islands which can be simply classified as high islands or low islands. High islands, like their name suggests, extend higher above sea level, and often support a larger number of flora and fauna and generally have fertile soil. Low islands are generally atolls built by layers of calcium carbonate secreted by reef building corals and calcareous algae on a volcanic core of a former high island that has submerged below sea level. Over geologic time, the rock of these low islands has eroded or subsided to where all that is remaining near the ocean surface is a broad reef platform surrounding a usually deep central lagoon (Nunn 2003).

The circulation of ocean water in the WCPRA and throughout the Pacific Ocean is a complex system primarily driven by solar radiation that results in wind being produced from the heating and cooling of ocean water and the evaporation and precipitation of atmospheric water (WPRFMC 2009d). Figure 3.1-2 shows the major surface currents of the Pacific Ocean. While the equatorial area has relatively consistent weather patterns and surface currents, variability within the ocean-atmosphere system still results in changes. One example in the Pacific Ocean is El Nino-Southern Oscillation (ENSO). ENSO is linked to climatic changes in normal prominent weather features of the Pacific and Indian Oceans, such as the location of the Intertropical Convergence Zone. ENSO, which can occur every 2–10 years, results in the reduction of normal trade winds, which reduces the intensity of the westward flowing equatorial surface current. In turn, the eastward flowing countercurrent tends to dominate circulation, bringing warm, low-salinity, low-nutrient water to the eastern margins of the Pacific Ocean. As the easterly trade winds are reduced, the normal nutrient-rich upwelling system does not occur, leaving warm surface water pooled in the eastern Pacific Ocean (WPRFMC 2009d).

As described in Table 2.2-1, a range of different surveys are conducted in the WCPRA under the Status Quo. These surveys could be divided into (1) ones that occur near the islands and atolls of the PRIA and (2) ones that occur far away from any islands or atolls, in deep, pelagic waters. Nearshore surveys include: Cetacean Ecology, Marine Debris Research and Removal, Coral Reef Benthic Habitat Mapping, Deep Coral and Sponge Research, Insular Fish Life History Survey and Studies, RAMP, and Lagoon Ecosystem Characterization. Off-shore surveys include: Sampling Pelagic Stages of Insular Species, Spawning Dynamics of Highly Migratory Species, Surface Night-Light Sampling, and Pelagic Oceanographic Cruise.

3.1.2 Special Resource Areas and EFH

Special resource areas within the PIFSC research areas include EFH (Section 3.1.2.1), HAPC (Section 3.1.2.2), MPAs (Section 3.1.2.3), and foreign or international MPAs (Section 3.1.2.4).

3.1.2.1 Essential Fish Habitat and Habitat Areas of Particular Concern

EFH is defined and established under the MSA (50 CFR part 600) and comprised of the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. 1802 sec. 3(10)). Waters include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. Substrate includes sediment, hard bottom, structures underlying the waters, and associated biological communities. Since EFH includes hard bottom structures and associated biological communities, it encompasses corals, seagrass, algae, and mangroves. Ecologically, EFH includes waters and substrate that focus distribution (e.g., migration corridors, spawning areas, rocky reefs) and other characteristics less distinct (e.g., turbidity zones, salinity gradients). EFH is not only a geographic area where a species occurs but an all-encompassing habitat designation.

Regulatory guidelines explain that EFH should be sufficient to “support a population adequate to maintain a sustainable fishery and the managed species’ contributions to a healthy ecosystem” (50 CFR 600, subpart J). EFH applies to federally managed species in both state and federal jurisdictional waters throughout the range of the species within U.S. waters. Where a species’ range extends beyond U.S. waters, EFH stops at the boundary. Therefore, no EFH exists outside of the U.S. EEZ.

The designation of EFH by itself does not confer any protection of the areas from non-fishing or fishing impacts. Instead, it is a tool used by managers, through a consultation process with NMFS, to reduce adverse impacts on EFH and improve fisheries management. It is described and identified in FMPs that are developed by regional FMCs. NMFS regional offices implement FMPs to facilitate long-term protection of EFH through conservation and management measures. Five current FMPs, termed FEPs, have been developed by the WPRFMC: Hawai‘i Archipelago FEP, Mariana Archipelago FEP American Samoa Archipelago FEP, Remote Pacific Island Areas FEP, and Pacific Pelagic FEP (WPRFMC 2009 a, b, c, d, e).

EFH may be designated separately for each major life history stage (e.g., eggs, larvae, juveniles, adults). EFH has been designated for all federal Management Unit Species (MUS) (i.e., Bottomfish and Seamount Groundfish, Pelagics, Crustaceans, Precious Corals, Coral Reef Ecosystem) in the Pacific Islands Region. Bottomfish and Seamount Groundfish MUS include snappers and other groundfish. Pelagic MUS include tunas, some oceanic sharks, billfishes, some squids, and other species. Lobsters, crab, and shrimp comprise Crustacean MUS. Various pink/red, gold, bamboo, and black corals are considered Precious Coral MUS. A more detailed description of the species within each MUS is described in Sections 3.2.1 (fish) and 3.2.5 (invertebrates). A wide variety of currently harvested and potentially harvested coral reef taxa are Coral Reef Ecosystem MUS.

The EFH provisions of the MSA recommend that specific areas of habitat within EFH are identified as "habitat areas of particular concern." HAPC are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. FMCs may designate a specific habitat area as a HAPC for one or more of the following reasons: the importance of the ecological function provided by the habitat; the extent to which the habitat is sensitive to human-induced environmental degradation; whether and to what extent development activities are, or will be, stressing the habitat type; or the rarity of habitat type.

The intended goal of identifying HAPC is to focus conservation efforts on the most important areas. While the HAPC designation does not trigger any specific regulatory process or confer any specific protection, it highlights certain habitat types that are of high ecological value. This designation is manifested in EFH consultations, during which NMFS can recommend protective measures for specific HAPC.

Several FMCs have designated discrete habitat areas as HAPC, while others have broadly designated all areas of a specific habitat type as HAPC. The WPRFMC has designated HAPC for bottomfish, pelagic species, crustaceans, precious corals, and coral reef ecosystem species. No HAPC has been designated for seamount groundfish or deep-water shrimp.

Table 3.1-1 summarizes the EFH and HAPC for the five management units. The combined EFH includes all bottom habitat to a depth of 400 m and the water column to a depth of 1,000 m between the shoreline and outer limit of the EEZ. Additional EFH for seamount groundfish species includes bottom habitat within the EEZ to a depth of 600 m bounded by latitude 29°-35° N and longitude 171°-179° W. Additional EFH for deep-water shrimp species includes outer reef slopes within the EEZ to a depth of 700 m. On February 12, 2016, NMFS published a proposed rule to revise EFH and HAPC for Hawaiʻi bottomfish and seamount groundfish in the Hawaiian Archipelago (81 FR 7494). In a letter dated April 21, 2016, NOAA's Pacific Islands Regional Administrator approved Amendment 4 to the Hawaiian Archipelago FEP (RIN 0648-XD907). Amendment 4 revised EFH and HAPC for 14 species of bottomfish and three species of seamount groundfish. EFH has been designated for all the federally managed species referred to as the "management unit species" in the Pacific Islands Region. For more in-depth information on EFH and HAPC in the Pacific Islands Region, refer to the appropriate FEPs (WPRFMC 2009a,b,c,d,e). Boundaries for EFH in the HARA, MARA, and ASARA are presented in Figures 3.1-3 to 3.1-5.

Table 3.1-1 EFH and HAPC Designations by MUS in the Pacific Islands Region

All areas bounded by the shoreline and the seaward boundary of the EEZ unless otherwise indicated.

MUS	Species Complex	EFH	HAPC
Bottomfish and Seamount Groundfish	Shallow-water species (0-100 m): e.g., groupers, snappers, jacks (genera Lethrinus, Lutjanus, Epinephelus, Aprion, Caranx, Variola, Cephalopholis) Deep-water species (100-400 m): e.g., snappers, groupers (genera Pristipomoides, Etelis, Aphareus, Epinephelus, Cephalopholis)	For bottomfish eggs and larvae: the water column from shoreline out to the EEZ to a depth of 400 m For seamount groundfish: water column to 200 m depth of all EEZ waters bounded by 29 – 35 ° N 171° E-179° W Juveniles and adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 m	All slopes and escarpments from 40-280 m deep and three known areas of juvenile opakapaka habitat: two off O‘ahu and one off Moloka‘i

	Seamount groundfish species (100-400 m): armorhead (Pseudopentaceros richardsoni), ratfish/butterfish (Hyperoglyphe japonica), alfonsin (Beryx splendens)	Eggs, larvae, and juveniles: the epipelagic zone (0-200 m) of all waters bounded by latitude 29°-35° N and longitude 171° E-179° W Adults: water column and bottom habitat bounded by latitude 29°-35° N and longitude 171° E-179° W from 80-600 m deep	No HAPC designated for seamount groundfish

Pelagic	Temperate and tropical fish: e.g., tunas (genera Thunnus, Euthynnus, Katsuwonus, Auxis, Gymnosarda, Allothunnus), billfishes (genera Makaira, Tetrapturus, Istiophorus, Xiphias), pomfret (family Bramidae), other pelagics (genera Coryphaena, Acanthocybium, Lampris, Scomber) Sharks: genera Alopias, Carcharhinus, Prionace, Isurus, Lamna Squid: Ommastrephes bartamii, Thysanoteuthis rhombus, Sthenoteuthis oualaniensis	Eggs and larvae: water column down to 200 m depth within the EEZ Juveniles and adults: water column down to 1,000 m depth	Water column down to 1,000 m that lies above seamounts and banks with summits shallower than 2,000 m

Crustaceans	Spiny and slipper lobster complex: genera *Panulirus, Scyllarides, Parribacus* Kona crab : *Ranina ranina* Deepwater shrimp: *Heterocarpus* spp.	Lobsters/crab: water column down to 150 m depth from shoreline out to EEZ boundary. Deepwater shrimp: outer reef slopes between 300-700 m depth.	Lobsters/crab: bottom from shoreline down to 100 m depth Deepwater shrimp: outer reef slopes between 550-700 m depth
Precious Corals	Deep-water precious corals (300-1,500 m): e.g., pink/red, gold, and bamboo corals from genera *Corallium, Gerardia, Callogorgia, Narella, Calyptrophora, Lepidisis, Acanella*	Known precious coral beds in the Hawaiian Islands located at: Keāhole point, between Miloli‘i and South Point, the ‘Au‘au Channel, Makapu‘u, Ka‘ena point, the southern border of Kaua‘i, Wespac bed, Brooks bank bed, and 180 Fathom Bank.	Includes the Makapu‘u bed, Wespac bed, Brooks Banks bed
	Shallow-water precious corals (20-100 m): black corals (*Antipathes dichotoma, A. ulex, Antipathis grandis*)	Three known black coral beds in the Main Hawaiian Islands between Miloli‘i and South Point on Hawai‘i Island, the ‘Au‘au Channel, and the southern border of Kaua‘i	For black corals, the ‘Au‘au Channel has been identified as an HAPC
Coral Reef Ecosystems	Currently Harvested Coral Reef Taxa Potentially Harvested Coral Reef Taxa	The water column and all benthic substrate to a depth of 100 m within the EEZ	The water column and all benthic substrate to a depth of 100 m within the EEZ

Source: WPRFMC 2009a,b,c,d,e

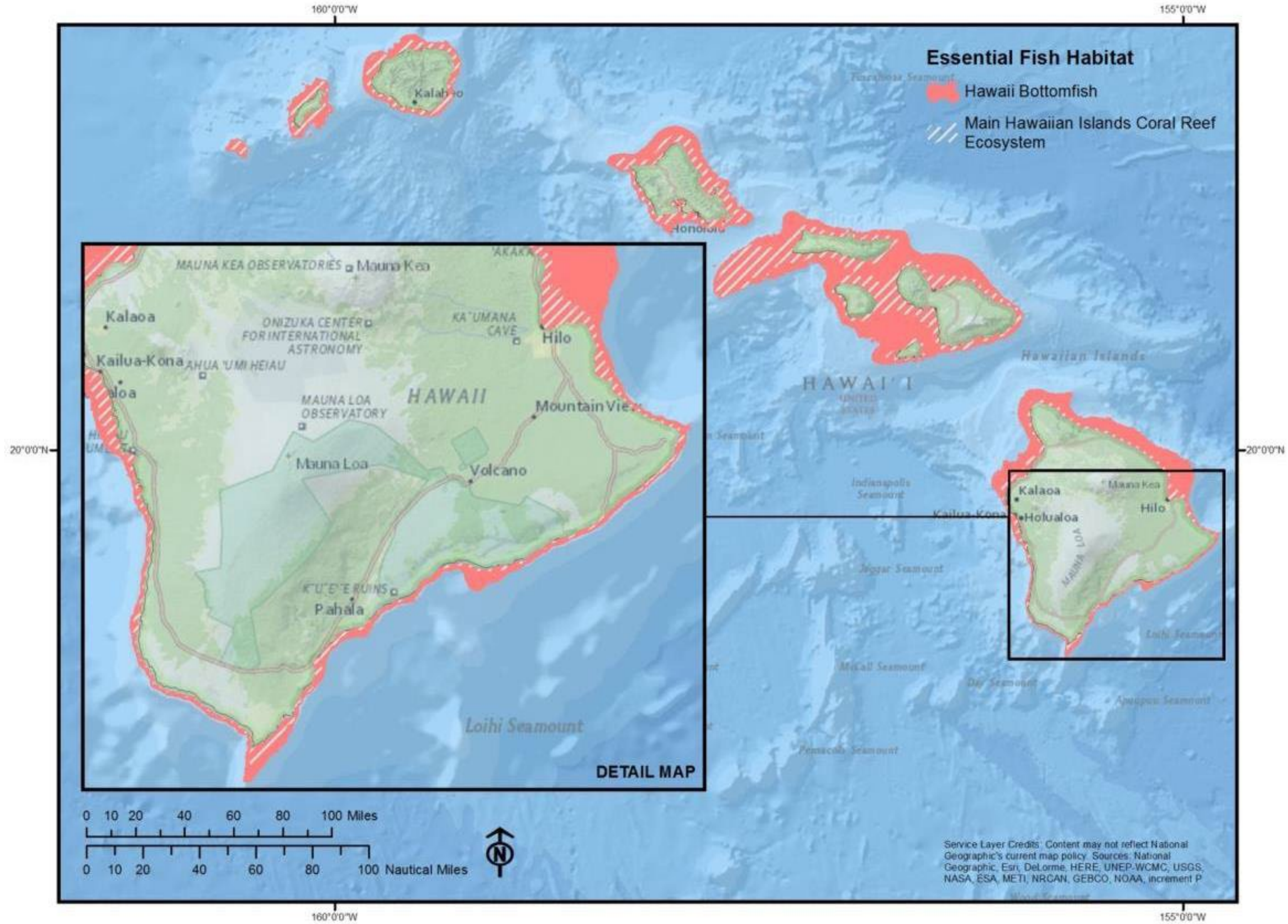


Figure 3.1-3 EFH for HARA

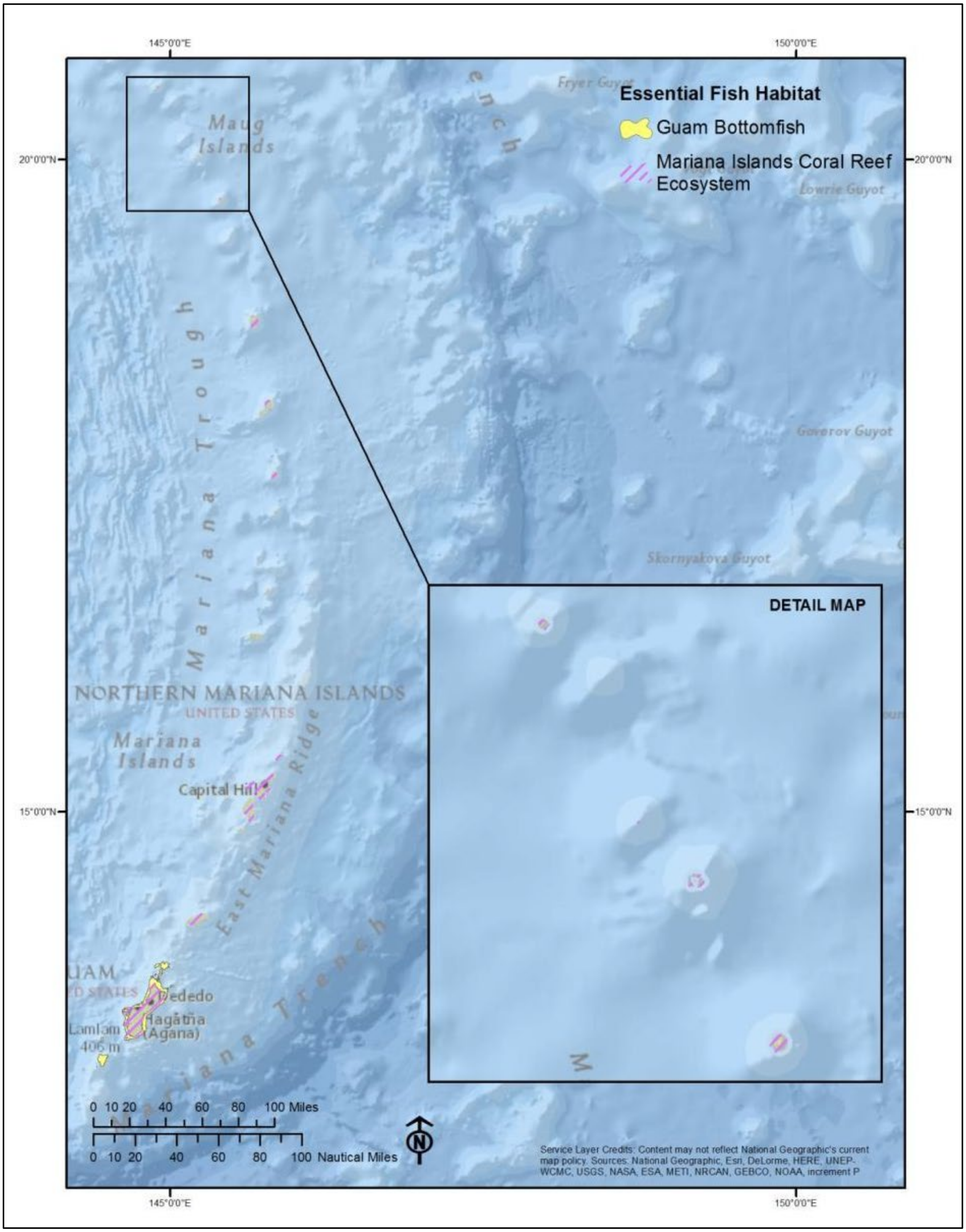


Figure 3.1-4 EFH for MARA

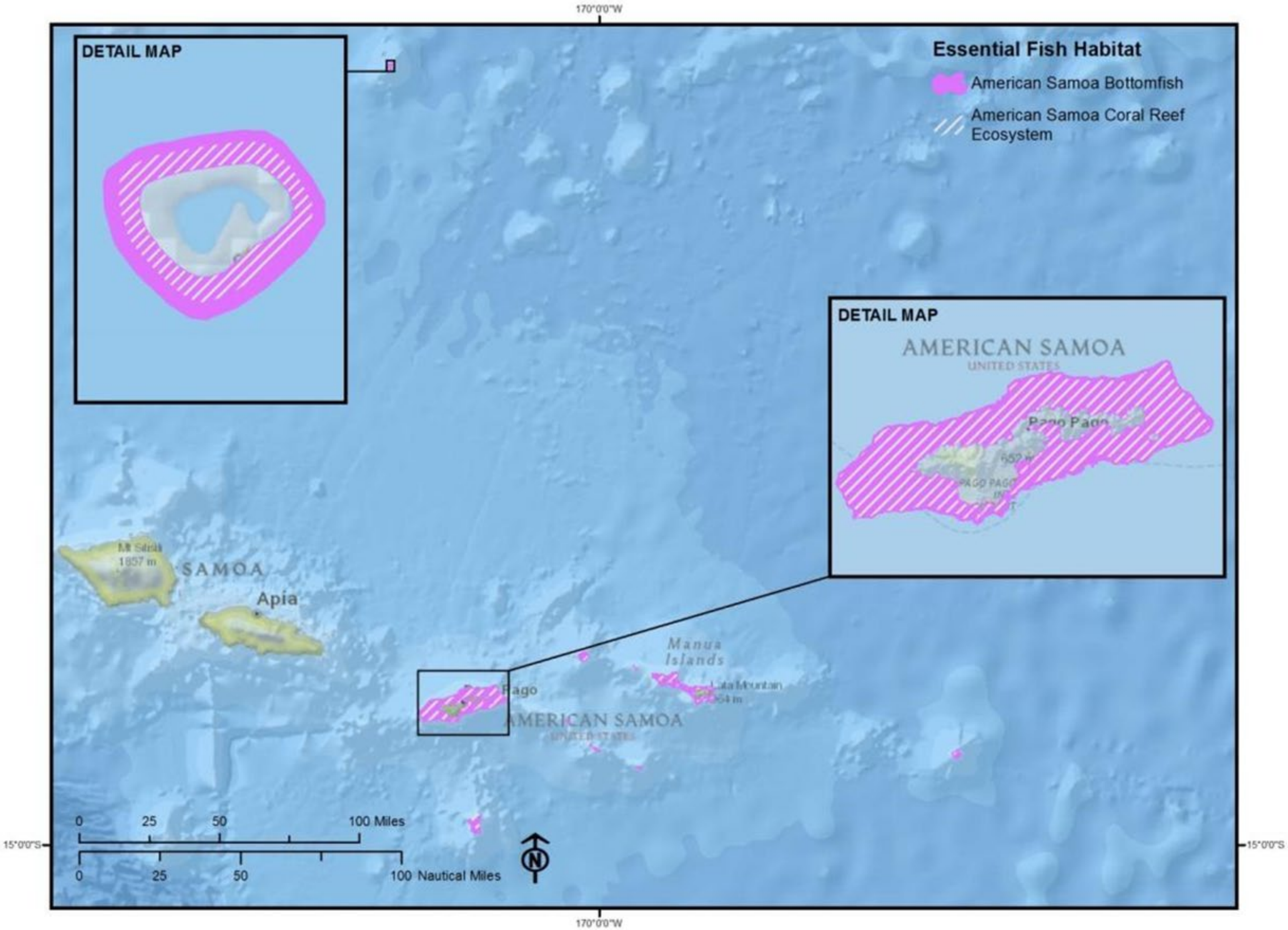


Figure 3.1-5 EFH for ASARA

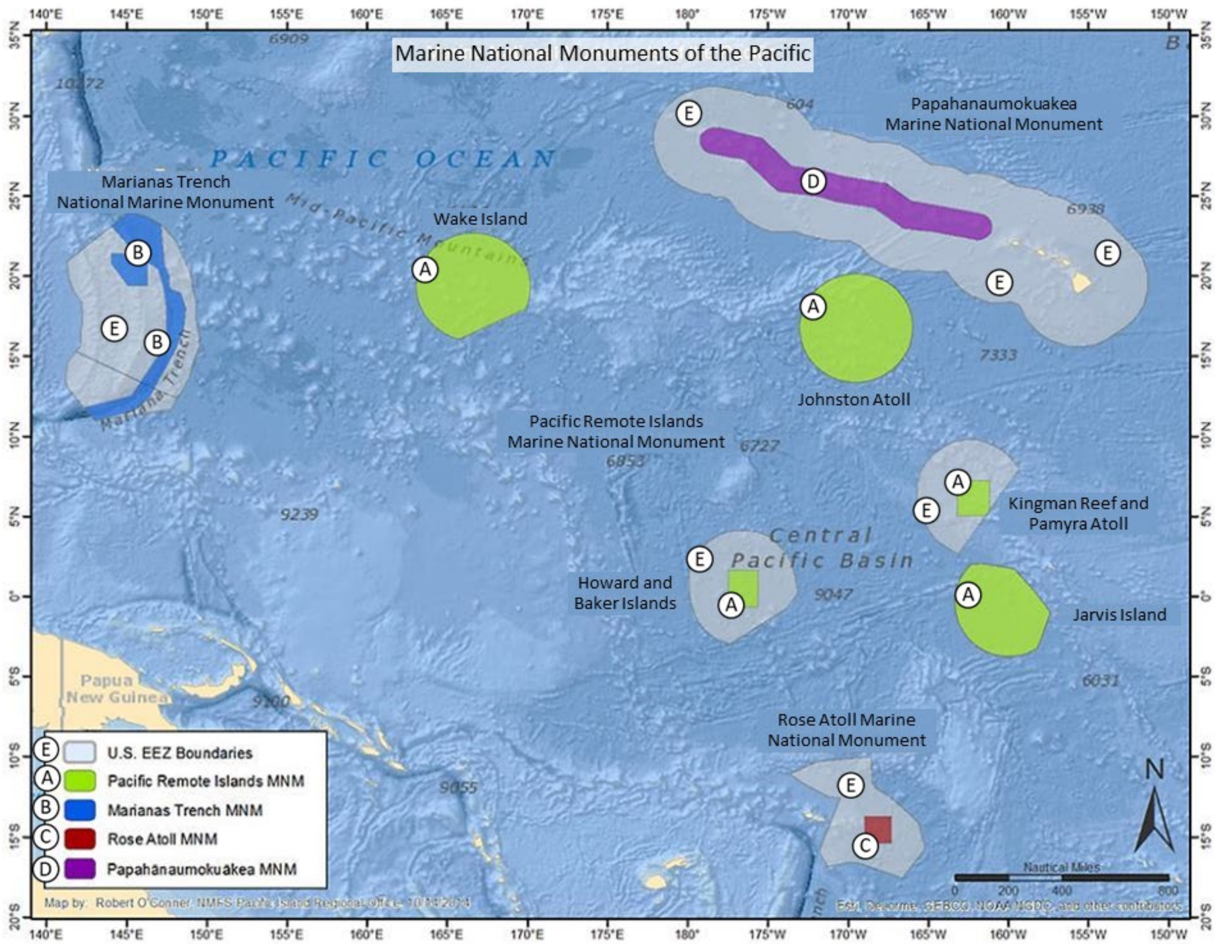
3.1.2.2 Marine Protected Areas

A MPA is defined by EO 13158 as "any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." They are a group of sites, networks, and systems established and managed by federal, state, tribal, and local governments. Most MPAs have legally established goals, conservation objectives, and intended purposes.

MPAs can be found throughout the PIFSC research areas and are considered an essential part of marine resource management. MPAs also provide a valuable control site for many different types of research projects given their protected status. MPAs in the region include state reserves, no-take marine life conservation districts, fishery management areas (FMAs), refuges, national parks, MNMs, and NMSs. For many of the island regions there are overlapping protections, which can create complex management issues. MPAs vary widely in the level and type of legal protection afforded to the site's natural and cultural resources and ecological processes. Many of the MPAs within the action area impose various types of prohibitions (e.g., fishing restrictions). Additional details of MPAs located within the U.S. EEZ, such as geographical coordinates, can be found on the List of National System MPAs (NOAA 2013a).

U.S. Marine National Monuments

National monuments are designated by Presidential Proclamation, under the authority of the Antiquities Act of 1906. The Antiquities Act provides broad power to set aside lands and waters of the United States for protection and requires no public process. MNMs are located within the Pacific Islands Region (Figure 3.1-6) and together they encompass approximately 557,947 square miles of water.



Source: https://www.fisheries.noaa.gov/region/pacific-islands

Figure 3.1-6 MNM in the Pacific Islands Region

Papahānaumokuākea Marine National Monument

On December 4, 2000, the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (NWHICRER) was created by EO 13178 to encompass 137,792 square miles of marine water and submerged lands of the NWHI, pursuant to the NMSA. As part of the establishment of NWHICRER, EO 13178 contains conservation measures that restrict certain activities, and establishes Reserve Preservation Areas around some islands, atolls, and banks where all consumptive or extractive uses are prohibited. On January 18, 2001, after the 30-day comment period, the process and establishment of the reserve was finalized by issuance of EO 13196. This modified EO 13178 by revising certain conservation measures and making permanent the Reserve Preservation Areas, with modifications. NOAA had initiated the process to designate NWHICRER as a national marine sanctuary under the NMSA, when President George W. Bush signed Presidential Proclamation No. 8031 in June 2006 establishing the Northwestern Hawaiian Islands MNM.

Presidential Proclamation 8112 renamed the NWHI as Papahānaumokuākea MNM in 2007 and the monument was added to the World Heritage list in July 2010. On August 26, 2016, President Obama signed a proclamation expanding Papahānaumokuākea MNM to 582,578 square miles making it the largest contiguous protected conservation area under the U.S. flag. The national monument designation superseded the Midway NWR, the proposed NWHI NMS, the NWHI Coral Reef Ecosystem Reserve, and the NWHI Bird Refuge. The monument is administered jointly by four co-trustees: (1) the Department of Commerce through NOAA's ONMS and NMFS PIRO; (2) the Department of the Interior through USFWS's Pacific Region National Wildlife Refuge System, Pacific Islands Fish and Wildlife Office; (3) the State of Hawaiʻi Department of Land and Natural Resources (DLNR); and (4) the Office of Hawaiian Affairs (OHA).

Within Papahānaumokuākea MNM, Proclamation No. 8031 allows the Secretary of Commerce and the Secretary of the Interior to prohibit access into the monument and certain activities unless a permit is acquired (50 CFR 404.11). Permits can be issued for research, education, conservation and management, Native Hawaiian practices, special ocean uses, and recreational activities. Commercial fishing was prohibited in the monument in 2011, 5 years from the date of the monument designation. The prohibitions for monument access do not apply to activities and exercises of the Armed Forces (including those carried out by the USCG); for emergencies threatening life, property, or the environment; or to activities necessary for law enforcement purposes.

The Papahānaumokuākea MNM is also home to many cultural and historic sites. Many Native Hawaiian cultural sites are found on the islands of Nihoa and Mokumanamana, both of which are on the National Register of Historic Places. Midway Atoll includes several National Historic Landmarks on Eastern and Sand Islands that document the Battle of Midway during World War II (WWII) (National Park Service [NPS] 2014).

Rose Atoll Marine National Monument

On January 6, 2009, Presidential Proclamation 8337 established the Rose Atoll MNM, which consists of approximately 13,451 square miles of emergent and submerged lands and waters of and around the Rose Atoll in American Samoa. The Secretary of the Interior has management responsibility for the monument, including Rose Atoll NWR in consultation with the Secretary of Commerce. The Secretary of Commerce, through NOAA, has the primary management responsibility regarding management of marine areas and, as directed by Presidential Proclamation 8337, incorporated the marine waters of the monument and waters surrounding the Vailuluʻu Seamount into the National Marine Sanctuary of American Samoa (NMSAS) on July 26, 2012 (15 CFR 922). Additionally, the designated lands and submerged lands in the lagoon of the Rose Atoll NWR at the center of the monument are managed by the USFWS. However, for both the refuge and the sanctuary, the monument designation is the dominant federal withdrawal. The Proclamation also directs the Secretaries, in consultation with the Government of American Samoa, to ensure that recreational fishing is managed as a sustainable activity.

Per Proclamation 8337, certain scientific research efforts may be conducted within the monument: Subject to such terms and conditions as the Secretaries deem necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study, and the Secretary of Commerce may permit fishing within the monument for scientific exploration and research purposes to the extent authorized by the Magnuson-Stevens Fishery Conservation and Management Act. The prohibitions required by this proclamation shall not restrict scientific exploration or research activities by or for the Secretaries, and nothing in this proclamation shall be construed to require a permit or other authorization from the other Secretary for their respective scientific activities.

Marianas Trench Marine National Monument

In 2009, President Bush established the Marianas Trench MNM, through Presidential Proclamation 8335, setting aside approximately 95,216 square miles of submerged lands and waters. The monument includes three units: the Islands Unit, the waters and submerged lands of the three northernmost Mariana Islands; the Volcanic Unit, the submerged lands within one nautical mile of 21 designated volcanic sites; and the Trench Unit, the submerged lands extending from the northern limit of the EEZ in the CNMI to the southern limit of the EEZ in the Territory of Guam. No waters are included in the Volcanic and Trench Units, and the CNMI maintains all authority for managing the three islands within the Islands Unit (Farallon de Pajaros, also known as Uracas; Maug; and Asuncion) above the mean low water line.

Proclamation 8335 assigned management responsibility of the monument to the Secretary of the Interior, in consultation with the Secretary of Commerce. The Secretary of the Interior delegated management responsibility to the USFWS. The Secretary of Commerce, through NOAA, was assigned primary management responsibility with respect to fishery-related activities in the waters of the Islands Unit, where commercial fishing is prohibited. Sustenance, recreational, and traditional indigenous fishing are allowed within the Islands Unit after consultation with the Government of CNMI. The Secretaries have also established a Mariana Trench Monument Advisory Council to provide advice and recommendations on the development of management plans and management of the monument.

Per Proclamation 8335, certain scientific research efforts may be conducted within the monument: Subject to such terms and conditions as the Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study, and the Secretary of Commerce may permit fishing within the monument for scientific exploration and research purposes to the extent authorized by the Magnuson-Stevens Fishery Conservation and Management Act. The prohibitions required by this proclamation shall not restrict scientific exploration or research activities by or for the Secretaries, and nothing in this proclamation shall be construed to require a permit or other authorization from the other Secretary for their respective scientific activities.

Pacific Remote Islands Marine National Monument

On January 6, 2009, Presidential Proclamation 8336 established the Pacific Remote Islands MNM. The monument consists of Baker, Howland, Jarvis Islands, Wake Atoll, Johnston Atoll, Kingman Reef, and Palmyra Atoll which lie to the south and west of Hawaiʻi. It incorporates approximately 86,888 square miles within its boundaries, which extend 50 nm from the mean low water lines of the encompassed islands, reefs, and atolls. The land areas at Wake and Johnston Atolls remain under the jurisdiction of the U.S. Air Force. Due to its significance during WWII, Wake Atoll is also a registered National Historic Landmark. For all of the areas, fishery-related activities seaward from the 12-nm refuge boundaries out to the 50-nm monument boundary are managed by NOAA. Proclamation 8336 permits noncommercial fishing at specific locations upon request as well as noncommercial fishing currently allowed by the USFWS at Palmyra Atoll until the Secretary of the Interior determines that this would be incompatible with the purposes of the Palmyra Atoll NWR. On September 25, 2014, the Pacific Remote Islands MNM was expanded from 50 nm to 200 nm for Jarvis Island, Wake Atoll, and Johnston Atoll.

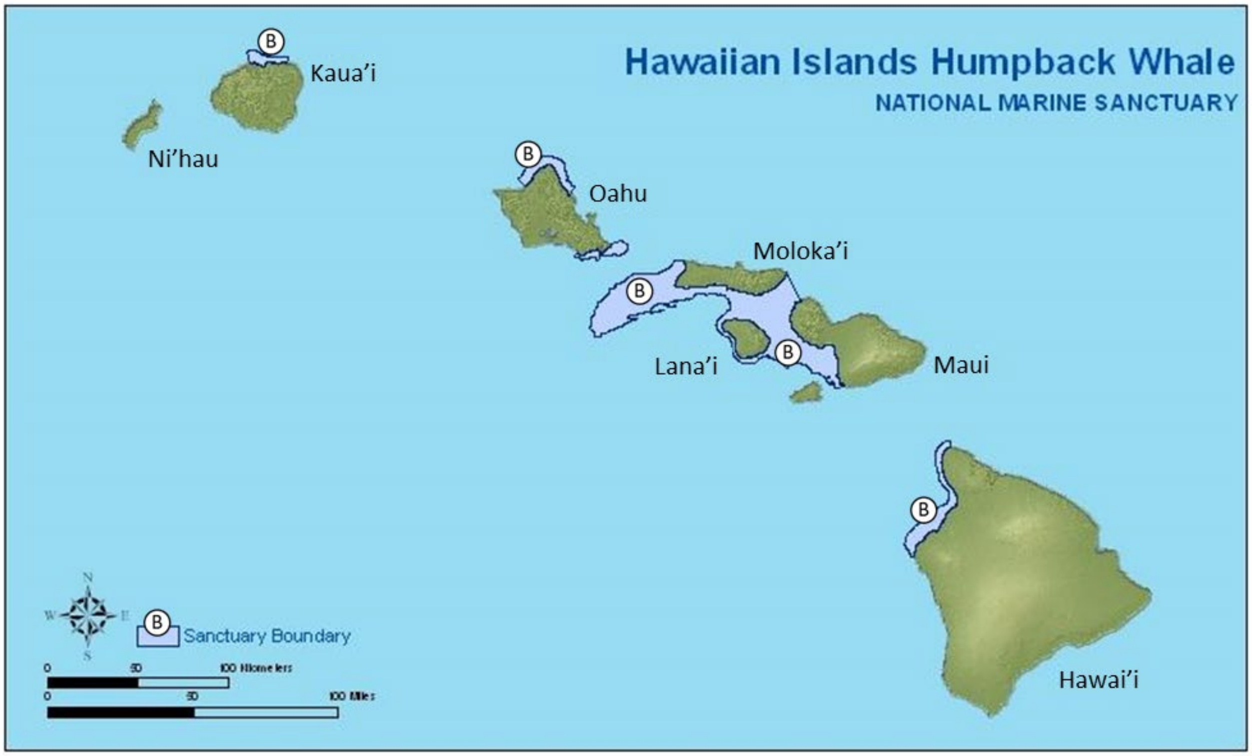
Per Proclamation 8336, certain scientific research efforts may be conducted within the monument: Subject to such terms and conditions as the respective Secretary deems necessary for the care and management of the objects of this monument, the Secretary of the Interior may permit scientific exploration and research within the monument, including incidental appropriation, injury, destruction, or removal of features of this monument for scientific study, and the Secretary of Commerce may permit fishing within the monument for scientific exploration and research purposes to the extent authorized by the Magnuson-Stevens Fishery Conservation and Management Act. The prohibitions required by this proclamation shall not restrict scientific exploration or research activities by or for the Secretaries, and nothing in this proclamation shall be construed to require a permit or other authorization from the other Secretary for their respective scientific activities.

U.S. National Marine Sanctuaries

The NMSA authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as NMSs. Day-to-day management of NMSs has been delegated by the Secretary of Commerce to NOAA's ONMS. The primary objective of the NMSA is to protect marine resources, such as coral reefs, sunken historical vessels, and unique habitats. The National Marine Sanctuary System consists of 14 MPAs that encompass more than 150,000 square miles of marine and Great Lakes waters. Descriptions of the two Pacific Island sanctuaries are provided below.

Hawaiian Islands Humpback Whale National Marine Sanctuary

The Hawaiian Islands Humpback Whale NMS spans 1,370 square miles and is located within waters from the shoreline to the 100-fathom (180-m) isobath around the islands of Hawai‘i, Maui, Moloka‘i, Lana‘i, and parts of O‘ahu and Kaua‘i (Figure 3.1-7). The Hawaiian Islands Humpback Whale NMSs purpose is to protect humpback whales and their habitat and manage human uses within the sanctuary. The sanctuary's management plan and designation document do not provide for the management of fishing operations (NOAA 2002). Pursuant to NMSA, NOAA must periodically review management plans for each marine sanctuary. During the sanctuary's first management plan review in 2002, numerous public comments requested the sanctuary to increase its scope to include conservation and management of other marine resources and species. In 2007, the Governor of Hawai‘i approved a document, presented by the sanctuary, for the consideration of additional marine resources for inclusion in the sanctuary. As part of the current management plan review, which began in 2010, the Ecosystem Protections Working Group was established to consider the inclusion of additional marine resources. In 2012, the working group recommended "the Hawaiian Islands Humpback Whale NMS future management plan adopts an integrated approach that considers the entire ecosystem, including humans within the currently designated sanctuary boundaries" (Hawaiian Islands Humpback Whale NMS Advisory Council 2012). Regulations governing access and uses within the Hawaiian Islands Humpback Whale NMS can be found in 15 CFR Part 922 Subpart Q.



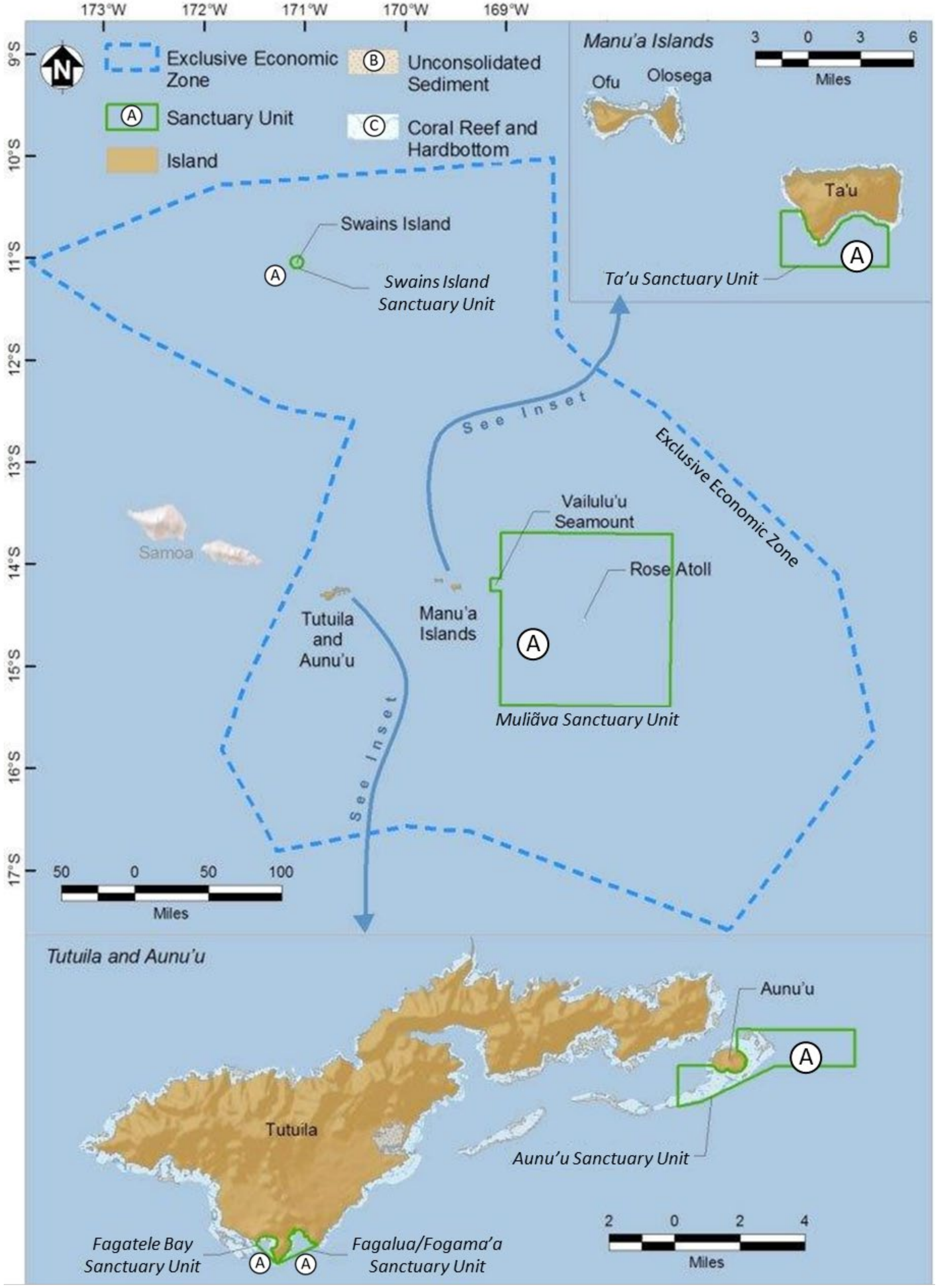
Source: http://hawaiihumpbackwhale.noaa.gov/documents/images/boundary6.jpg

Figure 3.1-7 Hawaiian Islands Humpback Whale NMS

National Marine Sanctuary of American Samoa

The NMSAS is comprised of six protected areas covering 13,581 square miles of nearshore coral reef and offshore open-ocean waters across the Samoan Archipelago (Figure 3.1-8). The sanctuary was originally designated as Fagatele Bay National Marine Sanctuary in 1986 in response to a proposal from the American Samoa Government to the National Marine Sanctuary Program. The original sanctuary included 0.25 square miles of coral reef ecosystems within Fagatele Bay off the southwest coast of Tutuila Island. In 2012, NOAA expanded the sanctuary to include Fagalua/ Fogama‘a (the next bay east of Fagatele); areas at Aunu‘u, Ta‘u, and Swains islands; and Rose Atoll (called Muliāva in Samoan), which includes the nearby Vailulu‘u Seamount. This is the largest and most remote of the NMSs and includes the only true tropical reef in the sanctuary program. Various activities and gear types are allowed or prohibited on a sanctuary-wide or unit-specific basis. Scientific research that involves otherwise prohibited activities may be permitted by the Director of the ONMS. Per Presidential Proclamation 8337, the Departments of Commerce and the Interior do not need permits to conduct scientific activities within the Muliāva unit (see description of Rose Atoll MNM in Section 3.1.2.3).

Regulations governing access and uses within the NMSAS can be found in 15 CFR Part 922 Subpart J.



Source: http://sanctuaries.noaa.gov/pgallery/atlasmaps/images/as_lg.jpg

Figure 3.1-8 National Marine Sanctuary of American Samoa

U.S. National Parks

The National Park Service (NPS) has jurisdiction over several National Parks and Historic Sites in the Pacific Islands Region that include marine waters within the scope of analysis. The War in the Pacific National Historical Park in Guam, American Memorial Park in the Northern Mariana Islands as well as the Puʻuhonua o Hōnaunau National Historical Park and Kaloko Honokohau National Historic Park in Hawaiʻi are focused on preserving important cultural and historical sites but within each park's boundaries are ecologically important coral reefs and seagrass beds. The National Park of American Samoa has jurisdiction over several thousand acres of coral reefs along coastlines within park units in American Samoa. The NPS manages these waters as MPAs, however, some fishing is allowed.

U.S. Fish and Wildlife Refuges

Nine individual NWRs are scattered across the Pacific Islands Region. USFWS's primary objective with designated refuges is to conserve and manage fish, wildlife, and plant resources and habitats for the benefit of present and future generations. At the turn of the 20th Century, uninhabited atolls in the central Pacific Ocean were heavily exploited by feather poachers and guano miners. Between 1897 and 1914, over 3.5 million seabirds were killed in the islands in the central Pacific Ocean to supply feathers for the millinery trade (Spennemann 1998). Human activity also led to the introduction of invasive species such as rats, feral cats, and rabbits, which resulted in further environmental degradation. At each of the refuges, USFWS has played an important role in controlling and eradicating invasive species, terrestrial plant restoration, monitoring ecosystem recovery, and managing seabirds and migratory birds. Each of the Pacific Islands refuge within the scope of analysis is addressed below.

Hawaiian Islands NWR spans 254,418 acres of islands, reefs, and atolls from Nihoa to Pearl and Hermes Atoll. It was originally established as the Hawaiian Islands Bird Reservation in 1909 by President Theodore Roosevelt in response to the slaughter of millions of seabirds by poachers. In 1940, President Franklin Delano Roosevelt renamed it the Hawaiian Islands National Wildlife Refuge. When the refuge became part of the Papahānaumokuākea MNM (see Section 3.1.2.3) in 2006, all activities within the refuge became subject to restrictions and permitting established to protect wildlife and marine resources within the monument (NOAA 2014a).

Johnston Atoll NWR was first established as a federal bird refuge in 1926, through EO 4467. The refuge included Johnston and Sand Islands, which totaled approximately 100 acres of emergent lands. In 1934, through EO 6935, the atoll was placed under the jurisdiction of the Navy for administrative purposes and has been used as a military installation since 1939. In 1941, EO 8682 designated Johnston and other Pacific atoll NDSAs (see Section 3.1.2.3). Since 1976, the USFWS, under agreement with the military, assists in the management of fish and wildlife resources on the atoll. In 2009, the refuge became part of the Pacific Remote Islands MNM (see Section 3.1.2.3).

Rose Atoll NWR is part of American Samoa and is located approximately 78 miles east-southeast of Tau Island in the Manua Group of islands. The exterior boundary of Rose Atoll NWR is the extreme low waterline outside of the perimeter reef (i.e., the terrestrial lands and interior lagoon of the atoll). The refuge was established through a cooperative agreement between the Territory of American Samoa and the USFWS in 1973 and is under the joint jurisdiction of the Departments of Commerce and Interior, in cooperation of the Territory of American Samoa. On January 6, 2009, Rose Atoll MNM was established, which includes Rose Atoll NWR within its boundaries.

In 2012, the refuge became part of the NMSA, as directed by Presidential Proclamation 8337, the monument designation document.

Jarvis Island NWR has been administered by USFWS as an NWR since 1974. Originally, the refuge encompassed 1,273-acre Jarvis Island and the surrounding waters out to 3 nm. In 2009, the refuge was expanded to include submerged lands within 12 nm (22 km) of the island. Jarvis Island NWR is closed to the public but scientific research may be allowed through a Special Use Permit. In 2009, the refuge became part of the Pacific Remote Islands MNM (see Section 3.1.2.3).

Baker Island NWR has been administered by USFWS as an NWR since 1974. Originally, the refuge encompassed 531-acre Baker Island and the surrounding waters out to 3 nm. In 2009, the refuge was expanded to include submerged lands within 12 nm (22 km) of the island. Baker Island NWR is closed to the public, but scientific research may be allowed through a Special Use Permit. In 2009, the refuge became part of the Pacific Remote Islands MNM (see Section 3.1.2.3).

Howland Island NWR has been administered by USFWS as an NWR since 1974. Originally, the refuge encompassed 400-acre Howland Island and the surrounding waters out to 3 nm. In 2009, the refuge was expanded to include submerged lands within 12 nm of the island. Howland Island NWR is closed to the public, but scientific research may be allowed through a Special Use Permit. In 2009, the refuge became part of the Pacific Remote Islands MNM (see Section 3.1.2.3).

Midway Atoll NWR is located in the NWHI and was established under EO 13022 in 1996 with a refuge boundary of approximately 12 miles seaward from the shoreline. The refuge encompasses 590,991 acres of submerged lands and waters. In 1941, the Navy established a Naval Air Facility at Midway followed by the creation of an overlay refuge by the USFWS in 1988 to manage fish and wildlife on the atoll. The Naval Air Facility was closed in 1993 and the property was transferred to the USFWS in 1996. In 2006, the refuge became part of the Papahānaumokuākea MNM (see Section 3.1.2.3).

Palmyra Atoll NWR is a limited take MPA that includes 680 acres of emergent lands and approximately 515,232 acres of submerged lands and associated waters, out to its 12-nm boundary. The refuge was established in 2001 (66 FR 7660). Palmyra Atoll NWR is closed to commercial fishing but limited recreational bonefishing and sportfishing are permitted. In 2009, the refuge became part of the Pacific Remote Islands MNM (see Section 3.1.2.3).

Kingman Reef NWR is a no-take MPA that includes 3 acres of emergent reef and 483,754 acres of submerged reefs and associated waters, out to its 12-nm. The United States annexed the reef in 1922; and in 2001, it was established as a NWR (66 FR 7660). Kingman Reef NWR is closed to the public, but research and biological surveys may be allowed through a Special Use Permit. In 2009, the refuge became part of the Pacific Remote Islands MNM (see Section 3.1.2.3).

<u>Department of Defense Naval Defensive Sea Areas</u>

Multiple EOs have provided administrative authority over territories and possessions to the U.S. military for use as airfields and for weapons testing. Of note, EO 8682 of 1941 authorizes the Secretary of the Navy to control entry into the NDSAs around Johnston Atoll, Wake Atoll, Kingman Reef, and Midway Atoll. These NDSAs include “territorial waters between the extreme high-water marks and the three-mile marine boundaries.” The objectives of NDSAs are to control entry into naval defensive sea areas; to provide for the protection of military installations; and to protect the physical security of, and ensure the full effectiveness of, bases, stations, facilities, and other installations (32 CFR Part 761). In addition, the Navy has joint administrative authority with the USFWS of Johnston Atoll and has recently transferred administrative authority over Kingman Reef to the USFWS. The Wake Atoll NDSA has been suspended until further notice. Additionally, EO 13022 rescinded the Midway Atoll NDSA.

State and Territorial MPAs

In addition to federally managed MPAs, there is a variety of local state and territorial MPAs in the PIFSC research areas. Table 3.1-2 provides an overview of these local MPAs. Detailed information on each of these MPAs is provided in the proceeding paragraphs.

Table 3.1-2 Local MPAs within the Pacific Islands Region

MPA Description	Size (km^2)	Restricted Activities
HAWAIʻI		
Hanauma Bay Marine Life Conservation District (MLCD)	0.41	Closed to all taking or injuring of marine life, fish feeding, and operation of any watercraft
Pūpūkea MLCD	0.71	Closed to all taking or injuring of marine life and snagging of any akule while fishing from shoreline of Waimea Bay
Waikīkī MLCD	0.31	Closed to all taking or injuring of marine life
Kealakekua Bay MLCD	1.24	Closed to all taking or injuring of marine life, and fish feeding
Lapakahi MLCD	0.59	Closed to all taking or injuring of marine life, and fish feeding
Old Kona Airport MLCD	0.88	Closed to all taking or injuring of marine life, fish feeding, anchoring watercraft in the "No Boating Zone" and commercial diving
Waialea Bay MLCD	0.14	Closed to all taking or injuring of marine life, and fish feeding
Waiopae Tidepools	0.2	Closed to all taking or injuring of marine life, anchoring or mooring of any vessel, and commercial activities
Honolua-Mokuleʻia Bay MLCD	0.18	Closed to all taking or injuring of marine life
Manele-Hulopoʻe MLCD	1.25	Closed to all taking or injuring of marine life, and restrictions to anchoring and mooring
Molokini Shoal MLCD	0.31	Closed to all taking or inuring of marine life, fish feeding, and mooring boats for commercial use
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS (CNMI)		
Managaha Marine Conservation Area	5	Closed to all taking, fishing, and collecting
Forbidden Island Marine Sanctuary	2.53	Closed to all taking, fishing, and collecting
Bird Island Marine Sanctuary	1.47	Closed to all taking, fishing, and collecting
Sasanhaya Fish Reserve	0.84	Closed to all taking, fishing, and collecting; no anchoring within the Reserve
Tinian Marine Reserve Area	~5	Removal, disturbance, damage, or destruction of any marine life is prohibited except that seasonal fish may be removed during seasons

MPA Description	Size (km^2)	Restricted Activities
GUAM		
Tumon Bay Marine Preserve	4.52	Closed to shell collecting, use of gaffs, and removal of sand and rocks; Fishing practices are restricted[1]
Sasa Bay Marine Preserve	3.12	Closed to shell collecting, use of gaffs, and removal of sand and rocks; Fishing practices are restricted[1]
Piti Bomb Holes Marine Preserve	3.63	Closed to shell collecting, use of gaffs, and removal of sand and rocks; Fishing practices are restricted[1]
Achang Reef Flat Marine Preserve	4.85	Closed to shell collecting, use of gaffs, and removal of sand and rocks; Fishing practices are restricted[1]
Pati Point Marine Preserve	20	Closed to shell collecting, use of gaffs, and removal of sand and rocks; Fishing practices are restricted[1]
AMERICAN SAMOA		
Alega Private Marine Reserve	0.15	Only subsistence fishing with traditional methods by village members is allowed
Alofau Community-Based Fisheries Management Program (CFMP) Reserve	0.32	Fishing is prohibited except on occasional Saturday openings for subsistence fishing only
Amanave CFMP Reserve	0.34	Closed to all commercial and recreational fishing except when opened for subsistence fishing one month per year
Amaua and Auto CFMP Reserve	0.37	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Aoa CFMP Reserve	0.34	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Aua CFMP Reserve	0.23	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Fagamalo CFMP Reserve	0.38	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Fagamalo No-Take MPA	2.9	Closed to all types of fishing
Leone Pala Special Management Area (SMA)	0.02	No fishing regulation exist beyond territorial regulations
Masausi CFMP Reserve	0.2	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Matu‘u and Faganeanea CFMP Reserve	0.32	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Nu‘uuli Pala SMA	2	No fishing regulation exist beyond territorial regulations
Ofu Vaoto Marine Reserve	0.48	Closed to fishing/shellfish harvesting except for subsistence fishing/harvesting by Ofu Island residents per territorial regulations
Pago Pago Harbor SMA	1.2	No fishing regulation exist beyond territorial regulations
Poloa CFMP Reserve	0.36	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year

MPA Description	Size (km^2)	Restricted Activities
Sailele CFMP Reserve	0.08	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year
Vatia CFMP Reserve	0.62	Closed to all commercial and recreational fishing except for subsistence fishing at certain times of the year

Source: CNMI Division of Fish and Wildlife 2014; Hawai‘i Division of Aquatic Resources 2014; Kendall and Poti 2011; Marine Conservation Institute 2014; Waddell and Clarke 2008.

Hawai‘i

Eleven MLCDs have been established in Hawai‘i to conserve and replenish marine resources. The MLCDs are managed by the DLNR, Division of Aquatic Resources (DAR). In more than half of the MLCDs, it is prohibited to fish for, catch, take, injure, kill, possess, or remove any marine life, or to take, alter, deface, destroy, possess, or remove any sand, coral, rock, or other geological feature. Approximately 0.4 percent of nearshore MHI waters are closed to fishing because of MLCDs (Friedlander et al. 2008). In addition to these protections, each MLCD has more specific regulations, such as anchoring restrictions or designated allowable fishing methods (e.g., fishing for finfish for home consumption is permitted from shore using thrownet or pole and line without reel). Some MLCDs are divided into two subzones that allow different uses (e.g., subzone A = no-take, subzone B = hook-and-line and thrownet for finfish allowed) (Wusinich-Mendez and Trappe 2007).

Hawai‘i also has FMAs which are managed by DAR. FMAs have zones that restrict uses by user type, or areas that are closed to certain fishing gears (e.g., net fishing) or activities (e.g., boating) to reduce conflict and avoid depletion of resources. Each FMA has detailed, site-specific rules that target the issue(s) that it was established to address (Wusinich-Mendez and Trappe 2007). Bottomfish Restricted Fishing Areas (BRFAs) also exist around Hawai‘i, which restrict possession of bottomfish while in a vessel that is drifting or anchored within any BRFAs (Hawai‘i Division of Aquatic Resources 2015).

Established in 1973, Ahihi Kina‘u Natural Area Reserve is the only National Area Reserve (NAR) with a marine component. NARs are managed by DLNR’s Division of Forestry and Wildlife. In all NARs, it is prohibited to remove, injure, kill, or introduce any form of plant and animal life, or to remove, damage, or disturb any geological or paleontological feature or substance. Operation of any motorized water vehicle on or in the waters of Ahihi Kina‘u NAR is also prohibited (Wusinich-Mendez and Trappe 2007).

Kaho‘olawe Island Reserve comprises the island of Kaho‘olawe, a former military training ground and bombing range, and the waters extending two nm from its shoreline. The reserve is managed by the Kaho‘olawe Island Reserve Commission (KIRC) within DLNR. The reserve was established for the purposes of preservation, and practice of, native Hawaiian rights for cultural, spiritual, and subsistence purposes; preservation of the island’s archaeological, historical, and environmental resources; rehabilitation, habitat restoration, and re-vegetation; and education. Access to the Reserve is permitted only with authorization of KIRC for specific purposes, such as restoration, education, and culture. Trolling is permitted on two scheduled weekends each month in waters deeper than 30 fathoms (60 m) (Wusinich-Mendez and Trappe 2007). No other fishing, ocean recreation, or additional activities are allowed within the reserve. Bottomfishing and use of anchors are also prohibited.

American Samoa

There are a variety of territorial MPAs in American Samoa. There are about a dozen village MPAs (VMPAs) that are part of the Community-Based Fishery Management Program (CFMP). These areas are managed by local villages and the American Samoa Department of Marine and Wildlife Resources (DMWR). The goal of the program is to improve inshore fishery resources and enhance stewardship of marine resources by the village community. Restrictions in VMPAs vary by village but range from no-take to open only on Saturdays to open to villagers only (Richmond and Levine 2012).

The American Samoa Department of Parks and Recreation and DMWR manage Ofu Vaoto Territorial Marine Park. It was established in 1994 "to protect its unique coral reef wildlife habitat while enabling the public to enjoy the natural beauty of the site" (American Samoa Code Annotated (ASCA) §18.0214). Fishing and shellfish harvesting are prohibited, with the exception of subsistence fishing and harvesting by Ofu Island residents according to territorial regulations (ASCA §18.0214).

There are three territorial Special Management Areas (SMAs) which contain terrestrial and marine components. They are Leone Pala SMA, Nu'uuli Pala SMA, and Pago Pago Harbor SMA. The SMAs are primarily managed by the American Samoa Coastal Management Program. The main purpose of the SMAs is to protect unique marine ecosystems by regulating upland activities that could degrade these systems. While the SMAs include a marine component, there are no regulations within the marine area that go beyond general territorial regulations (Wusinich-Mendez and Trappe 2007).

Guam

In 1997, five marine preserves were created in Guam through Public Law 24-21 to protect and restore Guam's fishery resources. In 2006, Public Law 28-107 included the protection and preservation of aquatic life, habitat, and marine communities and ecosystems and strengthened the protection of the preserves by making all forms of fishing and taking or altering aquatic life, coral, and any other resources unlawful (unless permitted by the Guam Division of Aquatic and Wildlife Resources). The five preserves are Pati Point Preserve, Tumon Bay Preserve, Piti Bomb Holes Preserve, Sasa Bay Preserve, and Achang Reef Flat Preserve (Burdick et al. 2008).

Commonwealth of the Northern Mariana Islands

There are several MPAs in CNMI with varying levels of restricted activities. No-take reserves prohibit the fishing or harvesting of any marine species of plant or animal, prohibit take of coral (live or dead), and prohibit all exploitive or destructive activities to marine life. Mañagaha Marine Conservation Area, Forbidden Island Marine Sanctuary, and Bird Island Marine Sanctuary are no-take reserves in Saipan. Sasanhaya Fish Reserve is located on Rota and is a no-take zone for all marine species. A new, primarily no-take, marine reserve has been established on the Island of Tinian from Southwest Carolinas Point to Puntan Diablo.

3.1.2.3 Foreign or International Marine Protected Areas

There are many foreign and international MPAs in the central and western Pacific. This section focuses on some of the largest MPAs in the region.

Phoenix Islands Protected Area (PIPA) was established in 2008 and comprises 408,250 km2 of marine and terrestrial habitats in Kiribati, including 11 percent of the country's EEZ. In 2010, PIPA was designated as a World Heritage Site. Cook Islands Marine Park was established in 2012 and encompasses 1.065 million km2 in the southern portion of the Cook Islands. Similar to the PIPA in Kiribati, the Cook Islands Marine Park will contain a variety of zones with different levels of protection, including areas where all fishing will be banned, and buffer areas where tourism and carefully monitored fishing will be allowed. These MPAs are part of a total of 14 established large-scale MPAs worldwide (Big Ocean 2014).

Several countries in the Pacific Islands Region including Palau, Marshall Islands, French Polynesia, Cook Islands, and New Caledonia have banned shark fishing within their EEZs, effectively creating vast shark sanctuaries. Similarly, Indonesia created an extensive manta ray sanctuary when they banned manta ray fishing in the entire EEZ in 2014.

3.2 BIOLOGICAL ENVIRONMENT

The biological environment of the PIFSC research areas include fish (Section 3.2.1), marine mammals (Section 3.2.2), birds (Section 3.2.3), sea turtles (Section 3.2.4), and invertebrates (Section 3.2.5).

3.2.1 Fish

Thousands of finfish species occur within the PIFSC research areas. This section of the PEA provides baseline information for species important to the analysis of effects in Chapter 4, important target species caught in PIFSC survey efforts, and prohibited and highly migratory species.

3.2.1.1 Threatened and Endangered Fish Species

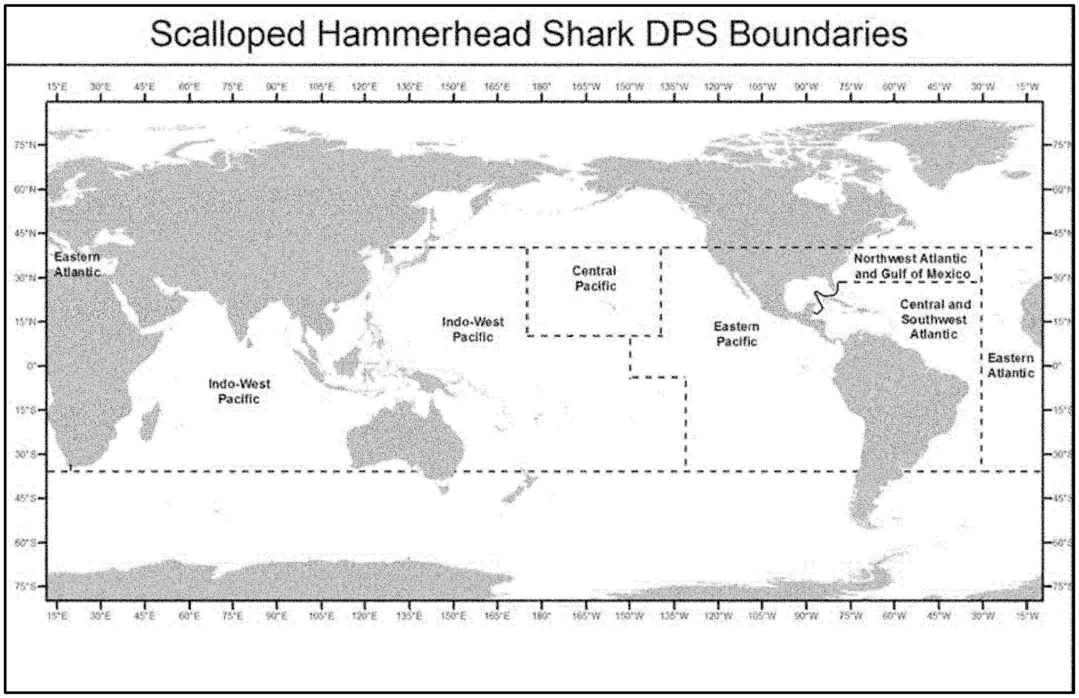
The information presented in the following species account is primarily from the OPR website (NOAA 2014c).

Scalloped Hammerhead Shark

The Scalloped hammerhead shark (*Sphyrna lewini*) is a circumpolar species and ranges from the intertidal and surface to depths of approximately 500 m. Scalloped hammerhead sharks are highly mobile and partly migratory (Maguire et al. 2006). In Kane‘ohe Bay, Hawai‘i, scalloped hammerhead sharks can travel as far as 5.1 km in the same day (Duncan and Holland 2006).

Based on analysis of available data, the scalloped hammerhead shark can be characterized as a long lived (20-30 years), late maturing, and relatively slow growing species (Miller et al. 2014). Juvenile and adult scalloped hammerhead sharks can live as solitary individuals, pairs, or in schools. Neonate and juvenile aggregations are common in nearshore nursery habitats, such as In Kane‘ohe Bay, coastal waters off Oaxaca, Mexico, Guam’s inner Apra Harbor, coastal areas in the Republic of Transkei, and coastal intertidal habitats in Cleveland Bay, Australia (Duncan and Holland 2006; Bejarano-Álvarez et al. 2011; Diemer et al. 2011; Tobin et al. 2013).

There are six different DPS for the scalloped hammerhead shark, four of which are listed under the ESA. Two DPS occur in the PIFSC region: the Central Pacific DPS (not ESA-listed) and the Indo-West Pacific DPS (threatened). The Indo-West Pacific DPS was listed as Threatened in July 2014 (79 FR 38213). The Indo-West Pacific DPS includes scalloped hammerhead sharks in the area bounded to the south by 36° S. lat., to the west by 20° E. longitude, and to the north by 40° N. latitude. In the east, the boundary line extends from 175° E. longitude, then due south to 4° S. latitude, then due east along 4° S. latitude to 130° W. longitude, and then extends due south along 130° W. longitude, as depicted in Figure 3.2-1. There is no designated critical habitat for the Indo-West Pacific DPS of scalloped hammerhead shark at this time.



Source: 79 FR 38213

Figure 3.2-1 Map of Six Scalloped Hammerhead Shark DPS Boundaries

Oceanic Whitetip Shark

On September 21, 2015, NMFS received a petition to list the oceanic whitetip shark (*Carcharhinus longimanus*) as threatened under the ESA throughout its range and to designate critical habitat. NMFS found the action may be warranted and announced the initiation of a status review of the species. The review was published on December 1, 2017 (Young et al. 2018) and summarized the best available data and information on the species and presented an evaluation of its status and extinction risk. On December 29, 2016, NMFS published a proposed rule to list the oceanic whitetip shark as threatened. Based on information published in the status review and the proposed rule, NMFS determined that the oceanic whitetip shark was not presently in danger of extinction but is likely to become so in the foreseeable future. As such, NMFS listed the species as threatened under the ESA throughout its range. NMFS also determined that critical habitat was not determinable at that time due to insufficient information regarding the physical and biological features essential to its conservation and recovery. Figure 3.2-2 presents the geographic distribution of the oceanic whitetip shark.

On January 30, 2018, NMFS listed the oceanic whitetip shark as threatened throughout its range (83 FR 4153). Bycatch in commercial fisheries combined with the rise in demand for shark fins is threatening oceanic whitetip sharks in the Pacific and Atlantic Oceans (Young et al. 2018).

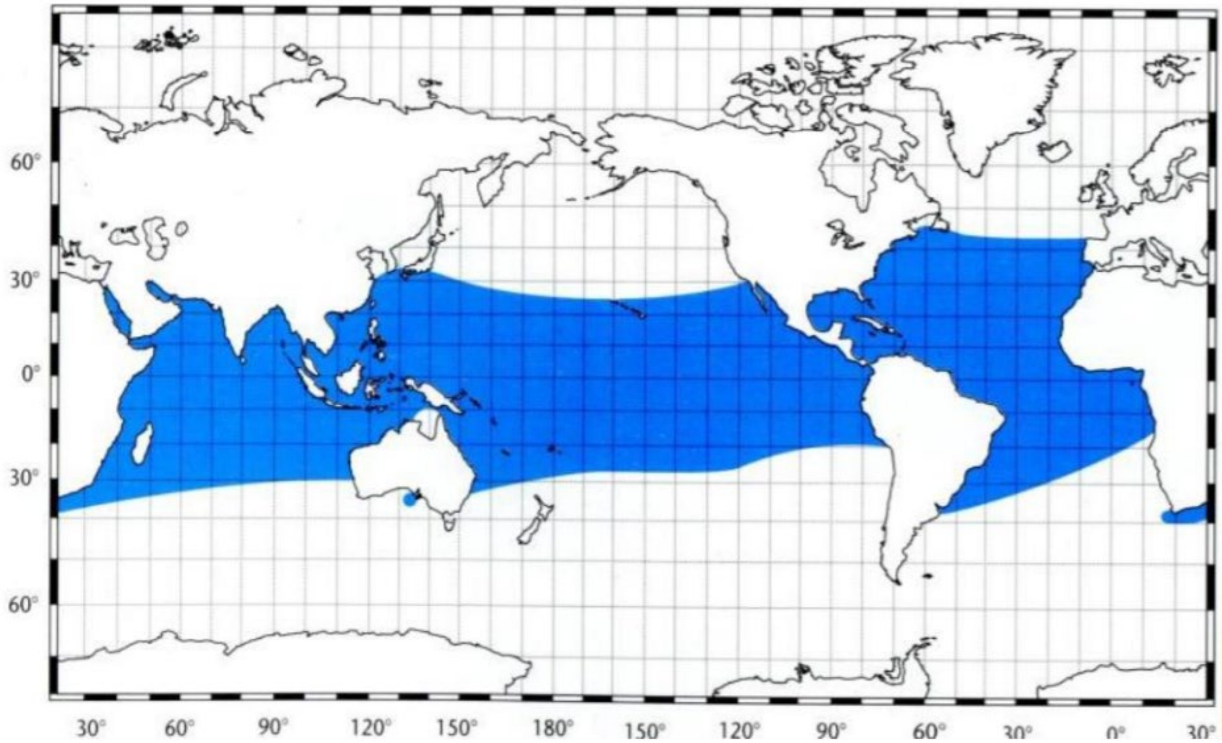


Figure 3.2-2 Geographic Distribution of Oceanic Whitetip Shark

Source: Last and Stevens 2009

Giant Manta Ray

On November 10, 2015, NMFS received a petition to list the giant manta ray, *Manta birostris*, as threatened or endangered under the ESA throughout its range. The petitioners also requested that critical habitat be designated with the ESA listing. The main threat to the giant manta ray is commercial fishing; the species is both targeted and caught as bycatch in a number of global fisheries throughout its range. Manta rays are particularly valued for their gill rakers, which are traded internationally. Demand for the gills of manta and other mobula rays has risen dramatically in Asian markets. With this expansion of the international gill raker market and increasing demand for manta ray products, estimated harvest of giant manta rays, particularly in many portions of the Indo-Pacific, frequently exceed numbers of identified individuals in those areas and is accompanied by observed declines of up to 95 percent in sightings and landings of the species. NMFS announced a final rule to list the giant manta ray as threatened on January 22, 2018 (83 FR 2916). Based on best available information, NMFS also concluded that critical habitat was not determinable.

3.2.1.2 Target Species

Target species are those fish which are managed for commercial and recreational fisheries and are the subject of PIFSC research surveys for stock assessment purposes or are often caught as incidental bycatch.

Fishery-caught species within WPRFMC jurisdiction are grouped into MUS or a “multi-species complex” for which annual catch limits are set. MUS are typically caught in sufficient quantities by fisheries to warrant management or specific monitoring by NMFS and the WPRFMC. After a recommendation by WPRFMC, NMFS published a final rule (84 FR 2767) in 2019 to reclassify certain bottomfish, coral reef ecosystem, precious coral, and crustacean MUS in three FEPs as ecosystem component species (ECS). The intent of the reclassification was to focus management on species in need of conservation and improve efficiency of fishery management. The action did not change fishery operations in terms of location, target and non-target species, catch, effort, participation, gear, seasonality, intensity, or bycatch. Rather, the rule reduced the number of MUS from 205 species or families to 11 in the American Samoa FEP, from 227 species or families to 13 in the Marianas FEP, and from 173 species or families to 20 in the Hawai‘i FEP. All former coral reef ecosystem management unit species are still to be monitored regularly but do not require ACL specifications or accountability measures. Reporting, record keeping, prohibitions, and experimental fishing regulations are also still in effect. In the future, if an ECS stock becomes a target of a Federal fishery, NMFS and WPRFMC may consider including that stock as a MUS to actively manage that stock. A full list of the species included in each MUS can be found at: https://www.wpcouncildata.org/archipelagicsafereport/. This chapter includes only those bottomfish MUS and coral reef ecosystem MUS often caught and which may be directly affected by PIFSC research activities.

Table 3.2-1 displays a list of target and pelagic species commonly caught in PIFSC research areas. The local names of fish species as shown in the regional FEPs (WPRFMC 2009a,b,c) are provided in Hawaiian, Samoan, Chamorro, and Carolinian where available. Chamorro and Carolinian are the two native languages of the Mariana Archipelago.

The following paragraphs provide brief information on the life history traits and habitat for species that are most often caught and kept. For detailed information, please see the WPRFMC website at http://www.wpcouncil.org/

Table 3.2-1 Target Fish Species in the PIFSC Research Areas

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
BOTTOMFISH MUS						
Silver jaw jobfish/snapper	*Aphareus rutilans*	Lehi (Hawaiian) Palu-gutusiliva (Samoan) Lehi (Chamorro) Maroobw (Carolinian)	Hawaiʻi bottomfish MUS (Deep 7 species) American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Not overfished Unknown	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Red/ruby snapper	*Etelis carbunculus*	Ehu (Hawaiian) Palu-malau (Samoan) Buninas agaga (Chamorro) Falaghal moroobw (Carolinian)	Hawaiʻi bottomfish MUS (Deep 7 species) American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Not overfished Unknown	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Longtail/red snapper	*Etelis coruscans*	Onaga (Hawaiian) ʻUlaʻula koaʻe (Hawaiian) Palu-loa (Samoan) Buninas (Samoan) Taighulupegh (Carolinian)	Hawaiʻi bottomfish MUS (Deep 7 species) American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Unknown Unknown	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Blacktip grouper	*Epinephelus fasciatus*	Fausi (Samoan) Gadao (Chamorro) Meteyil (Carolinian)	American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies
Hawaiian sea bass	*Epinephelus quernus*	Hāpuʻupuʻu (Hawaiian)	Hawaiʻi bottomfish MUS (Deep 7 species)	Not overfished	WPRFMC	Insular Fish Life History Survey and Studies

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
Blue stripe/ blueline snapper	*Lutjanus kasmira*	Ta'ape (Hawaiian) Savane (Samoan) Funai (Chamorro) Saas (Carolinian)	Hawai'i bottomfish MUS American Samoa bottomfish MUS Mariana bottomfish MUS	Not overfished Not overfished Not overfished	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Yellowtail snapper	*Pristipomoides auricilla*	Kalekale (Hawaiian) Palu-i'usama (Samoan) Buninas (Chamorro) Falaghal-maroobw (Carolinian)	Hawai'i bottomfish MUS American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Not overfished Unknown	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Pink snapper	*Pristipomoides filamentosus*	'Ōpakapaka (Hawaiian) Palu-'ena'ena (Samoan) Buninas (Chamorro) Falaghal-maroobw (Carolinian)	Hawai'i bottomfish MUS (Deep 7 species) American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Not overfished Unknown	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Yelloweye snapper	*Pristipomoides flavipinnis*	Palu-sina (Samoan) Buninas (Chamorro) Falaghal-maroobw (Carolinian)	American Samoa bottomfish MUS Mariana bottomfish MUS	Not overfished Not overfished	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Pink snapper	*Pristipomoides sieboldii*	Kalekale (Hawaiian) Palu (Samoan)	Hawai'i bottomfish MUS (Deep 7 species) American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Not overfished Unknown	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
Snapper	*Pristipomoides zonatus*	Gindai (Hawaiian) Palu-ula, palu-sega (Samoan) Buninas rayao amiriyu (Chamorro) Falaghal-maroobw (Carolinian)	Hawai‘i bottomfish MUS (Deep 7 species) American Samoa bottomfish MUS Mariana bottomfish MUS	Not overfished Not overfished Not overfished	WPRFMC	Sampling Pelagic Stages of Insular Fish Species, Insular Fish Life History Survey and Studies
Lunartail grouper	*Variola louti*	Papa, velo (Samoan) Bueli (Chamorro) Bwele (Carolinian)	American Samoa bottomfish MUS Mariana bottomfish MUS PRIA bottomfish MUS	Not overfished Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies
Coral Reef Ecosystem MUS, Currently Harvested Coral Reef Taxa (CHCRT) and Potentially Harvested Coral Reef Taxa (PHCRT)						
Sergeant-majors	*Abudefduf* spp.	Mamo (Hawaiian) tu'u'u, mutu, mamo, tu'u'u-lumane (Samoan)	Hawai‘i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, Surface Night-Light Sampling Survey, RAMP
Banded damselfish	*Abudefduf abdominalis*	Mamo (Hawaiian) tu'u'u, mutu, mamo, tu'u'u-lumane (Samoan)	Hawai‘i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, Surface Night-Light Sampling Survey, RAMP
blue-banded surgeonfish	*Acanthurus lineatus*	Alogo (Samoan)	Hawai‘i PHCRT American Samoa CHCRT Mariana CHCRT PRIA CHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Flat needlefish	*Ablennes hians*	N/A	Hawai‘i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey, RAMP

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
Longnose lancetfish	*Alepisaurus ferox*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Longline Gear Research, Pelagic Longline Hook Trials, Longline Gear Research
Bluefin trevally	*Caranx megalampys*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Unidentified Eteline snappers	*Etelis* spp.	N/A	N/A	Not overfished Not overfished Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies, RAMP
Unidentified flyingfish	*Exocoetidae* (unidentified)	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey
Barbel flyingfish	*Exocetus monocirrhus*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey
Tropical two-wing flyingfish	*Exocoetus volitans*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey
Eightbar grouper	*Hyporthordus octofasciatus*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
Unidentified sea chub	*Kyphosus* spp.	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey, RAMP
Snapper	*Lutjanus* spp.	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies, RAMP
Humpnose big-eye bream	*Monotaxis grandoculis*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Yellowstripe goatfish	*Mulloidichthys flavolineatus*	weke`a or weke a`a (Hawaiian) afolu, afulu (Samoan)	Hawai'i PHCRT American Samoa CHCRT Mariana CHCRT PRIA CHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Lagoon Ecosystem Characterization, Mariana Resource Survey, RAMP
Bigscale soldierfish	*Myripristis berndti*	menpachi, `u`u (Hawaiian) malau-ugatele, malau-va'ava'a (Samoan) saksak (Chamorro) mweel (Carolinian)	Hawai'i CHCRT American Samoa CHCRT Mariana CHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Orangespine unicornfish	*Naso literatus*	kalalei, umaumalei (Hawaiian) ili'ilia, umelei (Samoan) hangon (Chamorro) bwulaalay (Carolinian)	Hawai'i CHCRT American Samoa CHCRT Mariana CHCRT PRIA CHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Bluespine unicornfish	*Naso unicornus*	Kala (Hawaiian)	Hawai'i CHCRT	Not overfished	WPRFMC	Lagoon Ecosystem Characterization, Mariana Resource Survey, RAMP

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
		ume-isu (Samoan) tataga (Chamorro) igh-falafal (Carolinian)	American Samoa CHCRT Mariana CHCRT PRIA CHCRT	Not overfished Not overfished Unknown		
Hawaiian deep anthias	*Odontanthias fuscipinnis*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies, Surface Night-Light Sampling Survey, RAMP
Saddle-back snapper	*Paracaesio kusakarii*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies, RAMP
Ornate jobfish	*Pristipomoides argyrogrammicus*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Yelloweye snapper	*Pristipomoides flavipinnis*	N/A	Hawai'i PHCRT PRIA PHCRT	Not overfished Unknown	WPRFMC	Insular Fish Life History Survey and Studies, Mariana Resource Survey, RAMP
Unidentified driftfishes	*Psenes* spp.	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey
Freckled driftfish	*Psenes cyanophrys*	N/A	Hawai'i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
Bicolor parrotfish	*Scarus rubroviolaceus*	uhu, palukaluka (Hawaiian) fuga, galo-uluto'i, fuga-valea, laea-mamanu (Samoan) laggua (Chamorro)	Hawai‘i CHCRT American Samoa CHCRT Mariana CHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Mariana Resource Survey, RAMP
Unidentified jack	*Seriola* spp.	N/A	Hawai‘i PHCRT American Samoa PHCRT Mariana PHCRT PRIA PHCRT	Not overfished Not overfished Not overfished Unknown	WPRFMC	Surface Night-Light Sampling Survey, RAMP
Pacific Pelagic MUS						
Snake mackeral	*Gempylus serpens*	N/A	Pacific pelagic MUS, snake mackerals – Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Sickle pomfret	*Taractichthys steindachneri*	N/A	Pacific pelagic MUS, pomfrets – Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Blue shark	*Prionace glauca*	N/A	Pacific pelagic MUS, Blue shark – North Pacific	Not overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
White tip shark	*Carcharhinus longimanus*	N/A	Pacific pelagic MUS , oceanic whitetip shark – Tropical Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Silky shark	*Carcharhinus falciformis*	N/A	Pacific pelagic MUS, silky shark – Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Shortfin mako shark	*Thysanoteuthis rhombus*	N/A	Pacific pelagic MUS, shortfin mako – North Pacific	Unknown	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Longfin mako shark	*Sthenoteuthis oualaniensis*	N/A	Pacific pelagic MUS, longfin mako – North Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Pelagic thresher shark	*Alopias pelagicus*	N/A	Pacific pelagic MUS, pelagic thresher – North Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline

Common Name	Scientific Name	Local Name	Stock	Stock Status	Fishery Management Council	PIFSC Surveys
Bigeye thresher shark	*Alopias superciliosus*	N/A	Pacific pelagic MUS, bigeye thresher – North Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Bigeye tuna	*Thunnus obesus*	Ahi	Pacific pelagic MUS, bigeye tuna – Pacific	Overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Yellowfin tuna	*Thunnus albacares*	Ahi	Pacific pelagic MUS, Yellowfin tuna, central western Pacific and eastern tropical Pacific	Not overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Skipjack tuna	*Katsuwonus pelamis*	Aku	Pacific pelagic MUS, skipjack tuna – central western Pacific and eastern tropical Pacific	Not overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Blue marlin	*Makaira nigricans*	Kajiki	Pacific pelagic MUS, blue marlin – Pacific	Not overfished	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Striped marlin	*Kajikia audax*	Nairagi	Pacific pelagic MUS, striped marlin – eastern tropical Pacific	Not overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Striped marlin	*Kajikia audax*	Nairagi	Pacific pelagic MUS, striped marlin – western and central Pacific	Overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Swordfish	*Xiphias gladius*	Mekajiki	Pacific pelagic MUS, swordfish – North Pacific	Not Overfished	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Wahoo	*Acanthocybium solandri*	Ono	Pacific pelagic MUS, wahoo – Pacific	Unknown	WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline
Dolphinfish	*Coryphaena hippurus*	Mahimahi	Pacific pelagic MUS, dolphinfish – Pacific	Unknown	PFMC/WPRFMC	Circle and tuna hook trials, longline gear research, marlin longline

<u>Bottomfish MUS</u>

Snappers and Groupers

Snappers and groupers are often the target of commercial fishermen. There are distinct depth associations for certain species of snappers and groupers. Many snappers and some groupers are restricted to feeding in deep water (Parrish 1987). For example, species of the genus Pristipomoides occur at intermediate depths and congregate around rocky outcrops and promontories (Ralston et al. 1986), while Eteline snappers occupy deeper waters. Species of groupers are relatively larger and mostly occur in shallow areas. However, some may occupy deep-slope habitats. Groupers are typically more sedentary and territorial than snappers or emperors, and they rely more on hard substrates. In general, groupers may be less dependent on hard substrates at depth (Parrish 1987). The schooling behavior of snappers and groupers are reported more frequently for juveniles than for adults. Snapper and grouper species produce pelagic eggs and larvae and are most abundant over deep reef slope water (WPRFMC 2009a).

<u>Pacific Pelagic MUS</u>

Blue Shark

Blue sharks (Prionace glauca) are found in warm seas worldwide and are likely the most wide-ranging of all sharks. Male blue sharks reach sexual maturity around 4 to 5 years of age, while females reach maturity between five and 6 years of age. Blue sharks bear fully formed, live young in litters averaging approximately 30 pups (NOAA 2011). Mating is thought to occur in waters from 20 to 30° N (Nakano and Seki, 2003).

In the North Pacific, seasonal migrations occur with northward movements extending into the Gulf of Alaska as waters warm during the summer months and southward movements occurring during the winter months (NOAA 2011). Blue sharks tagged off southern California have been recaptured to the south off Baja, California and Acapulco, Mexico; northward to off Oregon, and westward to off the Hawaiian Islands and Midway Islands in the central Pacific, indicating a wide-ranging stock that may overlap with the population fished by longliners in the central Pacific Ocean (NOAA 2011).

Blue sharks are the most common, incidentally-caught shark in pelagic longline fisheries worldwide (Taniuchi, 1990; Bonfil, 1994). Despite this, blue shark populations in both hemispheres have been found to be above the maximum sustainable yield reference point, and in many model scenarios, close to un-fished biomass levels (Kleiber et al. 2009).

Silky Shark

Silky shark (*Carcharhinus falciformis*), which is one of the largest species in this genus, is another common carcharhinid species with a circumglobal distribution in all tropical oceans. It also occurs in some warm-temperate waters, usually above 23°C. It has been described as semipelagic because it is often taken in coastal and insular regions. Silky sharks are most abundant near the Line Islands between 0°–10° N and 155°–165°W in the central Pacific Ocean (Walsh and Clarke 2011).

Tuna

Bigeye tuna (Thunnus obesus) is found across the Pacific Ocean between northern Japan and the north island of New Zealand in the western Pacific and from 40°N to 30°S in the eastern Pacific Ocean. Bigeye tuna are capable of large scale migrations and move freely within broad regions of favorable water temperature and dissolved oxygen levels. Juvenile and small adult bigeye tuna school at the surface, sometimes with skipjack and juvenile yellow fin tunas. Schools may associate with floating objects or large, slow moving marine animals such as whale sharks or manta rays. Once reaching sexual maturity at around 3 years of age, bigeyes are capable of spawning throughout the year in tropical waters and seasonally at higher latitudes at water temperatures above 75°F. Bigeye tuna release millions of eggs per spawning event, which float on the top layer of the ocean, buoyed at the surface by a single oil droplet, until they hatch (NOAA 2014b).

The yellowfin tuna (Thunnus albacares) is found throughout the tropical and sub-tropical waters of the Pacific Ocean. Yellowfin are known to gather around drifting flotsam, fish aggregating devices, anchored buoys, dolphins, and other large marine animals. Yellowfin tuna reach sexual maturity at approximately 2 years of age and spawn frequently but are short lived with a maximum life span of 6 to 7 years (NOAA 2014b).

The skipjack tuna (Katsuwonus pelamis) is made up of two stocks in the Pacific Ocean, one in the eastern Pacific Ocean and one in the western and central Pacific Ocean. Skipjack tuna live mostly in the open ocean, though they do spend part of their life cycle in nearshore waters. Skipjacks are often found in large schools swimming in surface waters throughout the Pacific. Skipjack tuna reach sexual maturity early, once they reach around 1.3 ft (4 m) in length and are capable of spawning almost daily. The maximum life span is estimated between 8 to 12 years (NOAA 2014b).

The North Pacific albacore tuna (*Thunnus alalunga*) is an abundant, circumglobal species. North Pacific albacore, particularly juveniles, begin their expansive migration in the spring and early summer in waters off Japan, move into inshore waters off the U.S. Pacific coast by late summer, then spend the late fall and winter in the western Pacific Ocean. The timing and distance of the albacore tunas' migrations in a given year depend largely on oceanic conditions. Less is known about the movements of albacore in the south Pacific Ocean, where juveniles move southward from the tropics when they are about a foot in length and then head eastward to about 130°W. When the fish reach sexual maturity at 5 to 6 years of age, they return to waters centered around 20°N to 20°S latitude to spawn (https://www.fisheries.noaa.gov/species/pacific-albacore-tuna).

The Pacific northern bluefin tuna (*Thunnus orientalis*) ranges throughout the Northern, Eastern, and Western Pacific and across the high seas, where they are fished by Japanese, Korean, Taiwanese as well as U.S. fisheries (ISC 2018). Bluefin tuna larvae have only been found in the vicinity of Japan and between Japan and the Philippines, so it is assumed that spawning occurs only in those areas (Inter-American Tropical Tuna Commission [IATTC] 2002). Some fish remain in the western Pacific Ocean, while others migrate to the Eastern Pacific Ocean during the first 2 years of life, eventually returning to the western Pacific Ocean.

Mahimahi

The dorado (Coryphaena hippurus), also known as dolphinfish or mahimahi, is found in tropical and subtropical waters of all oceans. Dorado are unmonitored, but it is believed the population is stable and is able to withstand a relatively high level of exploitation. Dorado reach sexual maturity at 4 to 5 months of age and are prolific spawners, reproducing repeatedly. Spawning is thought to occur year-round in temperate waters, above 75 °F, but peaks vary with latitude. Dorado spawning grounds appear to be in the North Pacific in waters less than 50 nm from islands and banks; off the continents, they appear to spawn on the continental shelf. The lifespan of dorado is thought to be 5 years for a female, longer for males (NOAA 2014b).

Marlin and Swordfish

The striped marlin (Tetrapturus audax) is widely distributed throughout most tropical and sub-tropical waters of the Pacific and Indian oceans. Movements tend to be diffuse as striped marlin do not form dense schools, but occur singularly or in small groups, usually segregated by size. Adult fish are found in the north- and south- central Pacific where spawning occurs, in the central Pacific and off central Mexico. Sub-adult fish move east toward the coast of Mexico where they are found in high abundance around the tip of the Baja peninsula, striped marlin are not reproductively active while off southern California (NOAA 2014b).

The North Pacific Swordfish (Xiphias gladius) is found worldwide in all tropical, subtropical, and temperate seas, though little is known of their migration patterns. Swordfish are abundant near boundary zones where there are sharp gradients of temperature and salinity. Swordfish reach sexual maturity around 5 to 6 years of age and about 5-5.5 ft (1.6 m) in length and have a maximum life span of at least 9 years. Swordfish do not seem to have a specific spawning season or grounds, they spawn throughout the year in equatorial waters but in higher latitudes, spawning is restricted to spring and summer (NOAA 2014b).

Coral Reef Ecosystem MUS

As discussed in Section 3.2.1.2, Coral Reef Ecosystem MUS are divided into Currently Harvested Coral Reef Taxa (CHCRT) and Potentially Harvested Coral Reef Taxa (PHCRT). There are approximately 50 to 100 different species of CHCRT and thousands of species of PHCRT within each stock. It is impractical to provide details for each of these species; a full list of the species included in CHCRT and PHCRT for each stock can be found in 50 CFR 665. The species highlighted in Table 3.2-1 are those whose average catch averaged more than 10 individuals per year by PIFSC research surveys.

3.2.2 Marine Mammals

The marine mammal species listed in Table 3.2-2 occur in the areas frequented by PIFSC research surveys in the HARA, MARA, ASARA, and WCPRA. All marine mammals are federally protected under the MMPA. In addition, seven cetacean species and one pinniped species in the PIFSC research areas are listed as endangered under the ESA and depleted under the MMPA. The survey areas also encompass designated critical habitat for the Hawaiian monk seal (see Section 3.2.2.2). Threatened and endangered species encountered in the PIFSC survey areas are described in Section 3.2.2.2. Non-ESA listed marine mammals for which takes are requested by PIFSC in the LOA Application (see Appendix C of the 2015 Draft PEA) are described in Section 3.2.2.3.

All life history and abundance data for the marine mammal species described below is obtained from literature as cited and where not cited, is from the most recent NMFS Stock Assessment Reports (Caretta et al. 2015, Allen and Angliss 2015), available on the NMFS website at http://www.nmfs.noaa.gov/pr/sars/region.htm. The minimum population size presented in each species account is calculated as the lower 20th percentile of the log-normal distribution of the most recent abundance estimate (Barlow et al. 1995). The PBR level is calculated as the minimum population size within the U.S. EEZ of the stock's region times one half the default maximum net growth rate for the species, times a recovery factor that varies from 1.0 to 0.1 depending on the status of the stock (Wade and Angliss 1997).

Table 3.2-2 Marine Mammal Species that are known to occur in the PIFSC Research Areas

Species		HARA	MARA	ASARA	WCPRA	Federal ESA/MMPA Status[1]
Common Name	Scientific Name					
CETACEANS						
Rough-toothed dolphin	Steno bredanensis	X	X	X	X	-
Risso's dolphin	Grampus griseus	X	X		X	-
Bottlenose dolphin[2]	Tursiops truncatus	X	X	X	X	-
Pantropical spotted dolphin[3]	Stenella attenuata	X	X	X	X	-
Spinner dolphin[4]	Stenella longirostris	X	X	X	X	-
Striped dolphin	Stenella coeruleoalba	X	X		X	-
Fraser's dolphin	Lagenodelphis hosei	X	X		X	-
Melon-headed whale[5]	Peponocephala electra	X	X		X	-
Pygmy killer whale	Feresa attenuata	X	X		X	-
False killer whale[6]	Pseudorca crassidens	X	X	X	X	Endangered[7] /depleted
Killer whale	Orcinus orca	X	X	X	X	-
Short-finned pilot whale	Globicephala macrorhynchus	X	X	X	X	-
Blainville's beaked whale	Mesoplodon densirostris	X	X		X	-
Cuvier's beaked whale	Ziphius cavirostris	X	X	X	X	-
Longman's beaked whale	Indopacetus pacificus	X			X	-
Deraniyagala's beaked whale	Mesoplodon hotaula				X	-
Pygmy sperm whale	Kogia breviceps	X	X		X	-
Dwarf sperm whale	Kogia sima	X	X	X	X	-
Sperm whale	Physeter macrocephalus	X	X	X	X	Endangered/ depleted
Blue whale	Balaenoptera musculus	X	X		X	Endangered/ depleted
Fin whale	Balaenoptera physalus	X	X		X	Endangered/ depleted
Bryde's whale	Balaenoptera edeni	X	X	X	X	-

Species		HARA	MARA	ASARA	WCPRA	Federal ESA/MMPA Status[1]
Common Name	Scientific Name					
Sei whale	Balaenoptera borealis	X	X		X	Endangered/ depleted
Minke whale	Balaenoptera acutorostrata scammoni	X	X	X	X	-
Humpback whale[8]	Megaptera novaeangliae	X	X	X	X	-
North Pacific right whale	Eubalaena japonica	X				Endangered/ depleted
PINNIPEDS[9]						
Hawaiian monk seal	Neomonachus schauinslandi	X			X	Endangered/ depleted

1. Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted. By default, all species listed under the ESA as threatened or endangered are also considered depleted under the MMPA. All marine mammal stocks are considered protected under the MMPA.
2. Kauaʻi and Niʻihau stock, Oʻahu stock, the "4-Islands Region" (Molokaʻi, Lānaʻi, Maui, Kahoʻolawe) stock, Hawaiʻi Island stock, and the Hawaiian pelagic stocks.
3. Hawaiian Islands stock complex: Oʻahu, "4-Islands Region", Hawaiʻi Island, and Hawaiian pelagic stocks.
4. Hawaiʻi Island, Oʻahu/ 4 -Islands, Kauaʻi/Niʻihau, Pearl and Hermes Atoll, Kure/Midway, Hawaiʻi Pelagic, and American Samoa stocks.
5. Hawaiian Islands stock complex: Hawaiian Islands and Kohala Resident stocks.
6. Hawaiian Islands stock complex: Hawaiʻi Hawaiʻi Insular, Hawaiʻi pelagic, Northwestern Hawaiian Islands, Palmyra Atoll, and American Samoa stocks.
7. Pertains only to the Main Hawaiian Islands insular false killer whale distinct population segment.
8. Including only the Oceania DPS (American Samoa stock) and the Hawaii DPS (Central North Pacific stock).
9. There are documented cases of Northern elephant seals (Mirounga angustirostris) in Hawaiʻi, but these occurrences are rare and these animals are considered vagrants as they are outside of their normal range.

3.2.2.1 Marine Mammal Acoustics and Hearing

Marine mammals rely on sound production and reception for social interactions (e.g., reproduction, communication), to find food, to navigate, and to respond to predators. General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au and Hastings (2008). Several recent studies on hearing in individual species or species groups of odontocetes and pinnipeds also exist (e.g., Kastelein et al. 2009, Kastelein et al. 2013, Ruser et al. 2014). Interfering with these functions through anthropogenic noise could result in potential adverse impacts.

Southall et al. (2007) provided a comprehensive review of marine mammal acoustics including designating functional hearing groups. Assignment was based on behavioral psychophysics (the relationship between stimuli and responses to stimuli), evoked potential audiometry, auditory morphology, and, for pinnipeds, whether they were hearing through air or water. Because no direct measurements of hearing exist for baleen whales, hearing sensitivity was estimated from behavioral responses (or lack thereof) to sounds, commonly used vocalization frequencies, body size, ambient noise levels at common vocalization frequencies, and cochlear measurements. NOAA modified the functional hearing groups of Southall et al. (2007) to extend the upper range of low-frequency cetaceans and to divide pinnipeds into phocids and otariids (NMFS 2018b).

Detailed descriptions of marine mammal auditory weighting functions and functional hearing groups are available in NMFS (2018b). Table 3.2-3 presents the functional hearing groups and representative species or taxonomic groups for each; most species found in the PIFSC project areas are in the first two groups, low frequency cetaceans (baleen whales) and mid frequency cetaceans (toothed whales).

Table 3.2-3 Summary of the Functional Hearing Groups of Marine Mammals

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups
Low Frequency Cetaceans (Mysticetes–baleen whales)	7 Hertz (Hz) to 25 kilohertz (kHz) (best hearing is generally below 1000 Hz (1 kHz), higher frequencies result from humpback whales)	All baleen whales
Mid- Frequency Cetaceans (Odontocetes—toothed whales)	150 Hz to 160 kHz (best hearing is from approximately 10-120kHz)	Includes species in the following genera: Steno, Tursiops, Stenella, Lagenodelphis, Grampus, Peponocephala, Feresa, Pseudorca, Orcinus, Globicephala, Physeter, Ziphius, Indopacetus, Mesoplodon
High-frequency Cetaceans (Odontocetes)	200 Hz to 48 kHz (best hearing is from approximately 10-150kHz)	Includes true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchus cruciger and L. australis
Phocid pinnipeds (true seals)	75 Hz to 100 kHz (best hearing is from approximately 1-30 kHz)	All seals

Source: Based on Southall et al. 2007 and NMFS 2018b .

3.2.2.2 Threatened and Endangered Marine Mammals

Table 3.2-2 lists all marine mammal species encountered in the PIFSC research areas; this section only discusses species listed as threatened or endangered under the ESA.

False Killer Whale (Pseudorca crassidens) – Hawaiian Islands Stock Complex: Hawaiʻi Insular, Hawaiʻi Pelagic, Northwestern Hawaiian Islands, Palmyra Atoll, and American Samoa Stocks

Status and trends: There are currently three demographically-independent populations in Hawaiian waters as follows: 1) MHI insular stock including animals within 72 km (approx. 38.9 nm) of the MHI; 2) NWHI stock including animals within a 93 km (50 nm) radius of the NWHI and Kauaʻi; 3) Hawaiʻi pelagic stock includes animals in waters more than 11 km (5.9 nm) from the MHI; 4) Palmyra Atoll stock includes animals within the U.S. EEZ of Palmyra Atoll, and 5) American Samoa stock includes animals within the U.S. EEZ of American Samoa (Caretta et al. 2019). The MHI insular stock is a DPS and the only stock listed under the ESA as endangered (77 FR 70915, November 28, 2012) and, therefore, the only stock discussed in further detail here. Critical habitat was designated for false killer whales on August 23, 2018 (83 FR 35062). The designated critical habitat area includes waters from the 45-m depth contour to the 3200-m depth contour around the main Hawaiian Islands from Niihau east to Hawaiʻi but excludes 14 areas from the designation because NMFS determined that the benefits of exclusion outweigh the benefits of inclusion, and exclusion will not result in extinction of the species (see 83 FR 35062).

The minimum population estimate for the MHI insular false killer whales is 149 animals and the PBR for this stock is 0.3 animals. The average estimated annual human-caused M&SI in the Hawaiʻi-based deep-set longline fishery for the period 2013 – 2015 was 0.7 animals per year (Carretta et al. 2019).

Based on the best available scientific information, the Hawaiian insular false killer whales have been declining over the past 20 years; listed as endangered under the ESA (77 FR 70915, 28 November 2012), they are automatically considered "strategic" under the 1994 amendments to the MMPA (Carretta et al. 2015, Oleson et al. 2010).

Distribution and habitat preferences: False killer whales are found worldwide in tropical and warm temperate oceans and, occasionally, in cold temperate waters. They are typically pelagic, yet also occur near to shore and in shallow waters around oceanic islands (Baird 2009a). The population of MHI insular false killer whales is in residence in waters around the MHI, year-round. Feeding occurs throughout this area and there is no specific breeding area within this range. Satellite telemetry and photo-identification data suggest that the MHI insular false killer whale population consists of three social clusters with distinct high-use areas. The three identified high-use areas are 1) off the north end of Hawaiʻi Island, 2) north of Maui and Molokaʻi, and 3) southwest of Lanaʻi (Baird et al. 2012). The higher density areas tend to be in shallow water, with gentle slopes, close to shore, with higher chlorophyll concentrations, and on the windward side of the islands (Baird et al. 2012).

Behavior and life history: Three large, distinct social groups exist within the MHI insular false killer whale population (Baird et al. 2012). Males and females show strong fidelity to natal social groups. Mating occurs within and between social groups, which could lead to inbreeding depression and further impact this small population (Martien et al. 2011).

False killer whales in Hawaiʻi largely feed on fish found primarily at the surface but may also bring prey up from depth. Seven of the ten species of pelagic fish documented as prey of false killer whales from the MHI insular stock are harvested commercially: yellowfin tuna (Thunnus albacares), albacore tuna (T. alalunga), skipjack tuna (Katsuwonus pelamis), broadbill swordfish (Xiphias gladius), dolphin fish (or mahimahi, Coryphaena hippurus), wahoo (or ono, Acanthocybium solandri), and lustrous pomfret (or monchong, Eumegistus illustrus) (Baird 2009b).

<u>Sperm whale (*Physeter macrocephalus*): Hawaiʻi Stock</u>

Status and trends: Sperm whales within the Pacific U.S. EEZ are divided into three stocks: 1) waters around Hawaiʻi, 2) California, Oregon, and Washington waters, and 3) Alaskan waters (Carretta et al. 2014, Carretta et al. 2013). The Hawaiian stock includes whales found within the Hawaiian Islands EEZ and in adjacent international waters. Stock status is, however, based on data from the Hawaiian Islands, as data on abundance, distribution, and human-caused impacts are limited for international waters. Sperm whales are listed as endangered under the ESA and, consequently, the Hawaiian stock is also considered as a depleted and strategic stock under the MMPA (Carretta et al. 2013).

The minimum population estimate is 3,478 whales and the calculated PBR is 13.9 sperm whales per year (Carretta et al. 2019). There are no recent fishery-related mortalities or serious injuries of sperm whales in the Hawaiian Islands EEZ (Carretta et al. 2019). One observed interaction with the Hawai‘i-based deep-set longline fishery occurred during the period 2011 – 2015 which resulted in a prorated probability of M&SI of 75 percent. The PBR for the Hawai‘i stock is calculated as the minimum population size (3,478) times one half of the default maximum net growth rate for cetaceans (1/2 of 4%) times a recovery factor of 0.2. Based on the calculation, PBR for this stock is 14 whales per year (Carretta et al. 2019).

Distribution and habitat preferences: Sperm whales are distributed across the entire North Pacific and into the southern Bering Sea in summer, but most are thought to be south of 40°N in winter. Sperm whales are the most abundant large whale in Hawaiian waters during summer and fall. During shipboard surveys in 2002, they were broadly distributed throughout the U.S. EEZ waters surrounding Hawai‘i, including the NWHI (Barlow 2006). Sperm whales near the MHI most commonly occur in deep water (>3,000 m) (Baird et al. 2013).

Behavior and life history: Females reach sexual maturity at about age 9 when they are roughly 9 m long; they give birth about every 5 years following a gestation period of 14-16 months. Males may not be active breeders until their late 20s and may not reach physical maturity until roughly 50 years old and 16 m long (Whitehead 2009). Female and immature sperm whales are quite social animals, whereas young males leave their natal units to between 4 and 21 years of age. Older males are generally seen alone and tend to frequent higher latitude areas (Whitehead 2009). Sperm whales consume numerous varieties of deep water fish and cephalopods.

Blue whale (*Balaenoptera musculus musculus*): Central North Pacific Stock

Status and trends: The two stocks of blue whales within the Pacific U.S. EEZ are the central North Pacific stock that includes whales around the Hawaiian Islands during winter, and the eastern North Pacific stock that feeds primarily off California (Carretta et al. 2015). Although there are acoustic recordings off O‘ahu Island and Midway Atoll and few documented sightings, blue whales are uncommon in Hawaiian waters. No blue whales were sighted during aerial surveys in 1993-1998 or during shipboard surveys in 2002. Two blue whales were sighted during a survey of the Hawaiian U.S. EEZ in November 2010 and four sightings were made by observers on Hawai‘i-based longline vessels (Bradford et al. 2017 in Carretta et al. 2020). Four sightings were made by observers on Hawaii-based longline vessels (NMFS/PIR, unpublished data).

A 2010 line-transect survey of the Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 133 blue whales (Bradford et al. 2017 in Carretta et al. 2020). Although currently considered the best available estimate for Hawaiian waters, most blue whales from this stock were likely feeding in higher latitudes during the time of the survey (Carretta et al. 2020). The PBR for this stock in the Hawaiian Islands EEZ is 0.1 per year, based on a minimum population estimate of 63 whales. There have been no fishery-related mortalities or serious injuries of blue whales reported within the Hawaiian Islands EEZ (Carretta et al. 2020). Blue whales are listed as endangered under the ESA and are therefore automatically considered a depleted and strategic stock under the MMPA.

Distribution and habitat preferences: Blue whales occur worldwide in circumpolar and temperate waters and undertake seasonal migrations between high-latitude and subtropical waters. Blue whales of the central Pacific stock may feed during summer near Kamchatka, the Aleutian Islands, and in the Gulf of Alaska and migrate to lower-latitudes in the western and central Pacific, including Hawaiʻi, in winter (Stafford et al. 2001, Stafford 2003). There have been no sightings or strandings of blue whales reported in the waters of American Samoa or the PRIA (WPRFMC 2009c, d).

Behavior and life history: Blue whales reach sexual maturity at 5-15 years of age; length at sexual maturity in the Northern Hemisphere for females is 21-23 m. and for males it is 20-21 m. (Sears and Perrin 2009). Females give birth about every 2-3 years in winter after a 10-12 month gestation. Longevity is thought to be at least 80-90 years (Sears and Perrin 2009). Blue whales occur primarily in offshore deep waters and feed almost exclusively on euphausiids.

Fin whale (*Balaenoptera physalus physalus*): Hawaiʻi Stock

Status and trends: The three stocks of fin whales in the North Pacific recognized in MMPA stock assessment reports are the: 1) Hawaiʻi stock, 2) California/Oregon/Washington stock, and 3) Alaska stock. The Hawaiʻi stock includes fin whales within the Hawaiian Islands EEZ and adjacent high-seas waters. Few data exist for the high seas, so stock status is based on data from Hawaiian Islands EEZ waters (Carretta et al. 2015). Fin whales are listed as endangered under the ESA and are considered a depleted and strategic stock under the MMPA.

Currently, the best abundance estimate for the Hawaiʻi stock of fin whales is 154, derived from a 2010 shipboard line-transect survey of the Hawaiian Islands EEZ; however, most fin whales were likely feeding in higher latitudes during the time of the survey (Bradford et al. 2017 in Carretta et al. 2020). Based on the 2010 abundance estimate, the minimum population size is 75 and the PBR is 0.1 fin whales per year. There were no reported fishery-related mortalities or serious injuries within the Hawaiian Islands EEZ (Carretta et al. 2020); however, between January and March 2015 the Hawaiʻi-based pelagic longline fishery reported an interaction with a fin whale, which was categorized as “released injured”. Following this interaction, NMFS will review the more detailed observer notes and calculate the total fishery-related M&SI designation for this stock. McCracken (2017 in Carretta et al. 2020) estimated the 5-yr annual M&SI for fin whales as 0 both inside and outside the Hawaiian Islands EEZ.

Distribution and habitat preferences: Fin whales are distributed widely in the world’s oceans and occur in both the Northern and Southern Hemispheres between 20o to 75o latitude (Department of the Navy [DON] 2008). In the northern hemisphere, they migrate from high Arctic feeding areas to low latitude breeding and calving areas. Fin whales seasonally migrate into the PIFSC research areas, although sightings are few. There have been no reports of fin whales in American Samoa waters (WPRFMC 2009c).

Behavior and life history: Fin whales become sexually mature between 6 to 10 years of age and reproduce primarily in the winter. Gestation lasts about 11 months and nursing occurs for 6 to 11 months (Aguilar 2009). Fin whales feed on planktonic crustaceans, including Thysanoessa sp. and Calanus sp., as well as schooling fish including herring, capelin, and mackerel (Aguilar 2009).

Sei whale (*Balaenoptera borealis borealis*): Hawaiʻi Stock

Status and trends: Sei whales within the Pacific U.S. EEZ are divided into three areas for the purposes of stock assessments: 1) waters around Hawaiʻi, 2) waters off California, Oregon, and Washington, and 3) Alaskan waters. The Hawaiʻi stock includes sei whales within the Hawaiian Islands EEZ and in adjacent high-seas waters. Data are scarce for the high-seas areas, so stock status is based on data from U.S. EEZ waters of the Hawaiian Islands (Carretta et al. 2015 and citations therein).

Encounter data from a ship-based survey from 2010 were recently evaluated resulting in an abundance estimate of 77 for the Hawai‘i stock of sei whales. Although this is currently the best available abundance estimate for this stock, most sei whales would be expected to be feeding in higher latitudes waters during the time of the survey. The minimum estimate is 204 whales and the PBR is 0.4 sei whales per year (Carretta et al. 2020). A single sei whale was seen entangled in heavy-gauge polypropylene line in 2011; the source of the line was not determined. There have been no other observed fisheries-related mortalities and serious injuries. The estimated rate of fisheries-related M&SI of sei whales in the Hawaiian Islands EEZ is 0.2 animals per year for the period from 2011 to 2015 (Carretta et al. 2020).

Sei whales are listed as endangered under the ESA and, consequently, the Hawai‘i stock is automatically considered to be a depleted and strategic stock under the MMPA.

Distribution and habitat preferences: Sei whales have a worldwide distribution but are found primarily in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood 2009). Sei whales spend the summer months feeding in subpolar higher latitudes and return to lower latitudes to calve in the winter. There is some evidence from whaling catch data of differential migration patterns by reproductive class, with females arriving at and departing from feeding areas earlier than males. For the most part, the location of winter breeding areas is unknown (Horwood 2009).

Behavior and life history: Sei whales mature at about 10 years of age for both sexes. They are most often found in deep, oceanic waters of the cool temperate zone. Sei whales appear to prefer regions of steep bathymetric relief, such as the continental shelf breaks, canyons, or basins situated between banks and ledges. In feeding grounds, their distribution is largely associated with oceanic frontal systems (Horwood 2009). In the North Pacific, sei whales feed along the cold eastern currents (Perry et al. 1999). Prey includes calanoid copepods, krill, fish, and squid.

North Pacific Right Whale (*Eubalaena japonica*)

North Pacific right whales are found in temperate and subpolar waters of the North Pacific Ocean. The species was originally listed with the North Atlantic right whale (i.e., “Northern” right whale) as endangered in 1970. The North Pacific right whale was listed separately as endangered on March 6, 2008 (73 FR 12024). Migratory patterns of North Pacific right whales are unknown, although it is thought they migrate from high-latitude feeding grounds in summer to more temperate waters during the winter (Muto *et al.* 2020). There have been two sightings in Hawaiian waters, one in 1996 and one in 1979 (Muto *et al.* 2020). Based on photo-identification from 1998 to 2013 it is estimated that the population of this stock is only 31 animals (Wade et al. 2011). The calculated PBR level for this stock is 0.05, which would be equivalent to one take every 20 years. Critical habitat has been designated in the Bering Sea and Gulf of Alaska for North Pacific right whales. There is no designated critical habitat for this species in the PIFSC research areas.

Hawaiian Monk Seal (*Neomonachus schauinslandi*)

Status and trends: The best estimate of total abundance is 1,351 (Johanos 2018 in Carretta et al. 2020). Other than Niihau and Lehua Islands, abundance in the MHI is estimated as the minimum tally of all individuals identified by an established sighting network during the calendar year. Pups are tallied at all sites in the MHI. As described in Baker et al. (2016 and Harting et al. (2017), site-specific abundance estimates and their uncertainty are combined using Monte Carlo methods to obtain a range-wide abundance estimate distribution. The minimum population size for all sites combined is 1,325 (Carretta et al. 2020). Range-wide estimates from 2013 – 2017 indicate estimates may be negatively-biased, only 5 percent of the distribution was below 1, indicating a 95 percent chance the population increased during this period. PBR is 4.6 seals (Carretta et al. 2020).

Fishery interactions with monk seals include direct interaction with gear and entanglement in derelict gear. In the MHIs, nearshore gillnets are a common source of mortality, with three confirmed deaths (in 2006, 2007, and 2010), and one possible death in 2010 under similar circumstances, but the carcass was not recovered (Carretta et al. 2015). In 2017, 21 seal hookings were documented with two classified as serious and 19 as non-serious injuries (Carretta et al. 2020). M&SI have not been attributed to the MHI bottomfish handline fishery (Carretta et al. 2014 and citations therein). In the past, interactions between the Hawai‘i-based domestic pelagic longline fishery and monk seals were documented (Carretta et al. 2015 and citations therein). There are no fisheries operating in the NWHI (Carretta et al. 2020).

At least 323 cases of seals entangled in fishing gear or other debris have been observed since 1982, including eight documented deaths result from entanglement in marine debris (Carretta et al. 2015 and citations therein). However, the fishing gear entangling Hawaiian monk seals only rarely includes the types used in Hawai‘i fisheries. For example, trawl net and monofilament gillnet accounted for approximately 35 percent and 34 percent, respectively, of the debris removed from reefs in the NWHI by weight, and trawl nets accounted for 88 percent of the debris by frequency (Donohue et al. 2001). However, trawl fisheries have been prohibited in Hawai‘i since the 1980s (Carretta et al. 2015). Annual human-caused mortality 2013 – 2017 was 3.0 which included >1.6 per year fishery-related mortalities and intentional killing of >1.4 per year (Carretta et al. 2020).

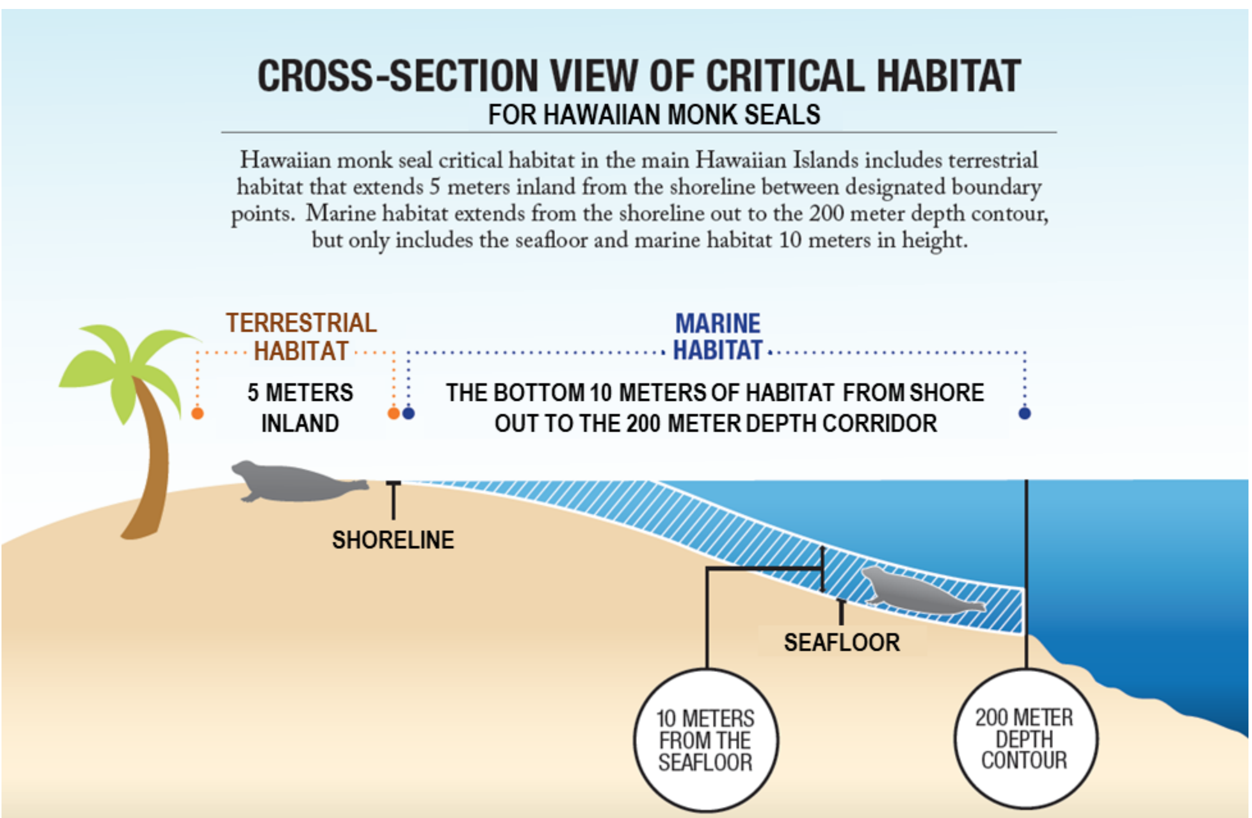
Distribution and habitat preferences: Hawaiian monk seals occur throughout the MHIs and the NWHI, with subpopulations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Atoll, Midway Atoll, Kure Atoll, and Necker and Nihoa Islands (the southernmost islands in the NWHI), and Johnston Atoll (NMFS 2014a). Recent studies confirm a high degree of connectivity and movement within the Northwestern Hawaiian Islands and within the MHIs, as well as between the MHI and NWHI, two populations which were previously considered effectively isolated from one another (Johanos et al. 2013).

Monk seals require both marine and terrestrial environments. Although most of their time is spent in the water, monk seals haul-out on sandy beaches, rocky shores, ledges, and reefs to rest, molt, give birth, nurse, and avoid predators (NMFS 2014a). The marine environment is used for foraging, resting, thermoregulating, and socializing. Seals use submerged habitat to depths of at least 500 m, including sea mounts, banks, reefs, and marine terraces, and forage at depths from one to 500 m (NMFS 2014a).

In 1986, critical habitat for the Hawaiian monk seal was originally designated at all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and ocean waters out to a depth of 10 fathoms (18.3 m) around Kure Atoll, Midway Islands (except Sand Island), Pearl and Hermes Reef, Lisianski Island, Laysan Island, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island in the NWHI (51 FR 16047; April 30, 1986). In 1988, critical habitat was expanded to include Maro Reef and waters around previously designated areas out to the 20 fathom (36.6 m) isobath (53 FR 18988; May 26, 1988). On August 21, 2015 (80 FR 50925), a final rule was published in the Federal Register revising critical habitat for Hawaiian monk seals across the Hawaiian Archipelago.

The revised boundaries include 16 occupied areas within the range of the species: 10 areas in the NWHI; and six in the MHI. These areas contain one or a combination of habitat types: preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas, that will support conservation for the species. Specific areas in the NWHI include all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and including marine habitat through the water's edge, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, out to the 200-m depth contour line around the following ten areas: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island. Specific areas in the MHI include marine habitat from the 200-m depth contour line, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, through the water's edge 5 m into the terrestrial environment from the shoreline (Figure 3.2-3) between identified boundary points on the islands of: Ka‘ula, Ni‘ihau, Kaua‘i, O‘ahu, Maui Nui (including Kaho‘olawe, Lāna‘i, Maui, and Moloka‘i), and Hawai‘i. In areas where critical habitat does not extend inland, the designation ends at a line that marks mean lower low water.

Certain areas within these general boundaries were excluded from designation because they were inaccessible, lacked natural areas to support seals, presented national security benefits for exclusion, or were managed under Integrated Natural Resource Management Plans (see 80 FR 50925). The final rule became effective September 21, 2015.



Source: http://www.fpir.noaa.gov/PRD/prd_critical_habitat.html

Figure 3.2-3 Cross-section View of Designated Critical Habitat for Hawaiian Monk Seal

Behavior and life history: Female Hawaiian monk seals become reproductively active at about 6-7 years of age, on average. Births usually occur from February to August, with a peak in April to June, but can occur at other times of the year. During lactation, female monk seals do not forage (Gilmartin and Forcada 2009). Pups wean at about six weeks of age. The life expectancy of monk seals is 25-30 years, though it is uncommon for them to live this long in the wild.

Hawaiian monk seals eat a variety of fish species ranging from reef fish to deep water fish (i.e., at depths over 1,500 ft). They also eat squid, octopus, eels, and several types of crustaceans (i.e., crabs, shrimp, lobsters). (Gilmartin and Forcada 2009). Recent analyses suggest that the approximately 200 monk seals in the MHIs consume about 1300 kg/day (2900 pounds (lb)/day or 15 lb/day/seal) of prey (Sprague et al. 2013).

3.2.2.3 Non-ESA Listed Marine Mammals that Could Be Taken during PIFSC Fisheries and Ecosystem Research Activities

Species included in this section are non-ESA listed species that could be taken by M&SI during the course of PIFSC fisheries research over the next 5 years. This includes species that have been taken in analogous commercial fisheries having vulnerabilities similar to the gears used in anticipated fisheries research, primarily studies involving longline gear, but also midwater trawls and scientific instruments deployed or anchored with lines. Detailed species descriptions and take determinations are available in Appendix C of the Draft PEA published in November 2015 (the LOA Application) and, for the latter, in Table 4.2-7 of this PEA.

<u>Bottlenose Dolphin (Tursiops truncatus truncatus) – Hawaiian Islands Stock Complex: Kaua‘i/Ni‘ihau Stock, O‘ahu Stock, “4-Islands Region” (Moloka‘i, Lāna‘i, Maui, Kaho‘olawe) Stock, Hawai‘i Island Stock, and the Hawaiian Pelagic Stock</u>

Status and trends: As summarized in Carretta et al. (2012, and citations therein), recent photo-identification and genetic studies off O‘ahu, Maui, Lāna‘i, Kaua‘i, Ni‘ihau, and Hawai‘i suggest limited movement of bottlenose dolphins between islands and into offshore waters. These data suggest the existence of demographically distinct resident populations at each of the four main Hawaiian Island groups – Kaua‘i & Ni‘ihau, O‘ahu, the “4- Island Region” (Moloka‘i, Lāna‘i, Maui, Kaho‘olawe), and Hawai‘i. In addition, the genetic data indicate that the deeper waters surrounding the MHIs are utilized by a larger pelagic population. For the MMPA Pacific stock assessment reports, bottlenose dolphins within the Pacific U.S. EEZ are divided into seven stocks, five of which occur in the PIFSC research areas: (1) Kaua‘i and Ni‘ihau, (2) O‘ahu, (3) the “4-Islands Region” (Moloka‘i, Lāna‘i, Maui, Kaho‘olawe), (4) Hawai‘i Island and (5) the Hawaiian pelagic stock, including animals found both within the Hawaiian Islands EEZ and in adjacent international waters. Photo-identification studies 2012 – 2015 of 97 dolphins indicates the minimum population estimate for the Kaua‘i / Ni‘ihau stock (Baird et al. 2017 in Carretta et al. 2020).

Distribution and habitat preferences: In general, bottlenose dolphins are distributed world-wide; in the North Pacific they are commonly found as far north as the southern Okhotsk Sea, Kuril Islands, and central California. Bottlenose dolphins are distributed in tropical and warm-temperate waters that range from about 10o to 32ºC. They inhabit temperate and tropical shorelines, adapting to a variety of marine and estuarine habitats, even ranging into rivers (Wells and Scott 2009). They are primarily coastal, but do occur in pelagic waters, near oceanic islands and over the continental shelf. In many regions separate coastal and offshore populations exist and there is some evidence that these two populations occur in Hawaiian waters. As summarized in Carretta et al. (2012, and citations therein), over 99 percent of the bottlenose dolphins are known to be part of one of the insular populations which are photo-identified around the main Hawaiian Islands (Baird et al. 2009) and have been documented in waters of 1000 m or less. Based on these data, the boundaries between the insular stocks and the Hawaiʻi pelagic stock have been placed along the 1000 m isobath. Since that isobath does not separate Oʻahu from the "4-Islands Region," the boundary between those stocks would run approximately equidistant between the 500 m isobaths around Oʻahu and the "4-Islands Region," through the middle of Kaiwi Channel.

Behavior and life history: Births have been reported from all seasons with peaks during spring-summer months. Females may give birth as late as their 48th year. The bottlenose diet consists of a large variety of fish and squid but varies by region; although they do seem to prefer sciaenids (drums and croakers), scombrids (mackerels and tunas), and mugilids (mullets) (Wells and Scott 2009). Most fish consumed by bottlenose dolphins are bottom dwellers and sharks are probably the most important predators on bottlenose dolphins. As summarized in DON (2008a, and citations therein), dive durations as long as 15 minutes are recorded for trained individuals but typical dives are shallower and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 seconds at shallow depths and can last longer than 5 minutes during deep offshore dives. Offshore bottlenose dolphins regularly dive to 450 m and possibly as deep as 700 m.

Blainville's Beaked Whale (Mesoplodon densirostris)—Hawaiʻi Stock

Status and trends: Recent evaluation of 2010 shipboard line-transect survey data from the entire Hawaiian Islands EEZ resulted in an abundance estimate of 2,105 for the Hawaiʻi stock of Blainville's beaked whales (Bradford et al. 2017 in Carretta et al. 2020). The minimum population estimate is 980 whales within the Hawaiian Islands EEZ; the calculated PBR is 10 whales per year (Carretta et al. 2020).

Blainville's beaked whales are not listed as depleted or strategic under the MMPA. Information on fishery-related mortality of cetaceans in Hawaiian waters is limited, but gear types used in Hawaiian fisheries are responsible for marine mammal M&SI in other fisheries throughout U.S. waters. From 2007 to 2011, no Blainville's beaked whales were observed killed or seriously injured within the Hawaiian EEZ in the SSLL fishery (with 100 percent observer coverage) or the DSLL fishery (20-22 percent observer coverage) (Bradford and Forney 2013, Carretta et al. 2015 and citations therein). However, one Blainville's beaked whale was observed taken, but not seriously injured, in the SSLL fishery and one unidentified Mesoplodon whale and one unidentified beaked whale were taken in the SSLL fishery and both were considered to be seriously injured (Bradford and Forney 2013). Average M&SI for 2007-2011 are zero Blainville's beaked whales within or outside of the U.S. EEZs, and 0.4 Mesoplodon or unidentified beaked whales outside the U.S. EEZs (Carretta et al. 2015).

Distribution and habitat preferences: Blainville's beaked whales have a cosmopolitan distribution in tropical and temperate waters; apparently, they have the most extensive known distribution of any Mesoplodon species (Mead 1989). Analysis of Blainville's beaked whale resighting and movement data near the MHIs suggest the existence of an insular and offshore (pelagic) population of this species in Hawaiian waters and a division of an additional island-associated stock may be warranted in the future (Carretta et al. 2015 and citations therein). They prefer deep water with mean and maximum depths of 3.5 km and 5.75 km, respectively, that ranges from well-mixed to stratified (Ferguson et al. 2006). They were sighted 1000 km offshore, on average, but distance from shore ranged from 40 to over 3,700 km (Ferguson et al. 2006).

Behavior and life history: Blainville's beaked whales are usually found individually or in small social groups averaging between 3-7 individuals but have been occasionally seen in larger groups of up to 12 animals. Groups may consist of various combinations and/or be segregated depending on age or sex. Adult populations in productive waters over the continental shelf (like the Bahamas) may be grouped in harems and consist of several adult females with a single adult mature male (Jefferson et al. 2008). Males commonly battle over access to females, which is probably the cause of the long linear scars seen on individuals.

Cuvier’s Beaked Whale (Ziphius cavirostris) Hawaiian Pelagic Stock

Status and trends: Previous abundance estimates for this species of beaked whale have been imprecise and biased downward by an unknown amount because of the large proportion of time this species spends submerged. Wade and Gerrodette (1993) made an estimate for Cuvier's beaked whales in the Eastern Tropical Pacific (ETP), but it is not known whether any of these animals are part of the same population that occurs around the Hawaiian Islands. Data from a 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ were recently re-evaluated and resulted in an abundance estimate of 723 Cuvier’s beaked whales (Bradford et al. 2017 in Carretta et al. 2020). This is currently the best available abundance estimate for this stock. The minimum population estimate is 428 whales within the Hawaiian Islands EEZ with a calculated PBR of 4.3 whales per year. Cuvier’s beaked whales are not listed as depleted or strategic under the MMPA.

Distribution and habitat preferences: Cuvier’s beaked whales are distributed in all oceans and seas except the high polar regions. Cuvier’s beaked whales are generally sighted in waters >200 m deep and are frequently recorded at depths >1,000 m; they are commonly sighted around seamounts, escarpments, and canyons (Heyning and Mead 2009). In Hawai‘i, a study of Cuvier’s beaked whales spanning 21 years showed a high degree of site fidelity and showed that there was an offshore population and an island associated population (McSweeney et al. 2007). The site fidelity in the island associated population was hypothesized to take advantage of the influence of islands on oceanographic conditions that may increase productivity (McSweeney et al. 2007). Waters deeper than 1,000 m are the area of highest utilization for the Cuvier’s beaked whale in the Northeast Pacific, while water depths between 500 m and 1,000 m are less utilized. Occurrence in waters shallower than 500 m is rare (DON 2008b).

Behavior and life history: Little is known of the feeding preferences of Cuvier’s beaked whales. They may be midwater and bottom feeders on cephalopods and, rarely, fish. There is little information on beaked whale reproductive behavior. Studies by Baird et al. (2006) show that Cuvier’s beaked whales dive deeply (maximum of 1,450 m) and for long periods (maximum dive duration of 68.7 min), but also spent time at shallow depths. Tyack et al. (2006) has also reported deep diving for Cuvier’s beaked whales with a mean depth of 1,070 m and mean duration of 58 min.

Dwarf Sperm Whale (Kogia sima) -Hawaiʻi Stock

Status and trends: The Hawaiʻi stock of dwarf sperm whales includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands. Baird (2005) reports that dwarf sperm whales are the sixth most commonly sighted odontocete around the MHIs. This species' small size, tendency to avoid vessels, deep-diving habits, combined with the high proportion of Kogia sightings that are not identified to the species level, may result in negatively biased relative abundances in this region. There were no on-effort sightings of dwarf sperm whales during the 2010 shipboard survey of the Hawaiian EEZ (Carretta et al. 2020), hence there is no current abundance estimate for this stock and therefore no minimum population estimate or PBR (Carretta et al. 2020). There have been no recent records of fishery-related M&SI within the Hawaiian Islands EEZ for this stock.

Distribution and habitat preferences: Dwarf sperm whales have a worldwide distribution in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans (McAlpine 2009).

Behavior and life history: As summarized in DON (2008b, and citations therein) pygmy and dwarf sperm whales likely prey on fish and invertebrates that feed on the zooplankton in tropical and temperate waters. There is no information regarding the breeding behavior of either species. Kogia feed on cephalopods and, less often, on deep-sea fishes and shrimps. Kogia make dives of up to 25 min and median dive times of around 11 minutes have been documented. A satellite-tagged pygmy sperm whale released off Florida was found to make long nighttime dives, presumably indicating foraging on squid in the deep scattering layer (Scott et al. 2001). Most sightings are brief; these whales are often difficult to approach and they may actively avoid aircraft and vessels.

Humpback whale (*Megaptera novaeangliae*): Central North Pacific (Hawaii DPS) and American Samoa Stocks (Oceania DPS)

Status and trends: On September 8, 2016, NMFS issued a final rule that revised the global listing status of the humpback whale by dividing the species into 14 distinct DPSs (81 FR 62260). Of the 14 DPS, NMFS listed four as endangered and one as threatened. Two non-listed DPS occur in PIFSC research areas, the Hawaii DPS and Oceana DPS. These two separate populations migrate between specific summer/fall feeding areas and winter/spring calving and mating areas. The Hawaii DPS is the most abundant DPS in the North Pacific (Wade 2017) and consists of whales that breed in Hawaii and feed in the east Bering Sea, Gulf of Alaska, and northern British Columbia. The Oceania DPS consists of whales that breed/winter in the South Pacific Islands between west of New Caledonia to east of French Polynesia, including American Samoa, the Cook Islands, Fiji, French Polynesia, Republic of Kiribati, Nauru, New Caledonia, Norfolk Island, New Zealand, Niue, the Independent State of Samoa, Solomon Islands, Tokelau, Kingdom of Tonga, Tuvalu, Vanuatu, and Wallis and Futuna (81 FR 62260).

Research during the period 2015 – 2018 on humpback whales breeding in the Mariana Archipelago reported a total of 14 mother-calf pairs and 27 other non-calf pairs. Prior to 2015, the identity of this population of whales was unknown. Based on DNA sampling of these whales, they were identified as most closely related to whales that breed in the Ogasawara breeding ground and the Commander Islands feeding ground (Hill et al. 2020).

Based on photo-identification data from 2004 – 2006, an abundance estimate for the entire North Pacific Basin is 21,808 humpback whales (Barlow et al. 2011). Point estimates of abundance for Hawai‘i range from 7,469 to 10,103 whales. Currently, the minimum population estimate for the central North Pacific stock of humpback whales is 7,891 whales and the calculated PBR is 83 whales (Carretta et al. 2020).

Reports of entangled humpback whales found swimming, floating, or stranded with fishing gear attached, occur in both Alaskan and Hawaiian waters. In 2014, one central North Pacific humpback whale was seriously injured in the Hawai‘i deep-set longline fishery, resulting in a mean annual M&SI rate of 0.9 whales in this fishery between 2013 and 2017 (Bradford and Forney 2017 in Muto et al. 2020). No incidental M&SI of central North Pacific humpback whales was observed in federally-managed U.S. commercial fisheries in Alaska waters between 2013 and 2017. Minimum mean annual M&SI for the central North Pacific stock is 9.5 whales for the period 2013 – 2017 (Muto et al. 2020).

The Oceania DPS, American Samoa stock has been documented breeding and calving in American Samoa waters (Carretta et al. 2020). The feeding area of American Samoan whales is not well defined, but at least two whales from Samoa have also been seen off the Antarctic Peninsula (Robbins et al. 2011). There is currently no estimate of abundance for humpback whales in American Samoan waters. The minimum population estimate for this stock is 150 whales, based on those photo–ID data between 2003 and 2008 (Carretta et al. 2020). However, this is likely an underestimate of the true minimum population size as photo-ID studies were only conducted over a few weeks per year and there is evidence of exchange of animals between other feeding and breeding grounds (Carretta, et al. 2020). Data are not sufficient to estimate the proportion of time Oceania humpback whales spend within or outside of waters of American Samoa. Since this stock is migratory, whales likely spend at least half the year outside of the relatively small American Samoa EEZ. Therefore, the PBR allocation for U.S. waters is half of 0.8 (i.e., 0.4 whales). No human-related mortalities of humpback whales have been recorded in American Samoan waters (Carretta et al. 2020).

Distribution and habitat preferences: Humpback whales are found throughout the world’s oceans where they seasonally migrate from high latitude feeding grounds to low latitude breeding and calving areas, including the Hawaiian Islands and American Samoa. They are typically found in coastal or shelf waters in summer and close to islands and reef systems in winter (Clapham 2009). Humpbacks primarily occur near the edge of the continental slope and deep submarine canyons, where upwelling concentrates zooplankton near the surface for feeding. They often feed in shipping lanes which makes them susceptible to M&SI from large ship strikes (Douglas et al. 2008).

As summarized in Fleming and Jackson (2011), there is a high degree of interchange of humpback whales between the principal breeding and calving areas of the Hawaiian Islands, although the extent of interchange does not simply relate to distance between islands. In the coastal waters of American Samoa, humpbacks are most common to the north and west.

A 2011 report by Lammers et al. provided evidence that humpback whales use the NWHI as a wintering area. Using whale song as an indicator of winter breeding activity, Lammers et al. (2011) reported that humpback whale song was prevalent at Maro Reef, Lisianski Island, and French Frigate Shoals as well as Kure Atoll, Midway Atoll, and Pearl and Hermes Atoll. While the central North Pacific stock of humpback whales spends the boreal winters in the waters of the MHIs, humpbacks in the more southerly portions of the PIFSC research areas (e.g., NMSAS) occur during the austral winter months, beginning in June. In NMSAS, southern humpback whales mate and calve from June through September. Humpbacks arrive in American Samoa as early as June or July and remain as late as December, although they are most common during September and October (WPRFMC 2009c and citations therein).

Behavior and life history: Humpback whales are known for their spectacular aerial behaviors and the complex songs of males, the latter of which is presumably to attract females. They calve in warm tropical waters after an 11-month gestation period; calves feed independently after about 6 months. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009).

<u>Pygmy Sperm Whale (Kogia breviceps) – Hawai‘i Stock</u>

Status and trends: A 2010 shipboard line-transect survey within the Hawaiian EEZ did not result in any sightings of pygmy sperm whales (Bradford et al. 2013), hence no minimum estimate of abundance is available for pygmy sperm whales and PBR is undetermined.

Distribution and habitat preferences: Pygmy sperm whales are found throughout the world in tropical and warm-temperate waters (Caldwell and Caldwell 1989). Pygmy sperm whales have been observed in nearshore waters off O‘ahu, Maui, Ni‘ihau, and Hawai‘i Island (Shallenberger 1981, Mobley et al. 2000, Baird et al. 2013). Nothing is known about stock structure for this species.

Pygmy sperm whales have a worldwide distribution in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans (McAlpine 2009). Pygmy sperm whales are sighted primarily along the continental shelf edge and over deeper waters off the shelf. However, along the U.S. west coast, sightings of the whales have been rare, although that is likely a reflection of their pelagic distribution and small size rather than their true abundance (Carretta et al. 2012). Several studies have suggested that pygmy sperm whales live mostly beyond the continental shelf edge.

Behavior and life history: See summary for Kogia in the dwarf sperm whale account above.

Distribution and habitat preferences: False killer whales are found worldwide in tropical and warm temperate oceans and, occasionally, in cold temperate waters. They are typically pelagic, yet also occur near to shore and in shallow waters around oceanic islands (Baird 2009a).

Behavior and life history: Males and females show strong fidelity to natal social groups. Mating occurs within and between social groups, which could lead to inbreeding depression and further impact this species (Martien et al. 2011). False killer whales in Hawai‘i largely feed on fish found primarily at the surface but may also bring prey up from depth. Seven of the ten species of pelagic fish documented as prey of false killer whales from the MHI insular stock are harvested commercially: yellowfin tuna (Thunnus albacares), albacore tuna (*T. alalunga*), skipjack tuna (*Katsuwonus pelamis*), broadbill swordfish (*Xiphias gladius*), dolphin fish (or mahimahi, *Coryphaena hippurus*), wahoo (or ono, *Acanthocybium solandri*), and lustrous pomfret (or monchong, *Eumegistus illustrus*) (Baird 2009b).

Pantropical Spotted Dolphin (Stenella attenuata attenuata)—Hawaiian Islands Stock Complex: O‘ahu, “4-Islands Region”, Hawai‘i Island, and Hawai‘i Pelagic Stocks

Status and trends: There are four recognized management stocks of pantropical spotted dolphins within the Hawaiian Islands EEZ and in adjacent international waters: the O‘ahu stock, which includes spotted dolphins within 20 km of O‘ahu; the “4-Islands Region” stock, which includes spotted dolphins within 20 km of Maui, Moloka‘i, Lāna‘i, and Kaho‘olawe, collectively; the Hawai‘i Island stock, which includes spotted dolphins found within 65 km from Hawai‘i Island; and the Hawai‘i pelagic stock, which includes animals inhabiting the waters throughout the Hawaiian Islands EEZ, outside of the insular stock areas, but including adjacent high seas waters (Carretta et al. 2015, Oleson et al. 2013). Fishery interactions with pantropical spotted dolphins demonstrate that this species also occurs in U.S. EEZ waters around Palmyra Island, but it is not known whether these animals are part of the Hawaiian stock or a separate stock of pantropical spotted dolphins. Minimum population estimates are only available for the Hawai‘i pelagic stock, which has an estimated 40,338 dolphins with a calculated PBR of 403 animals. There are no recent records of fishery-related M&SI (Carretta et al. 2020).

Distribution and habitat preferences: Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin et al. 2009). Much of what is known about the species in the North Pacific has been learned from specimens obtained in the large, directed harvest in Japan and in the ETP tuna purse-seine fishery (Perrin et al. 2009). Spotted dolphins are common and abundant throughout the Hawaiian archipelago, including nearshore where they are the second most frequently sighted species during nearshore surveys (Baird et al. 2013).

Behavior and life history: Pantropical spotted dolphins often occur in large multi-species schools, particularly with spinner dolphins (Perrin 2009b). In 2006, >50 percent of the offshore spotted dolphins recorded were in mixed species schools (Jackson et al. 2008). School size ranges from a few hundred to several thousand, with mean school size of 120 in the ETP (Perrin 2009b).

Pygmy Killer Whale (Feresa attenuata) – Hawaiian Stock

Status and trends: A 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 10,640 pygmy killer whales (Bradford et al. 2017 in Carretta et al. 2020). This is currently the best available abundance estimate for this stock. The minimum population estimate for this stock is 6,998 pygmy killer whales within the Hawaiian EEZ. No data are available on current population trend and the calculated PBR is 56 pygmy killer whales.

Distribution and habitat preferences: Pygmy killer whales occur in tropical and subtropical waters worldwide (Donahue and Perryman 2009). Sightings are more common in warmer coastal waters near to Central America (Hamilton et al. 2009; Wade and Gerrodette 1993). As summarized in Carretta et al. (2015, 2012 and citations therein), most knowledge of this species in Hawaiian waters is from stranded or live-captured specimens. Several recent studies suggest that while relatively rare in Hawaiian waters, a small resident population of pygmy killer whales reside in the MHIs (Carretta et al. 2015). A 22-year study off the island of Hawai‘i indicates a year round and stable social group of pygmy killer whales, such that division of this population into a separate island-associated stock may be warranted in the future (Carretta et al. 2015).

Behavior and life history: Pygmy killer whales are generally in small schools of 12-50 animals, although larger schools have been observed. They are known to bow ride. Pygmy killer whale life history and feeding behavior is poorly understood. Remains of cephalopods and small fish have been found in stomachs of stranded and incidentally caught individuals.

Rough-Toothed Dolphin (Steno bredanensis)—Hawaiʿi Stock

Status and trends: Global estimates of abundance are lacking for this species and little is known about rough-toothed dolphin population or stock structure. However, preliminary results of genetic studies of individuals sampled from Kaua‘i/Ni‘ihau and Hawai‘i Island, together with resight data, suggest there may be at least two island-associated stocks of rough-toothed dolphins in the MHIs (Oleson et al. 2013; Jefferson 2009b).

The 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 72,528 rough-toothed dolphins (Bradford et al. 2017 in Carretta et al. 2020). This is currently the best available abundance estimate for this stock. The minimum population size is calculated as 52,833 for the Hawaiʿi stock with a PBR of 423 rough-toothed dolphins per year. Fishery interactions are not known.

Distribution and habitat preferences: Rough-toothed dolphins are a tropical to warm temperate species found in oceanic waters worldwide, as well as over continental shelf and coastal waters in some areas (Jefferson 2009b; May-Collado 2005). They are present around all the MHIs, though they are uncommon near Maui and the “4-Islands Region” (Baird et al. 2013) and have been observed close to the islands and atolls at least as far northwest as Pearl and Hermes Atoll (Bradford et al. 2013). Rough-toothed dolphins have occasionally been seen offshore throughout the EEZ of the Hawaiian Islands (Barlow 2006, Bradford et al. 2013).

Behavior and life history: Rough-toothed dolphins commonly occur in mixed schools with other delphinids and have been observed associating with flotsam (Jefferson 2009b). School size is variable, but commonly in the range of 10-20 (Jefferson 2009b). Rough-toothed dolphins feed on a variety of fish and cephalopods, and may take some large fish (Jefferson 2009b). The maximum recorded dive is 70 m. Rough-toothed dolphins, however, appear well adapted for deeper dives (Jefferson 2009b). The only life history information available is from Japan, where males reach sexual maturity at about 14 years of age and females at about 10 years old. The maximum recorded age was 32-36 years (Jefferson 2009b).

Risso’s Dolphin (Grampus griseus)—Hawaiʿi Stock

Status and trends: The Hawaiʿi stock includes animals found both within the Hawaiian Islands EEZ and in adjacent international waters; however, because data on abundance, distribution, and human caused impacts are largely lacking for international waters, the status of this stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands. The 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 11,613 Risso’s dolphins (Bradford et al. 2017 in Carretta et al. 2020); this is currently the best available abundance estimate for this stock. The minimum population estimate is 8,210 with a PBR of 82 Risso’s dolphins. Thirteen Risso’s dolphins were killed or seriously injured in the shallow-set longline between 2011 and 2015 while two were killed or seriously injured in the deep-set longline fishery for the same period (Carretta et al. 2020).

Distribution and habitat preferences: Risso's dolphins are distributed world-wide in tropical and warm-temperate waters. They seem to prefer steep edged habitat between 400 and 1000 m deep.

In the North Pacific, they can be found as far north as the Gulf of Alaska and the Kamchatka Peninsula and south to Tierra del Fuego and New Zealand (Baird 2009a).

Behavior and life history: As summarized in Baird (2009a, and citations therein), Risso's dolphins are relatively gregarious, typically traveling in groups of 10-50 individuals; the largest group reported had over 4,000 individuals. They have been observed "bow riding" and generally harassing gray whales and are often seen surfing in swells. Gestation is 13-14 months and calving intervals are about 2.4 years with peak calving during winter in the eastern North Pacific. Sexual maturity for females is thought to be 8-10 years of age and males 10-12 years of age. They feed almost exclusively on squid, likely at night (Baird 2009a).

Short-Finned Pilot Whale (Globicephala macrorhynchus)—Hawaiʿi Stock

Status and trends: The 2010 shipboard line-transect survey of the Hawaiian Islands EEZ resulted in an abundance estimate of 19,503 short-finned pilot whales (Bradford et al. 2017 in Carretta et al. 2020). This is currently the best available abundance estimate for short-finned pilot whales within the Hawaiian Islands EEZ. The minimum population size is estimated as 13,197 short-finned pilot whales, resulting in a PBR of 106.

Distribution and habitat preferences: The short-finned pilot whale is found in tropical to warm-temperate seas; they are commonly observed around the MHIs and are also present around the NWHIs (Shallenberger 1981, Barlow 2006, Baird et al. 2013, Bradford et al. 2013). Worldwide, pilot whales usually are found over the continental shelf break, in slope waters, and in areas of high topographic relief, but movements over the continental shelf and close to shore at oceanic islands can occur (Carretta et al. 2015).

Behavior and life history: Pilot whales are very social and may travel in groups of several to hundreds of animals, often with other cetaceans. They appear to live in relatively stable, female-based groups (DON 2008b). Sexual maturity occurs at 9 years for females and 17 years for males. The mean calving interval is 4 to 6 years. Pilot whales are deep divers; the maximum dive depth measured is about 971 m (Baird et al. 2002). Short-finned pilot whales feed on squid and fish. Stomach content analysis of pilot whales in the Southern California Bight consisted entirely of cephalopod remains. The most common prey item identified was *Loligo opalescens*, which has been documented in spawning concentrations at depths of 20-55 m.

Striped Dolphin (Stenella coeruleoalba)—Hawaiian Stock

Status and trends: Striped dolphins within the Pacific U.S. EEZ are divided into two discrete, non-contiguous areas: 1) waters off California, Oregon and Washington, and 2) waters around Hawaiʻi, including animals found both within the Hawaiian Islands EEZ and in adjacent international waters (Carretta et al. 2015). The abundance of striped dolphins in this region appears to be variable between years and may be affected by oceanographic conditions. The 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in an abundance estimate of 61,021 striped dolphins (Bradford et al. 2017 in Carretta et al. 2020). This is currently the best available abundance estimate for this stock. The minimum population estimate is 44,922 striped dolphins with a PBR of 449 dolphins. Fishery interactions are not known.

Distribution and habitat preferences: Striped dolphins are found in tropical to warm-temperate waters throughout the world (Perrin et al. 2009). In the Hawaiʻi region, sightings have historically been infrequent in nearshore waters (Carretta et al. 2015 and references therein). Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters and are often associated with convergence zones and waters influenced by upwelling.

Behavior and life history: As summarized from Archer (2009, and references therein), mating is seasonal and gestation lasts 12-13 months. Females become sexually mature between 5 and 13 years of age and males mature between 7 and 15 years of age. Striped dolphins are acrobatic and perform a variety of aerial behaviors but they do not commonly bow ride. They often feed in pelagic or benthopelagic zones along the continental slope or just beyond it in oceanic waters. The species feeds on a variety of pelagic and benthopelagic fish and squid. A majority of their prey possesses luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 200 to 700 m to reach potential prey. Striped dolphins may feed at night in order to take advantage of the deep scattering layer's diurnal vertical movements (Archer 2009).

Spinner dolphin (Stenella longirostris)

Status and trends: For the MMPA stock assessment reports, there are seven stocks of spinner dolphins found within the PIFSC fisheries research areas: 1) Hawaiʻi Island, 2) Oʻahu/”4-Islands Region”, 3) Kauaʻi/Niʻihau, 4) Pearl and Hermes Atoll, 5) Kure/Midway, 6) Hawaiʻi pelagic, including animals found both within the Hawaiian Islands EEZ (outside of island-associated boundaries) and in adjacent international waters, and 7) the American Samoa stock, which includes animals inhabiting the EEZ waters around American Samoa. The 2012 abundance estimate of 665 dolphins is based on models that used the most complete dataset (Tyne et al. 2016). These are the best available and most recent abundance estimates for this stock. Considerable seasonal variation). Between 2012 and 2016 no spinner dolphins were hooked or entangled in deep-set or shallow-set longline fisheries in the U.S. Hawaiʻi EEZ or high seas (Bradford 2018 in Carretta et al 2020).

Distribution and habitat preferences: Spinner dolphins occur in all tropical and most sub-tropical waters between 30-40o N and 20-40o S latitude; generally, in areas with a shallow mixed layer, shallow and steep thermocline, and little variation in surface temperatures (Perrin 2009a). Within the central and western Pacific, spinner dolphins are island-associated and use shallow protected bays to rest and socialize during the day then move offshore at night to feed. They are common and abundant throughout the entire Hawaiian archipelago (Carretta et al. 2012, and citations therein).

Behavior and life history: The most conspicuous behavior of the spinner dolphin – the spinning for which the species is named – is a mystery. Theories as to why spinners spin include communication, play, and dislodging remoras (Perrin 2009a). School size varies from a few animals to over a thousand. Mixed schools with other species, particularly pantropical spotted dolphins, are common (Perrin 2009a). Mating appears to be promiscuous. Gestation is about 10 months and breeding is seasonal. Females reach sexual maturity at 4-7 years, and males at 7-10 years. Calving interval is 3 years and calves nurse for 1-2 years (Perrin 2009a).

3.2.3 Birds

Numerous bird species occur within the PIFSC research areas. This section of the PEA provides baseline information for species important to the analysis of effects in Chapter 4, including ESA-listed bird species and others which may potentially interact with research vessels and gear.

3.2.3.1 Threatened and Endangered Species

The ESA allows the USFWS to list bird species as endangered or threatened regardless of which country the species lives in. Although greater legal protections are given to ESA-listed species within the U.S. EEZ, the law also provides protection to listed species wherever they occur from potentially adverse interactions with people and entities subject to U.S. jurisdiction, such as PIFSC and its researchers. Table 3.2-4 identifies the ESA-listed species that may interact with marine fisheries and ecosystem research activities and their occurrence within the four PIFSC research areas: HARA, MARA, ASARA, and WCPRA. There are numerous other listed species that occur in these areas that are primarily terrestrial (see http://www.fws.gov/pacificislands/teslist.html) and unlikely to interact with PIFSC fisheries and ecosystem research activities.

On December 14, 2016, PIFSC initiated informal consultation with the USFWS regarding potential effects of proposed research on ESA-listed birds listed in Table 3.2-4 (as well as sea turtles; see Section 3.2.4). The USFWS concurred with PIFSC in a response letter dated February 21, 2017 that proposed research is not likely to adversely affect the ESA-listed bird (or turtle) species discussed herein (Consultation No. 01EPIF00-2017-1-0073).

Table 3.2-4 ESA-listed Seabirds and Landbirds Occurring in the PIFSC Research Areas

Species		HARA	MARA	ASARA	WCPRA	Federal ESA Status
Common Name	Scientific Name					
Short-tailed albatross	*Phoebastria albatrus*	X			X	Endangered
Hawaiian dark-rumped petrel	*Pterodroma sandwichensis*	X				Endangered
Band-rumped storm petrel	*Oceanodroma castro*	X				Endangered
Newell's shearwater	*Puffinus auricularis newelli*	X	X	X	X	Threatened
Nihoa millerbird	*Acrocephalus familiaris kingi*	X				Endangered
Nihoa finch	*Telespiza ultima*	X				Endangered
Laysan finch	*Telespiza cantans*	X				Endangered
Laysan duck	Anas laysanensis	X				Endangered
Andrew's frigate bird	*Fregata andrewsi*				X	Endangered

Short-tailed Albatross

The short-tailed albatross (*Phoebastria albatrus*) is the largest of the three albatross species found in the north Pacific Ocean. The species used to be the most abundant albatross in the north Pacific but was almost exterminated by feather and meat hunters on its Japanese breeding grounds in the early 1900s. The short-tailed albatross was listed as endangered by the USFWS in 2000 and a Final Recovery Plan was published in 2008 (USFWS 2008). Conservation efforts have helped the population grow at near-maximum rates but the total population is still less than 3000 birds (USFWS 2009a). In January 2014 a short-tailed albatross chick hatched on Midway Atoll; only the third hatching in recorded history on any place other than two small islands near Japan

(USFWS 2014a). Major threats to this species include natural threats to their nesting habitat on volcanic islands, mortality in longline fisheries, and ingestion of plastic debris (USFWS 2008).

Hawaiian Dark-rumped Petrel

The Hawaiian dark-rumped petrel (*Pterodroma sandwichensis*) occurs in the central subtropical Pacific and nests only in the Hawaiian Islands. This species was listed as an endangered species by the USFWS in 1967 due to its limited distribution and the marginal status of known breeding populations. The Hawaiian dark-rumped petrel and Newell's shearwater recovery plan was finalized in 1983 (USFWS 1983). Major threats to this species include attraction to and disorientation by artificial lights leading to exhausted birds landing in dangerous situations and colliding with power lines and other structures, habitat destruction, and predation by non-native terrestrial mammals (USFWS 2011a).

Band-rumped Storm Petrel

The Hawaiʻi DPS of the band-rumped storm petrel (*Oceanodroma castro*) was listed as an endangered species on September 30, 2016 (81 FR 67786). This species is found in several areas of the subtropical Pacific and Atlantic Oceans (del Hoyo et al. 1992). In Hawaiʻi, band-rumped storm-petrels are known to nest in remote cliff locations on Kauaʻi and Lehua Island, in steep open to vegetated cliffs, and in little vegetated, high-elevation lava fields on Hawaiʻi Island (Wood et al. 2002, p. 17-18; VanderWerf et al. 2007, pp. 1, 5; Joyce and Holmes 2010, p. 3; Banko 2015 in litt.; Raine 2015, in litt.). Vocalizations were heard in Haleakalā Crater on Maui in 1992 (Johnston 1992, in Wood et al. 2002, p. 2), on Lānaʻi (Penniman 2015, in litt.), and in Hawaiʻi Volcanoes National Park (Orlando 2015, in litt.). Based on the scarcity of known breeding colonies in Hawaiʻi and their remote, inaccessible locations today compared to prehistoric population levels and distribution, the band-rumped storm-petrel appears to be significantly reduced in numbers and range following human occupation of the Hawaiian Islands, likely as a result of predation by nonnative mammals and habitat loss.

Newell's Shearwater

Newell's shearwaters (*Puffinus auricularis newelli*) occur in the central subtropical Pacific and breed exclusively in the Hawaiian Islands (Ainley et al. 1997). This species was listed as threatened in 1982 due to limited distribution and the marginal status of known breeding populations (USFWS 1983). Major threats to this species include predation on nesting grounds by non-native terrestrial mammals, human disturbance, destruction of nesting habitat, and attraction to artificial light. The Newell's Shearwater depends on tuna to force prey within its reach. These tuna are targeted in commercial fisheries which decrease their abundance and cause foraging shearwaters to exert more energy to find schools of tuna (Ainley et al. 1997).

Nihoa Millerbird

The Nihoa millerbird (*Acrocephalus familiaris kingi*) was listed as an endangered species by the USFWS in 1967 due to its limited distribution and the marginal status of known breeding populations. This species is endemic to the steep, rocky island of Nihoa in the Northwestern Hawaiian Islands. existing data do suggest that millerbird numbers on Nihoa have experienced pronounced fluctuations and have likely ranged between fewer than 50 and more than 800 individuals (H. Freifeld in litt. 2010), with the most recent estimates of 507 ± 295 individuals in

September 2010 and 775 ± 298 individuals in September 2011 (Kohley et al. 2010 VanderWerf et al. 2011). These fluctuations have had a significant impact on the genetic diversity of the remaining population, with the effective number of breeders being estimated as between 5 and 13 individuals (using samples collected in 2007 and 2009 [Addison et al. 2011]). Severe weather events such as hurricanes may cause direct mortality of millerbirds; a single severe storm could extinguish the entire population (H. Freifeld in litt. 2010). Since the species has an extremely small range and has severely low levels of genetic diversity, it is particularly vulnerable to extinction through exposure to disease (NOAA 2016).

Nihoa Finch

The Nihoa finch (*Telespiza ultima*) was listed as an endangered species in 1967 pursuant to the Endangered Species Preservation Act of 1966. This species is restricted to the steep, rocky island of Nihoa in the Northwestern Hawaiian Islands. (Berger 1972, Morin et al. 1997). Numbers fluctuate (James and Olson 1991, Morin and Conant 2002), although some variation may be due to differences in survey methods and time of year. Numbers on Nihoa have ranged from 6,686 in 1968 to 946 in 1987 (James and Olson 1991, Morin and Conant 2002). The most recent population estimate based on surveys in 2012 is 4,475 (±909, 95% CI) individuals (VanderWerf 2012), which very roughly equates to 3,000 (2,400-3,600) mature individuals. Threats to this species include grasshoppers (due to defoliating finch habitat), disease, drought, hurricanes, non-native plants, fire, and black rats (NOAA 2016).

Laysan Finch

The Laysan finch (*Telespiza cantans*) was listed as an endangered species by the USFWS in 1967 due to its limited distribution and the marginal status of known breeding populations. This species is confined to Laysan Island in the Northwestern Hawaiian Islands, as well as on two very tiny islands in the Hermes and Pearl Atoll, with around 30-50 birds, down from 772 in 1986 (Morin and Conant 2002), persisting from an introduction in 1967 (S. Conant in litt. 2007). Today, the primary forces regulating this species' population are storms and drought, which can cause almost total nest failure (Morin 1992a). Global warming is a further cause for concern, given that the maximum altitude on Laysan is only 12 m and that, as well as predicted sea-level rises of 0.5-2.0 m by 2100, the frequency and severity of hurricanes and droughts are expected to increase as a consequence (McNeely et al. 1995, Moulton and Marshall 1996).

Laysan Duck

The Laysan duck (*Anas laysanensis*) is endemic to the Hawaiian Islands where it became confined to Laysan. This species was listed as endangered in 1967 due to its limited distribution and the marginal status of known breeding populations. Since the early 1990s, the population gradually increased, reaching an estimated 521 birds in 2010 (M. Reynolds in litt. 2011). In 2014, 28 individuals were translocated from Midway Atoll to Kure Atoll, a mammalian predator-free island which lies approximately 1,350 miles (2,173 km) north-west of Honolulu (Ward and Fredrickson 2014). As of early May 2015, 19 ducklings had hatched on the island (Anon. 2015). A 2011 tsunami may have reduced the Laysan population by as much as 50 percent and the Midway population by as much as 20 to 30 percent (J.R. Walters *in litt*. 2013 as cited in NOAA 2016).

Andrew’s Frigate Bird

The Anrew’s frigate bird *(Fregata andrewsi)* is native to Asia, Australia, and Indian Ocean, but are rarely observed in the Line Islands of the WCPRA (USFWS, personal communication, comments on DPEA January 2016). They are solitary, diurnal carnivores. Most of their time is spent at sea, the minimal time that is spent on land is for roosting and breeding (https://animaldiversity.org/accounts/Fregata_andrewsi/).
They are listed as endangered throughout their range (https://eol.org/pages/45516067).

Phoenix Petrel

The Phoenxi petral (*Pterodroma alba*) is distributed throughout the central Pacific and breed on the Line Islands of the WCPRA (https://birdsoftheworld.org/bow/species/phopet1/cur/introduction). they are marine paelagic birds but visit land colononies in the day and early evening. they feed mostly on squid. Phoenix petrels are endangered thoughout their range (http://datazone.birdlife.org/species/factsheet/phoenix-petrel-pterodroma-alba).

3.2.3.2 Other Bird Species

There are many seabird species that occur in the four PIFSC fisheries research areas which may potentially interact with research vessels and gear. However, birds have never been caught incidentally in PIFSC fisheries surveys. The following accounts describe conservation concerns for seabirds in each of the four PIFSC research areas. Table 3.2-5 gives an overview of the marine bird communities found within the research areas.

Hawaiian Archipelago

Threats to seabirds in the Hawaiian Archipelago include: urban development and habitat loss; introduced species (cats, dogs, rats, and mongoose); longline fishery; oil spills; contaminants; physical and chemical effects of plastics; global warming and sea level rise. Longline fisheries can be a serious threat to seabird populations worldwide, and particularly affect surface-feeding albatrosses while the gear is being set. The pelagic longline fishery in Hawaiʻi targets tuna, billfish, oceanic sharks, and swordfish, and has killed approximately 1000-3000 each of Laysan and black-footed albatrosses annually from 1994 to 1998 (USFWS 2005). Seabird mortality decreased while swordfish fishing was banned in 2001-2004. Mitigation measures to protect seabirds and sea turtles are now required on Hawaiian based longline vessels. Recent mitigation measures include shorter leaders that place weighted swivels closer to hooks, reducing the likelihood of baited hooks becoming available to surface-scavenging albatrosses (Gilman et al. 2014).

On Midway Atoll, Laysan (*Phoebastria immutabilis*) and black-footed albatrosses (*Phoebastria nigripes*) are exposed to lead contamination, from lead-based paint that has flaked off of deteriorating buildings and contaminated the soil. Chicks ingest the contaminated soil and paint chips causing lead contamination and poor fledgling success. Midway Atoll supports the world's largest Laysan albatross colony (TenBruggencate 2006, USFWS 2005). The hook-and-line troll fishery can also cause seabirds to become entangled in gear. Feral cats and the Indian mongoose are present on most of the main Hawaiian Islands and have been implicated in the near extinction of the Hawaiian dark-rumped petrel and the Newell's Shearwater (USFWS 2005).

Mariana Archipelago

Major threats to seabirds in this research area include: longline fishery; introduced species (rats, monitor lizard, and brown tree snake); oil pollution; global warming and sea level rise. Oil spills in this area have been originating from vessels that sank during WWII (USFWS 2005).

American Samoa Archipelago

Threats to seabirds in the American Samoa Archipelago include introduced species (cats and rats), longline fishery, global warming, and sea level rise. Since 1995, the pelagic longline fishery replaced most of the troll-based fishery in American Samoa (USFWS 2005).

Pacific Remote Islands

Threats to seabirds on the Pacific Remote Islands include: introduced species (cats and rats); contamination; global warming; exposure and ingestion of marine debris (e.g., nets, monofilament, plastic) and sea level rise. On Jarvis Island, cats were responsible for killing an estimated 24,000 seabirds each year, and only four breeding species remained by the time that cats were eradicated from the island (USFWS 2005). In 2011, the USFWS implemented a rat eradication project on Palmyra Atoll (USFWS 2011b). Cats and rats have now been completely eradicated from most of the Pacific Remote Islands. Seabirds in the Pacific Remote Islands are at risk from various contaminants from historic military operations (USFWS 2005).

Table 3.2-5 Other Bird Species Occurring in the PIFSC Research Areas

Species	Scientific Name	HARA	MARA	ASARA	WCPRA
Black-footed albatross	*Phoebastria nigripes*	X			X
Laysan albatross	*Phoebastria immutabilis*	X			X
Wedge-tailed shearwater	*Puffinus pacificus*	X	X	X	X
Audubon's shearwater	*Puffinus lherminieri*		V	X	
Christmas shearwater	*Puffinus nativitatis*	X		X	X
Flesh-footed shearwater	*Puffinus carneipes*	X			
Sooty shearwater	*Puffinus griseus*	X			
Bonin petrel	*Pterodroma hypoleuca*	X			
Bulwer's petrel	*Bulwera bulwerii*	X			
Tahiti petrel	*Pseudobulweria rostrate*	V		X	
Herald petrel	*Pterodroma heraldica*	V		X	
Collared petrel	*Pterodroma brevipes*			X	
Mottled petrel	*Pterodroma inexpectata*	X		V	
Phoenix petrel	*Pterodroma alba*			V	
Petrels	*Pseudobulweria* spp., *Pterodroma* spp.				X
Leach's storm-petrel	*Oceanodroma leucorhoa*	X	V		
Matsudaira's storm-petrel	*Oceanodroma matsudairae*		V		
Tristrams storm petrel	*Oceanodroma tristrami*	X			
White-bellied storm-petrel	*Fregetta grallaria*			V	
Polynesian storm-petrel	*Nesofregetta fuliginosa*			V	

Species	Scientific Name	HARA	MARA	ASARA	WCPRA
Red-footed booby	*Sula sula*	X	X	X	X
Brown booby	*Sula leucogaster*	X	X	X	X
Masked booby	*Sula dactylatra*	X	X	X	X
White-tailed tropicbird	*Phaethon lepturus*	X	X	X	X
Red-tailed tropicbird	*Phaethon rubricauda*	X	X	X	X
Great frigatebird	*Fregata minor*	X	X	X	X
Lesser frigatebird	*Fregata ariel*	X		X	X
Common fairy-tern (white tern)	*Gygis alba*	X	X	X	X
Little tern	*Sternula albifrons*	X			
Spectacled tern	*Onychoprion lunatus*	X			
Sooty tern	*Sterna fuscata*	X	X	X	X
Black-naped tern	*Sterna sumatrana*			V	
Brown noddy	*Anous stolidus*	X	X	X	X
Black noddy	*Anous minutus*	X	X	X	X
Blue-gray noddy	*Procelsterna cerulean*	X		X	
Laughing gull	*Larus atricilla*	X		V	

Notes:
V = Visitor

3.2.4 Sea Turtles

Five species of sea turtles occur within the PIFSC research areas: green, hawksbill, leatherback, loggerhead, and olive ridley sea turtles (See Table 3.2-6). The two most common species found in the nearshore environment in the Pacific Islands Region are green and hawksbill sea turtles. PIFSC research activities cover an extremely large area, much of which is uninhabited, so while there are not documented sightings for all life stages and associated size classes, it is likely that they occur within the PIFSC research areas.

Table 3.2-6 Occurrences of Marine Turtles in the Four PIFSC Research Areas

Species	HARA	MARA	ASARA	WCPRA
Green sea turtle	N	N	N	X
Hawksbill sea turtle	N	N	N	X
Leatherback sea turtle	X	X	X	X
Loggerhead sea turtle	X	-	-	X
Olive ridley sea turtle	X	-	X	X

N – Nesting occurs within this research area.

Notes: This table shows the documented occurrences of marine turtles in the respective research areas. It is possible that leatherback, loggerhead, and olive ridley sea turtles occur in the Pacific Remote Islands, but since the area is remote and uninhabited, those occurrences have not been documented, so are not shown here.

Additional background information on the range-wide status of these species has been published in a number of documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995, Hirth 1997), as well as recovery plans for the green sea turtle (NMFS and USFWS 1998a), hawksbill sea turtle (NMFS and USFWS 1998b), leatherback sea turtle (NMFS and USFWS 1998c), loggerhead sea turtle (NMFS and USFWS 1998d), and olive ridley sea turtle (NMFS and USFWS 1998e).

3.2.4.1 Threatened and Endangered Species

All of the sea turtles found in the area of the PIFSC research activities are listed as threatened or endangered under the ESA. On December 14, 2016, PIFSC initiated informal consultation with the USFWS regarding potential effects of proposed research on ESA-listed sea turtles listed in Table 3.2-6 (as well as seabirds). The USFWS concurred with PIFSC in a response letter dated February 21, 2017, that proposed research is not likely to adversely affect the ESA-listed sea turtle (or bird) species discussed herein (Consultation No. 01EPIF00-2017-1-0073).The following sections describe these species and their occurrences in each of the PIFSC research areas.

Table 3.2-7 ESA-listed Sea Turtles found within the PIFSC Research Areas

Common Name	Scientific Name	Status
Green sea turtle	*Chelonia mydas*	Threatened[1]
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Endangered2
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened

Notes:

1. Central North Pacific DPS in the HARA, Central West Pacific DPS in the MARA, and Central South Pacific DPS in the ASARA
2. North Pacific Ocean DPS (north of the equator and south of 60° north latitude) and South Pacific Ocean DPS (south of the equator, north of 60° south latitude, west of 67° west longitude, and east of 141° east longitude)

Green Sea Turtle

Green sea turtles (Chelonia mydas) are a circumglobal and highly migratory species, nesting and feeding in tropical and subtropical regions with a preference for water temperatures above 20°C

(68°F) (WPRFMC 2009a). A comprehensive status review of the species was conducted and published as the ‘‘Status Review of the Green Turtle (Chelonia mydas) under the Endangered Species Act’’ (Seminoff et al. 2015). Based on the best scientific information presented in the status review, a final rule was published on March 23, 2015 (80 FR 15271) which removed the existing ESA listings, changing them to three endangered DPSs and eight threatened DPSs. PIFSC research areas are within three different DPSs: the Central North Pacific DPS in the HARA, the Central West Pacific DPS in the MARA, and the Central South Pacific DPS in the ASARA.

The life cycle of the green sea turtle involves a series of long-distance migrations to and from their feeding and nesting areas (Craig 2002). Green sea turtles often return to the same foraging areas following subsequent nesting migrations, then move within specific areas or home ranges where they seek out specific habitats for foraging and resting. However, some green sea turtles remain in the open-ocean environment for extended periods of time and may never recruit to coastal foraging locations (NMFS and USFWS 2007a).

Mortality related to commercial fishing accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities such as dredging, pollution, and habitat destruction account for an unknown level of other mortality. Removal of green sea turtles has been recorded by sea sampling coverage in the pelagic driftnet, pelagic longline, sea scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries (WPRFMC 2009a).

Green Sea Turtles in the HARA

Green sea turtles are known in Hawaiian as honu. In the Pacific, the only major (> 2,000 nesting females) populations of green turtles occur in Australia and Malaysia. Smaller colonies occur in the insular Pacific islands of Polynesia, Micronesia, and Melanesia (Wetherall 1993) and on six small sand islands at French Frigate Shoals, a long atoll situated in the middle of the Hawaiian Archipelago (Balazs et al. 1994). Approximately 90-95 percent of the nesting and breeding activity in the HARA occurs at the French Frigate Shoals, and at least 50 percent of that nesting takes place on East Island. In October 2019, Hurricane Walaka washed away approximately 11 acres of East Island, resulting in losing approximately 19 percent of nests laid by green turtles that year. East Island is now effectively gone, leaving only Tern and Gin Islands for suitable nesting habitat in these shoals (https://www.fisheries.noaa.gov/feature-story/motherload-story-fertile-turtle-hawaiian-islands). Long-term monitoring studies suggest that there is strong island fidelity within the regional rookery. Low-level nesting also occurs at Laysan Island, Lisianski Island, and on Pearl and Hermes Atoll (NMFS and USFWS 1998a).

The nesting population of Hawaiian green turtles has gradually increased following the establishment of the ESA in 1973 (Balazs 1996; Balazs and Chaloupka 2004). Between 1973 and 1977, the mean annual nesting abundance of green sea turtles on East Island was 83 females. Nester abundance increased rapidly at this rookery during the early 1980s, leveled off during the early 1990s, and again increased rapidly during the late 1990s to the present. The most recent survey from 2002 to 2006 counted a mean annual nesting abundance of 400 females. This increase over the last 30 years corresponds to an approximate increase of 5.7 percent per year (NMFS and USFWS 2007a). This increase is likely attributed to increased female survivorship since the harvesting of turtles was prohibited in addition to the cessation of habitat damage at the nesting beaches since the early 1950s (Balazs and Chaloupka 2004). While the Hawaiian green sea turtle stock has exhibited a sustained increase in nesting females since its protection 25 years ago, there are still substantial threats to the survival of the population (e.g., rising sea levels and the subsequent loss of nesting habitat in the NWHI, disease, loss of shoreline in the MHI, marine debris). A major gap would be created in the global range of the species if all turtles were lost from this vast geographic area (Seminoff et al. 2015).

Green Sea Turtles in the MARA

Green sea turtles are known in Chamorro, the indigenous language of the Mariana Islands, as *haggan*. An estimated 1,000 to 2,000 green sea turtles forage in the MARA, including the islands of Rota, Tinian, and Saipan (NOAA 2005).

For the Central West Pacific DPS, there are approximately 51 nesting sites and 6,518 nesting females (Seminoff et al. 2015). Nesting surveys for green sea turtles in Guam have been conducted since 1973 with the most consistent data collected since 1990. The annual number of nesting females on Guam from 1990 to 2001 fluctuated between 2 and 60 females (NMFS and USFWS 2007a). More recently, aerial surveys from 1994 to 2002 show a fairly constant nearshore abundance of 150 to 250 nesting females on Guam (Cummings 2002).

The green sea turtle is a traditional food of the native population and although harvesting them is illegal, divers have been known to take them at sea and others have been taken as nesting females (NMFS and USFWS 2007 as cited in Seminoff et al. 2015). Turtle eggs are also harvested in the CNMI. Nesting beaches and seagrass beds on Tinian and Rota are in good condition but beaches and seagrass beds on Saipan have been impacted by hotels, golf courses and general tourist activities (WPRFMC 2009b).

Green Sea Turtles in the ASARA

Green sea turtles are known as laumei ena`ena and fonu in native Samoan. The only confirmed nesting area within the ASARA is at Rose Atoll, with an estimated 25 to 35 nesting females (NMFS and USFWS 1998a). Green turtles leave Rose Atoll When they finish laying their eggs and migrate to their feeding grounds somewhere else in the South Pacific. After several years, the turtles will return to Rose Atoll to nest again. Every turtle returns to the same nesting and feeding areas throughout its life, but that does not necessarily imply that all turtles nesting at Rose Atoll will migrate to exactly the same feeding area (WPRFMC 2009c). A tagging study, conducted in the mid-1990s tracked eight tagged green sea turtles by satellite telemetry from their nesting sites at Rose Atoll to Fiji (Balazs et al. 1994).

Green Sea Turtles in the WCPRA

Green sea turtles are reported to nest at Palmyra and Jarvis Islands within the WCPRA. Resident green sea turtles inhabit the lagoon waters of Wake and Palmyra Atolls. Green turtles have also been observed around Howland Island, Baker Island, Kingman Reef, and Johnston Atoll but nesting at these areas is unknown.

Seawall construction at Johnston Atoll negates the potential for nesting while military hazardous and toxic wastes have contaminated the coastal waters (NMFS and USFWS 1998a). Beach erosion has been targeted as a problem at Palmyra Atoll, causing barriers to adult and hatchling turtle movements, and degrading nesting habitat. When the U.S. military occupied Palmyra during World War II, their base was along the coast of a northern island about 5 km from known turtle nesting and feeding areas (WPRFMC 2009d).

Hawksbill Sea Turtle

Hawksbill sea turtles (Eretmochelys imbricata) occur from approximately latitudes 30° N to 30° S within the Atlantic, Pacific, and Indian Oceans and associated bodies of water (NMFS and USFWS 1998b). They feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. Hawksbill turtles use different habitats at different stages of their life cycle but are most commonly associated with healthy coral reefs (WPRFMC 2009a).

The oceanic stage of juvenile hawksbill sea turtles are believed to occupy the pelagic environment. In the Pacific, the pelagic habitat of hawksbill juveniles is unknown. After a few years in the pelagic zone, small juveniles recruit to coastal foraging grounds; their size at recruitment is approximately 15 inches (38 cm) in carapace length in the Pacific. This shift in habitat also involves a shift in feeding strategies, from feeding predominantly at the surface to feeding below the surface primarily on animals associated with coral reef environments. In the Indo-Pacific, hawksbills continue eating a varied diet that includes sponges, other invertebrates, and algae (NMFS 2013). After reproduction, some turtles remain close to their rookery and others are highly mobile, traveling hundreds to thousands of km between nesting and foraging areas (NMFS and USFWS 2013a).

Hawksbills face threats on both nesting beaches and in the marine environment with the primary global threat to hawksbills being the loss of coral reef communities. In the Pacific, directed harvest of nesting females and eggs on the beach and hawksbills in the water is still widespread. Directed mortality is a major threat to hawksbills in American Samoa, Guam, the Republic of Palau, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, and the Republic of the Marshall Islands (NMFS and USFWS 1998b). In addition to directed harvest, increased human presence is a threat to hawksbills throughout the Pacific. In particular, increased recreational and commercial use of nesting beaches, beach camping and fires, litter and other refuse, general harassment of turtles, and loss of nesting habitat from human activities negatively impact hawksbills. Incidental capture in fishing gear (primarily in gillnets and monofilament) and vessel strikes also adversely affect the species' recovery (NMFS 2013).

Hawksbill Sea Turtles in the HARA

Hawksbill sea turtles are known in Hawaiian as honu‘ea or ‘ea. Hawksbill turtles occur in waters around the Hawaiian Archipelago and nest on Maui and the southeast coast of the Big Island (WPRFMC 2009a). There are fewer than 20 annual nesting females in Hawai‘i, a substantial drop from the historical abundance of this species (NMFS and USFWS 2013a). Most of these nesting sites are used consistently by nesting hawksbills and appear critical to species reproduction in Hawai‘i.

The primary threats to the Hawaiian population of nesting hawksbill sea turtles are incompatible human activity, non-native egg and hatchling predators, habitat loss by invasive weeds, changes in beach conformation, volcanism, and tidal inundation resulting in nest overcrowding and/or damage to nests and injury to hatchlings (NMFS and USFWS 2013a).

Hawksbill Sea Turtles in the MARA

Hawksbill sea turtles are known in Chamorro as *haggan* karai. Approximately 5-10 annual nesting hawksbill females occur in the MARA (NMFS and USFWS 2013a). In 2009, four hawksbill nests and in 2010, three hawksbill nests were reported on the Island of Guam (Guam

Division of Aquatic and Wildlife Resources [DAWR] 2011). The populations of hawksbill sea turtles in Guam are thought to be declining (NMFS and USFWS 2013a).

Hawksbill Sea Turtles in the ASARA

Hawksbill turtles are known in Samoan as laumei uga. Fewer than 30 annual nesting females are reported in the ASARA (NMFS and USFWS 2013a). Between October 2011 and March 2012, a total of six hawksbill nests were documented on two beaches on the island of Ofu (Tagarino 2012). They are most commonly found at Tutuila Island and the Manu‘a Islands and are also known to nest at Rose Atoll and Swains Island (Utzurrum 2002).

Hawksbill Sea Turtles in the WCPRA

There are no records of hawksbill turtles nesting in the WCPRA (NMFS and USFWS 2013a). However, the hawksbill sea turtle is regularly sighted in the waters of Palmyra Atoll and has been reported from Baker, Howland, and Jarvis Islands (WPRFMC 2009d). The waters around the WCPRA may provide marine feeding grounds for this species (NMFS and USFWS 1998b).

<u>Leatherback Sea Turtles</u>

Leatherback sea turtles (Dermochelys coriacea) are globally distributed from approximately 71°N to 47° S Latitude and nest from 38°N to 34°S latitude (NMFS and USFWS 2013b). The leatherback sea turtle is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances that allow it to forage into the colder waters (NMFS and USFWS 1995). They can consume twice their own body weight in prey per day, feeding exclusively on soft-bodied invertebrates like jellyfish and tunicates. Sea nettle jellyfish and other species of the genus Chrysaora are preferred prey for leatherback sea turtles. The Pacific Ocean leatherback population is generally smaller in size than that in the Atlantic Ocean. In the Pacific, the International Union for the Conservation of Nature notes that most leatherback nesting populations have declined more than 80 percent. In other areas of the leatherback's range, observed declines in nesting populations are not as severe, and some population trends are increasing or stable (WPRFMC 2009a).

Leatherback turtles forage widely in temperate pelagic waters, and only leave their pelagic lifestyle during the nesting season when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been proposed that mating most likely takes place outside of tropical waters before females move to their nesting beaches (Eckert and Eckert 1988). Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Eckert 1998). Leatherback may swim more than 10,000 km in a single year (Eckert 1998). There are no known nesting grounds at any of the PIFSC research areas.

Declines in the leatherback population have resulted from fishery interactions as well as exploitation of the eggs (Spotila et al. 1996). Eckert and Eckert (2005) and Spotila et al. (1996) reported that adult mortality has also increased substantially, particularly as a result of driftnet and longline fisheries. The sharp decline in leatherback populations has been attributed to the combination of the loss of long-lived adults in fishery related mortality, and the lack of recruitment, stemming from elimination of annual influxes of hatchlings because of egg harvesting. Leatherbacks are also susceptible to entanglement in lobster and crab pot gear (Zug and Parham 1996 as cited in WPRFMC 2009a).

Leatherback Sea Turtles in the HARA

Data from genetic research suggest that Pacific leatherback stock structure (natal origins) may vary by region. Due to the fact that leatherback turtles are highly migratory and that stocks mix in high-seas foraging areas, and based on genetic analyses of samples collected by both Hawai'i-based and west-coast-based longline observers, leatherback turtles inhabiting the northern and central Pacific Ocean comprise individuals originating from nesting assemblages located south of the equator in the western Pacific (e.g., Indonesia, Solomon Islands) and in the eastern Pacific along the Americas (e.g., Mexico, Costa Rica; Dutton et al. 1999). Recent information on leatherbacks tagged off the west coast of the United States has also revealed an important migratory corridor from central California to south of the Hawaiian Islands, leading to western Pacific nesting beaches. Leatherback turtles originating from western Pacific beaches have also been found along the U.S. mainland (WPRFMC 2009a). They are regularly observed in offshore waters at the southeastern end of the Hawaiian archipelago (NMFS and USFWS 1998c).

Leatherback Sea Turtles in the MARA

There have been occasional sightings of leatherback turtles around Guam and in the pelagic waters of the CNMI (Eldredge 2003; NMFS and USFWS 1998c). During aerial surveys of Guam from 1989 to 1991, 2.6 percent of the observed sea turtles were leatherbacks (NMFS and USFWS 1998c). However, the extent that leatherback turtles are present around Guam and CNMI is unknown (WPRFMC 2009b).

Leatherback Sea Turtles in the ASARA

In 1993, the crew of an American Samoa government vessel engaged in experimental longline fishing, pulled up a small freshly dead leatherback turtle about 5.6 km south of Swains Island. This was the first leatherback turtle seen by the vessel's captain in 32 years of fishing in the waters of American Samoa (NMFS and USFWS 1998c). The nearest known leatherback nesting area to the Samoan archipelago is the Solomon Islands (Grant 1994).

Leatherback Sea Turtles in the WCPRA

There are no known reports of leatherback sea turtles in waters around the WCPRA, however, these waters are within the habitat, and migration routes, of leatherback turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the WCPRA.

Loggerhead Sea Turtle

Loggerhead sea turtles (Caretta caretta) occur throughout the temperate and tropical regions of the Pacific, Atlantic, and Indian Oceans in a wide range of habitats. These include open-ocean, continental shelves, bays, lagoons, and estuaries (NMFS and USFWS 1998d). In the Pacific, loggerheads can be found throughout the tropical to temperate waters. However, their breeding grounds are restricted to a number of sites in the North Pacific and South Pacific (NMFS and USFWS 2009). Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz 1999; Witherington et al. 2006). Under certain conditions, they may also scavenge fish (NMFS and USFWS 1998d). As they age, loggerheads begin to move into shallower waters, where, as adults, they forage over a variety of benthic hard- and soft-bottom habitats (reviewed in Dodd, 1988).

In September of 2011 NMFS and the USFWS determined that the loggerhead sea turtle is composed of nine DPS listed as threatened or endangered. In the Pacific Ocean (and within the PIFSC research areas) two were named: the north Pacific Ocean population and the south Pacific Ocean population; both are listed as endangered. As of yet there is no critical habitat associated with these DPS (76 FR 58868).

Loggerheads face threats on both nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead turtle populations worldwide is incidental capture in fishing gear, primarily in longlines and gillnets, but also in trawls, traps and pots, and dredges. The main anthropogenic threats impacting loggerhead nesting habitat include the destruction and modification of coastal habitats worldwide. Beachfront lighting, placement of erosion control structures and other barriers to nesting, vehicular and pedestrian traffic, sand extraction, beach erosion and pollution, beach sand placement, removal of non-native vegetation and planting of non-native vegetation all represent serious threats to loggerhead nesting habitat (NMFS and USFWS 2009).

Loggerhead Sea Turtles in the HARA

Loggerheads in the north Pacific are opportunistic feeders that target items floating at or near the surface, and if high densities of prey are present, they will actively forage at depth (Parker et al. 2002). In general, during the last 50 years, north Pacific loggerhead nesting populations have declined 50–90 percent (Kamezaki et al. 2003 as cited in WPRFMC 2009a). The occurrence of loggerhead sea turtles in the HARA is rare. There have only been four records of loggerhead sea turtles in the HARA; they most likely drifted or traveled to the area from Mexico to the east or Japan to the West (NMFS and USFWS 1998d).

Loggerhead Sea Turtles in the MARA

There are no known reports of loggerhead turtles in waters around the MARA (WPRFMC 2009b).

Loggerhead Sea Turtles in the ASARA

There are no known reports of loggerhead turtles in waters around the ASARA (Tuato‘o-Bartley et al. 1993).

Loggerhead Sea Turtles in the WCPRA

There are no known reports of loggerhead turtles in waters around the WCPRA, however, these waters are within the habitat, and migration routes, of loggerhead turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the WCPRA.

Olive Ridley Sea Turtles

Olive ridley sea turtles (Lepidochelys olivacea) migrate annually between pelagic foraging areas and coastal nesting areas. Trans-Pacific ships have observed olive ridley sea turtles over 2,400 miles (4,000 km) from shore. They are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. In the Eastern Pacific, they occur from Southern California to Northern Chile. In the eastern Pacific, arribadas (massive, synchronized nesting events) occur from June through December on certain beaches on the coasts of Mexico, Nicaragua, and Costa Rica and on a single beach in Panama (NOAA 2013b). It is theorized that young olive ridley sea 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, similar to the juvenile loggerheads mentioned previously (WPRFMC 2009a).

Potential threats to olive ridley sea turtles include marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction from fishing gear and practices, agricultural runoff, and sewage discharge (NMFS and USFWS 2007b).

Olive Ridley Sea Turtles in the HARA

Occurrences of olive ridley sea turtles in the HARA are rare, but sightings have increased in the last few decades (NMFS and USFWS 1998e). Olive ridley sea turtles have been incidentally caught in the western Pacific longline fishery operating near the Hawaiian Islands (NMFS and USFWS 1995). More recently, Polovina et al. (2004) tracked 10 olive ridley sea turtles caught in the Hawai‘i-based longline fishery. The only known nesting ground in the United States was a single observed nesting on the island of Maui in the HARA (Balazs and Hau 1986 in NMFS and USFWS 1998e).

Olive Ridley Sea Turtles in the MARA

There are no known reports of olive ridley turtles in waters around the MARA (WPRFMC 2009e).

Olive Ridley Sea Turtles in the ASARA

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

Olive Ridley Sea Turtles in the WCPRA

There are no known reports of olive ridley turtles in waters around the PRIA however, these waters are within the habitat, and migration routes, of olive ridley turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the PRIA (WPRFMC 2009d).

3.2.5 Invertebrates

Invertebrates found within the PIFSC research areas include numerous species of cnidarians (particularly corals), crustaceans, mollusks, echinoderms, porifera (sponges), and bivalves. The below sections discuss the threatened and endangered species (Section 3.2.5.1), species targeted by PIFSC surveys (Section 3.2.5.2), and other species that may be incidentally caught (Section 3.2.5.3). It is important to note that many of these invertebrate species comprise EFH as part of hard bottom structures underlying the waters and associated biological communities (e.g., corals).

3.2.5.1 Threatened and Endangered Species

NMFS published a final rule in September 2014 to list 20 species of corals as threatened under the ESA (79 FR 53852, 10 September 2014). Fifteen of the 20 ESA-listed coral species may occur within PIFSC research areas (Table 3.2-8). Brief descriptions are given for each of these species including habitat, distribution, and threats. No listed corals occur in Hawai‘i. Other listed coral species may also occur in these research areas but have not yet been reported so the species in each area may change as more reliable information becomes available. There are conflicting geographic distributions for some of the ESA-listed Indo-Pacific coral species (Luck 2013, Veron 2014). However, the below occurrences are based on best available information analyzed in 79 FR 53852. Critical habitat was undeterminable at the time of listing for the below corals (79 FR 53852). On Nov. 27, 2020, NMFS proposed seventeen specific areas as coral critical habitat for these ESA-listed species. If critical habitat is established within the action area, NMFS would re-initiate consultation under Section 7 of the ESA to determine the impact of research activities on critical habitat and any necessary management measures.

ESA-Listed Coral Species in PIFSC research areas

Table 3.2-8 Occurrence of Threatened Corals in the Four PIFSC Research Areas

Scientific Name	HARA	MARA	ASARA	WCPRA
Acropora globiceps	X	X	X	X
Acropora jacquelineae			X	
Acropora lokani[1]				
Acropora pharaonis[1]				
Acropora retusa			X	X
Acropora rudis1				
Acropora speciosa			X	X
Acropora tenella1				
Anacropora spinosa[1]				
Euphyllia paradivisa			X	
Isopora crateriformis			X	
Montipora australiensis[1]				
Pavona diffluens[1]				
Porites napopora[1]				
Seriatopora aculeata		X		

1. Has not been conclusively reported in any PIFSC research area, but may be encountered

Acropora globiceps

Acropora globiceps colonies are small and compact, with the size and appearance of branches depending on the degree of exposure to wave action. This species is distributed from the oceanic west Pacific to the central Pacific as far east as the Pitcairn Islands. It occurs on upper reef slopes, reef flats, and adjacent habitats at depths from 0 to 8 m (NOAA 2014d). This species has been observed in the NWHI (NMFS unpublished data). Based on results from Richards et al. (2008) and Veron (2014), the absolute abundance of this species is likely at least tens of millions of colonies.

Acropora jacquelineae

Acropora jacquelineae colonies consist of flat plates up to 1 m in diameter. This species is distributed mostly in the Coral Triangle area. There are also confirmed records in eastern Micronesia, and it has been identified by two coral scientists in American Samoa Acropora jacquelineae occurs on subtidal walls, ledges, and shallow reef slopes at depths from 10 to 35 m (NOAA 2014d). The total population size of Acropora jacquelineae is estimated at 31,599,000 colonies (Richards et al. 2008).

Acropora lokani

Acropora lokani colonies consist of horizontal main branches that are robust and usually diverge. Upright branchlets diverge from main branches. Upright branchlets are short and diverge from main branches. This species is distributed mostly in the Coral Triangle area, with confirmed records in eastern Micronesia and Fiji as well. *Acropora lokani* is found in upper and mid-reef slopes and lagoon patch reefs at depths from 8 to 25 m (NOAA 2014d). The total population size of *Acropora lokani* is estimated at 18,960,000 colonies (Richards et al. 2008).

Acropora pharonis

Acropora pharonis colonies are large horizontal tables or irregular clusters of interlinked contorted branches. This species is likely distributed along the African east coast, western and central Indian ocean islands, the Red Sea, Persian Gulf and east towards India. Acrophora pharonis is found at least in upper-reef slopes, mid-slope terraces and lagoons at depths from 5 to 25 m (NOAA 2014d). Total population size is unknown but according to (Richards et al. 2008) and Veron (2014), absolute abundance is likely greater than millions of colonies.

Acropora retusa

Acropora retusa colonies consist of flat plates with short thick digitate branchlets. This species is widely distributed in the western Indian Ocean, the east coast of India, and from Vietnam east to the Pitcairn Islands. Acropora retusa occurs in shallow reef slopes and back-reef areas, such as upper reef slopes, reef flats, and shallow lagoons at depths from 0 to 5 (NOAA 2014d). Based on results from Richards et al. (2008) and Veron (2014), the absolute abundance of this species is likely in the millions.

Acropora rudis

Acropora rudis colonies consist of large, tapered, prostate branches that can reach a maximum size of 50 cm. This species is distributed in the central and eastern Indian Ocean from the Maldives to the western-most portion of Indonesia. Although not conclusively reported, Acropora rudis may also occur in areas surrounding New Caledonia and the Samoas. Acropora rudis occurs in lower reef crests and upper reef slopes at depths from 3 to 15 m (NOAA 2014d). The absolute abundance of this species is at least millions of colonies.

Acropora speciosa

Acropora speciosa colonies form thick cushions or bottlebrush branches with large and elongate axial corallites. This species is distributed from Indonesia to the Marshall Islands in the western and central Pacific Ocean. This species also occurs in the Maldives in the Indian Ocean and at least one site in French Polynesia. Acropora speciosa occurs on lower reef slopes and walls at depths from 12 to 30 m. It is often associated with clear water and high Acropora diversity (NOAA 2014d). The total population size of Acropora speciosa is estimated at 10,942,000 colonies (Richards et al. 2008).

Acropora tenella

Acropora tenella colonies are horizontal and platy, with flattened branches extending outwards. This species is distributed mostly in the Coral Triangle area, with confirmed records in southern Japan, Micronesia, and the Marshall Islands. This species is found on lower reef slopes and shelves in mesophotic areas at depths of 40 to 70 m (NOAA 2014d). The total population size of Acropora tenella is estimated at 5,207,000 colonies (Richards et al. 2008).

Anacropora spinosa

Anacropora spinosa colonies consist of compact branches tapering from less than 10 mm in diameter. This species is likely distributed almost exclusively in the Coral Triangle area, with confirmed records in southern Japan. *Anacropora spinosa* is found in upper and mid-reef slopes, lagoons on reefs, and non-reef areas at depths from 5 to 15 m (NOAA 2014d). The total population size of *Anacropora spinosa* is unknown but likely numbers at least millions of colonies (Richards et al. 2008).

Euphyllia paradivisa

Euphyllia paradivisa colonies consist of branching separate corallites. This species is distributed mostly in the Coral Triangle area but is confirmed to occur in American Samoa. This species is found in environments protected by wave action on upper reef slopes, mid-slope terraces, and lagoons at depths of 2 to 25 m (NOAA 2014d). Based on results from Richards et al. (2008) and Veron (2014), the absolute abundance of this species is likely at least tens of millions of colonies.

Isopora crateriformis

Isopora crateriformis forms flattened solid encrusting plates that may reach over a meter in diameter. This species is distributed within the Coral Triangle area and some western Pacific waters, including New Caledonia, the Samoas, and the Marshall Islands. This species predominantly occurs in shallow, high-wave energy environments, including reef flats and lower reef crests, and upper reef slopes. Isopora crateriformis has also been reported from low tide to at least 12 m in depth and may occur in the mesophotic zone below 50 m (NOAA 2014d). Based on results from Richards et al. (2008) and Veron (2014), the absolute abundance of this species is likely at least millions of colonies.

Montipora australiensis

Montipora australiensis colonies consist of irregular columns and thick plates. This species is likely distributed in the western Indian Ocean and in the western Pacific from Malaysia to Vanuatu and Southern Japan to northern Australia. *Montipora australiensis* occurs at depths from 2 to 30 m on upper reef slopes, lower reef crests, and reef flats. It also probably occurs in other habitats including mid-slopes (NOAA 2014d). Based on results from Richards et al. (2008) and Veron (2014), the absolute abundance of *Montipora australiensis* is unknown but is likely at least millions of colonies.

Pavona diffluens

Pavona diffluens colonies are submissive and consist of knobs that protrude from an encrusting base. This species is distributed along part of the east African coast, the Red Sea, and the northwestern Indian Ocean (NOAA 2014d). Although not conclusively reported, Pavona diffluens may also occur from the Marianas Islands and American Samoa (Kenyon et al. 2010). This species occurs in at least upper reef slopes, mid-slopes, lower reef crests, reef flats, and lagoons at depths of 5 to 20 m (NOAA 2014d). The absolute abundance of this species is at least millions of colonies.

Porites napopora

Porites napopora colonies have irregular clumps of tapered branches which are irregularly fused. This species is likely distributed mostly in the Coral Triangle area and adjacent areas of the South China Sea, southern Japan, and Micronesia. *Porites napopora* occurs in upper reef slopes, mid-slopes, lower reef crests, reef flats and lagoons at depths from 3 to 15 (NOAA 2014d). Absolute abundance of *Porites napopora* is unknown but is likely at least millions of colonies (Richards et al. 2008).

Seriatopora aculeata

Seriatopora aculeata colonies have thick, short, tapered branches that are usually fused in clumps. This species is distributed mostly in the Coral Triangle area, but also occurs in adjacent areas in the western Pacific from the Mariana Islands down to New Caledonia. This species occurs in a wide range of habitats on the reef slope and back-reef, including upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons at depths of 3 to 40 m (NOAA 2014d). Based on results from Richards et al. (2008) and Veron (2014), absolute abundance of Seriatopora aculeata is likely at least millions of colonies.

<u>Threats to ESA-Listed Corals</u>

NMFS identified nine threats to be the most important to the current or expected future extinction risk of reef-building corals: ocean warming (bleaching), disease, ocean acidification, trophic effects of fishing, sedimentation, nutrients, sea-level rise, predation, and collection and trade (79 FR 53852). Susceptibility of a coral species to the above threats can vary greatly between and within taxa, depending on the biological processes and characteristics of each coral species. Details on the species-specific or genera-specific threat susceptibilities of the above ESA-listed corals include:

- Acropora spp. – bleaching caused by irregularly warm water, predation by corallivorous species, damage from sedimentation, slow recovery from disease (white-band) or bleaching due to fragmentation as dominant form of reproduction, heavily collected and traded for aquariums
- Anacropora spp. – Moderate susceptibility to bleaching due to ocean warming and moderate vulnerability to disease and ocean acidification
- Euphyllia spp. – high susceptibility to bleaching events
- Isopora crateriformis – high susceptibility to bleaching events at a global scale, but reportedly tolerates high temperatures in shallow back-reef pools in American Samoa

- Montipora spp. – High susceptibility to ocean warming and moderate vulnerability to disease and ocean acidification
- Pavona spp. – susceptible to bleaching by irregularly warm water, predation by corallivorous species (e.g., crown-of-thorns seastar)
- *Porites* spp. – Moderate susceptibility to disease and ocean acidification
- Seriatopora spp. – highly susceptible to bleaching events, heavily traded for aquariums (although rare for S. aculeata)

Chambered Nautilus

NMFS received a petition on May 31, 2016, to list the chambered nautilus (*Nautilus pompilius*) as a threatened species. In response, NMFS initiated a status review (81 FR 58895) and on October 23, 2017, announced a 90-day finding and proposed rule to list chambered nautilus as threatened under the ESA (82 FR 48948). The final rule to list chambered nautilus was published on September 28, 2018 (83 FR 48976). The final rule also concluded critical habitat for the chambered nautilus is not determinable because data sufficient to perform the required analyses are lacking.

Chambered nautilus are found in coastal reef and deep-water habitats in the Indo-Pacific and considered an "extreme habitat specialist" given particular physiological constraints (82 FR 48948). The species is found in habitats with steep-sloped forereefs with sandy, silty, or muddy bottoms at depths between 100 and 500 m (CITES 2016 as cited in 82 FR 48948). Global abundance of chambered nautilus is currently unknown given the lack of historical baseline population data. The harvest of coral reefs and destructive and unselective fishing practices off the coast of Philippines, Indonesian and Malaysia are considered a significant threat to this species (83 FR 48948). Other threats include pollution, sedimentation, ocean warming and acidification, and overutilization for commercial, recreational, scientific, or educational purposes.

Giant Clam – Candidate Species

On August 7, 2016, NMFS received a petition to list Tridacninae giant clams (excluding *Tridacna rosewateri*) as endangered or threatened under the ESA. On June 26, 2017, NMFS published a 90-day finding (82 FR 28946) to list ten species of giant clam as endangered or threatened. NMFS concluded that listing may be warranted for seven species (*Hippopus hippopus, H. porcellanus, Tridacna costata, T. derasa, T. gigas, T. squamosa, and T. tevoroa*). The action was not warranted for three species including *T. crocea, T. maxima, or T. noae.* There has been no further action by NMFS regarding these species to date. Status reviews for these species in support of potential ESA-listings are ongoing[14].

Giant clams, members of the cardiid bivalve subfamily of Tridacninae (Su et al. 2014 as cited in 82 FR 28946) are the largest bivalves found in coastal areas of the Indo-Pacific and regarded as critical components of coral reef ecosystems (Neo and Todd 2013 as cited in 82 FR 28946). Giant clams can be found in a wide variety of habitats, including live coral, dead coral rubble,

[14](https://www.fisheries.noaa.gov/action/90-day-finding-petition-list-10-species-giant-clams-threatened-or-endangered-under-esa

boulders, sandy substrates, seagrass beds, macroalgae zones, etc. (Gilbert et al., 2006; Hernawan 2010 as cited in 82 FR 28946) but are typically live on sand or attached to coral rock and rubble by byssal threads (Soo and Todd 2014 as cited in 82 FR 28946). As described in the 90-day finding, given the expansive geographic ranges of these species, each may experience different impacts and be subject to a variety of threats ranging from overutilization and overharvesting, ocean acidification and warming, demand-driven trade and other manmade and natural factors.).

3.2.5.2 Target Species

Target species are those invertebrates which are managed for commercial and recreational fisheries and are collected by PIFSC surveys for research purposes.

As detailed in Section 3.21, species within the jurisdiction of the WPRFMC are grouped into MUS or multi-species Complexes for which annual catch limits are set. Invertebrate MUS targeted by PIFSC research activities include crustacean MUS, precious corals MUS, and coral reef ecosystem MUS PHCRT.

Table 3.2-9 displays a list of target invertebrate species collected during research activities throughout the PIFSC research areas. The stock status for all invertebrate MUS are either unknown or not overfished. The proceeding paragraphs provide descriptions of the biology and distributions of these species.

Table 3.2-9 Target Invertebrate Species in the PIFSC Research Areas

Common Name	Scientific Name	Stock/Area	PIFSC Surveys
CRUSTACEAN MUS			
Spiny lobster	*Panulirus marginatus*	HARA	lobster surveys
Slipper lobster	*Scyllarides squammosus*	HARA	lobster surveys
Ridgeback slipper lobster	*Scyllarides haanii*	HARA	lobster surveys
Chinese slipper lobster	*Parribacus antarcticus*	HARA	lobster surveys
CORAL REEF ECOSYSTEM MUS—PHCRT			
Stony corals	*Acanthastrea* spp.	ASARA	RAMP
	Acropora spp.	ASARA, WCPRA	RAMP
	Astreopora spp.	ASARA	RAMP
	Coscinaraea spp.	ASARA	RAMP
	Echinophyllia spp.	WCPRA	RAMP
	Favia spp.	ASARA	RAMP
	Galaxea spp.	ASARA	RAMP
	Goniopora spp.	ASARA	RAMP
	Hydnophora spp.	ASARA	RAMP
	Leptoseris spp.	WCPRA	RAMP
	Montipora spp.	ASARA, WCPRA	RAMP
	Mycedium spp.	ASARA	RAMP
	Pavona spp.	ASARA, WCPRA	RAMP
	Platygyra spp.	ASARA	RAMP
	Porites spp.	MARA, ASARA, WCPRA	RAMP
	Turbinaria spp.	ASARA	RAMP
Brain corals	*Cyphastrea* spp.	WCPRA	RAMP
	Echinopora spp.	ASARA	RAMP
	Favites spp.	ASARA	RAMP
	Goniastrea spp.	ASARA	RAMP
	Leptastrea spp.	ASARA, WCPRA	RAMP
Ahermatypic corals, lace corals	*Stylaster* spp.	ASARA, WCPRA	RAMP
	Distichopora spp.	WCPRA	RAMP
Mushroom corals	*Fungia* spp.	ASARA	RAMP
Blue corals	*Heliopora* spp.	ASARA	RAMP
Fire corals	*Millepora* spp.	MARA, ASARA, WCPRA	RAMP
Cauliflower corals	*Pocillopora* spp.	WCPRA	RAMP
Sun corals	*Tubastraea* spp.	WCPRA	RAMP

Spiny and Slipper Lobsters

Mature spiny lobsters inhabit protected waters on rocky substrate, under rocks, or within rock crevices (WPRFMC. 2009a). Juvenile and mature P. marginatus are not found in separate habitat areas apart from one another, unlike other species of Panulirus (Macdonald and Stimson 1980; Parrish and Polovina 1994). Spiny lobsters in the southwest area of the Pacific Ocean are associated with coral reef habitats that provide shelter and a diversity of food items (Pitcher 1993). Spiny lobsters are nocturnal predators that move onto the reef flats in the evening to forage.

The general life cycle of spiny and slipper lobsters includes external or internal egg fertilization that hatch into larvae after 30-40 days (MacDonald 1986; Uchida and Uchiyama 1986). The planktonic larvae stage varies depending on species and geographic range, but typically lasts from 6 to 12 months (WPRFMC 2009a). Oceanographic processes such as eddies and currents generally retain lobster larvae within island areas (Johnson 1968). Spiny lobster larvae can be transported up to 2,000 miles by strong ocean currents (MacDonald 1986).

Corals and Sponges

Corals and sponges can exist within three types of ecosystems: (1) shallow coral reef ecosystems; (2) mesophotic coral ecosystems; and (3) deep sea coral ecosystems. Shallow coral reef ecosystems are generally confined to the upper euphotic zone, with maximum reef growth and productivity occurring between 5 and 15 m (Hopely and Kinsey 1988). Mesophotic coral ecosystems are typically found at depths from 30-40 m to over 150 m in tropical and subtropical regions. Mesophotic coral ecosystems are light-dependent and considered to be an extension of shallow coral reef ecosystems (Blyth-Skyrme et al. 2013). Deep-sea coral ecosystems lack zooxanthellae (algal cells that have a symbiotic relationship with coral polyps) and occur below the euphotic zone (Grigg 1993). Mesotrophic and deep-sea coral ecosystems may overlap in tropical and subtropical regions.

Shallow Coral Reefs Ecosystems

Shallow coral reef ecosystems are the tropical rain forests of the oceans, in that they attract and concentrate a vast number of reef-dependent species, creating rich biodiversity. Coral reefs consist of carbonate rock structures at or near sea level that contain viable populations of reef-building corals. The zooxanthellae are able to photosynthesize and provide much of the coral polyp's nutritional requirements. Most corals also actively feed on zooplankton or dissolved organic nitrogen in the water. As a result of the coral polyps' symbiotic relationship with photosynthetic zooxanthellae, coral reefs generally do not occur below 100 m (Hunter 1995). Primary production is mainly attributed to benthic microalgae, macroalgae, zooxanthellae, and other symbiotic bearing invertebrates (Levington 1995). The Indo-Pacific region (which includes all of PIFSC research areas) is host to approximately 700 described species of coral (Brainard et al. 2011).

Mesophotic Coral Ecosystems

As an extension to shallow coral reefs, mesotrophic coral ecosystems likely have biological, physical, and chemical connectivity with these reefs and associated communities, as well as unique fish and invertebrate assemblages. Mesotrophic coral ecosystems can provide refuge for shallow and mid-depth species and a numerous depth-restricted species of fishes, invertebrates, algae, and a lower diversity of coral (Hinderstein et al. 2010).

Deep Sea Coral Ecosystems

Deep-sea corals are a taxonomically and morphologically diverse collection of organisms distinguished by their occurrence in deep oceanic waters (50 m to over 200 m). The calcified skeletons of certain branching stony coral species form large reef-like structures in deep water. Gorgonians, gold corals, and black corals often have branching tree-like forms and either occur singly or form thickets of many colonies. The three-dimensional features formed by many deep sea corals provide habitat for numerous fish and invertebrate species and, like shallow-water tropical corals, appear to enhance the biological diversity of many deep-sea ecosystems (NOAA 2010a).

Precious corals are a select group of deep sea corals commercially harvested for the jewelry trade. Precious corals from all areas are slow growing with low rates of mortality and recruitment. As a result of this characteristic, precious corals take longer than other corals to recover from exploitation. Precious coral MUS potentially caught in sufficient quantities to warrant management or specific monitoring by NMFS and the WPRFMC are summarized in Table 3.2-10. There are currently minimal harvests of precious coral species throughout the PIFSC region.

Table 3.2-10 Occurrence of Precious Coral MUS in the Four PIFSC Research Areas

Common Name	Scientific Name	HARA	MARA	ASARA	WCPRA
Pink coral/red coral	*Corallium secundum*	X	X	X	X
Pink coral/red coral	*Corallium regale*	X	X	X	X
Pink coral/red coral	*Corallium laauense*	X	X	X	X
Gold coral	*Gerardia* spp.	X	X	X	X
Gold coral	*Narella* spp.	X	X	X	X
Gold coral	*Calyptrophora* spp.		X	X	
Bamboo coral	*Lepidisis olapa*	X	X	X	
Bamboo coral	*Acanella* spp.		X	X	
Black coral	*Antipathes dichotoma*		X	X	X
Black coral	*Antipathes grandis*		X	X	X
Black coral	*Antipathes ulex*		X	X	X

Sponges

Sponges can occur in all three of the above coral reef ecosystems. Identified sponge species total 23 surrounding the HARA, 20 at the WCPRA, and 110 near the MARA (Waddell 2005).

A potentially invasive sponge species, the keyhole sponge (Mycale armata) has become abundant in some areas where it has grown at a sufficient rate to overgrow native dominant corals. The coral killing sponge, Terpios hoshinota, has been observed near the islands Guguan and Uracas of the

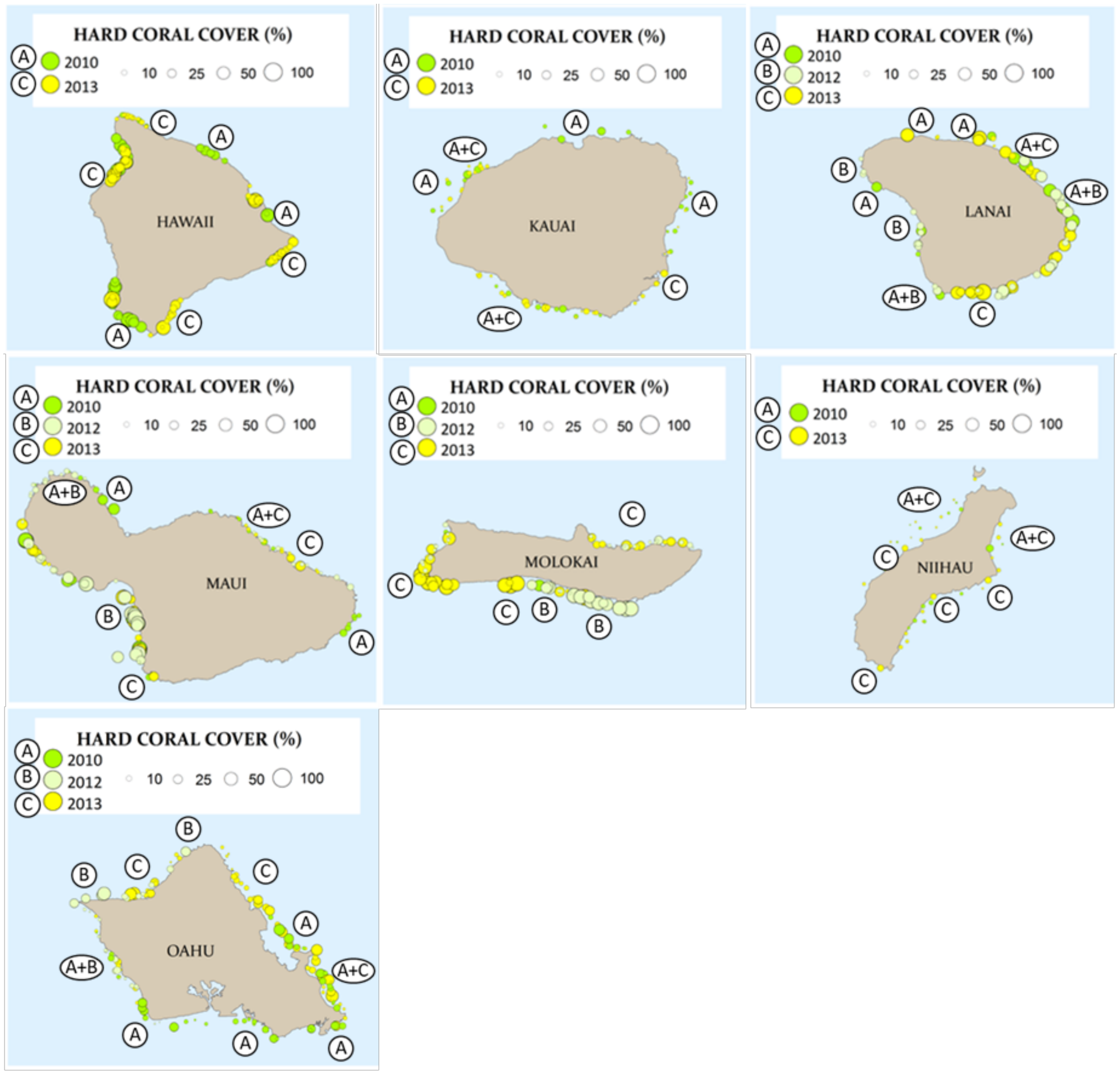
MARA. T hosinota is an encrusting sponge that is able to overgrow hard corals on a large scale (Waddell 2005).

Threats to Coral Ecosystems

General threats to coral reefs throughout the PIFSC research areas include bleaching, diseases, storms, coastal development, runoff, and pollution, tourism and recreation, fishing, coral trading, vessel groundings, marine debris, invasive species, security training activities, and offshore oil and gas exploration (Waddell 2005).

Corals of the HARA

The total potential area of coral reef in the Hawaiian Archipelago is approximately 2,826 km2 within a 10 fathom contour, and 20,437 km2 within a 100 fathom contour (Rohmann et al. 2005). Figure 3.2-4 displays the percent cover of hard corals surrounding the major islands of the HARA. The condition of coral reefs within the Hawaiian Archipelago range from fair to excellent. Many coral reefs are threatened by continued population growth, overfishing, urbanization, runoff, and coastal development (NOAA 2005). Coral reef diseases are present in the Hawaiian Archipelago, including documented outbreaks of Montipora White Syndrome in Kāneʿohe Bay, Oʿahu (USGS 2012a) and cyanobacterial infection of coral on the north shore of Kaua‘i (USGS 2012b). A baseline study of 18 sites around the island of O‘ahu found an average of 0.95 percent of diseased coral colonies (WPRFMC 2009a). Mesotrophic corals have been documented throughout the Hawaiian Archipelago, with peak coral cover between 50 to 60 m in the MHI and 30 to 40 m in the NWHI (Rooney et al. 2010). Deep sea corals in the Hawaiian Archipelago (Corallium secundum, Corallium lauuense, and Gerardia sp.) have been observed from 350 to 500 m, with densities from 13 to 63 colonies per 100 m^2 (Parrish 2007).



Source: Heenan et al. 2014.

Figure 3.2-4 Percent of Hard Coral Cover Surrounding the Populated Islands of the HARA

Corals of the MARA

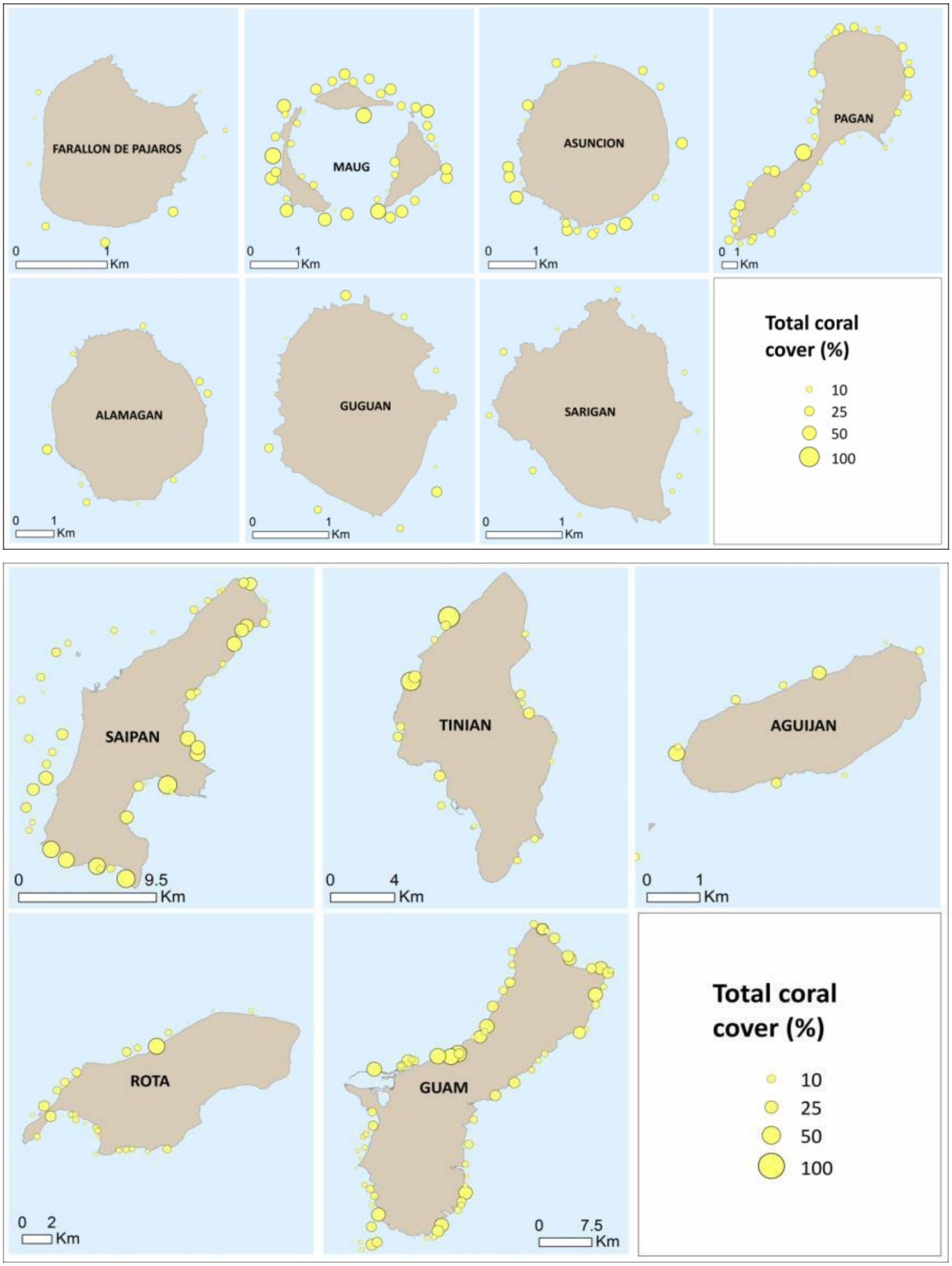
Corals of the MARA include the CNMI and Guam.

Corals of CNMI

The total coral reef area around the CNMI is estimated at 124 km2 within a 10 fathom contour, and 476 km2 within a 100 fathom contour, with the majority of coral reefs in the older southern islands (Eldredge 1983; Rohmann et al. 2005). Most of the coral reefs in the southern islands of the Marina Archipelago appear to be in good condition with the exception of a few heavily populated areas where coral reefs are degraded by human activities (Starmer et al. 2005). Coral reefs of the northern islands are also considered to be in good condition, likely due to isolation from human population centers (Birkeland 1997).

Corals of Guam

The estimated potential coral reef area surrounding the island of Guam is 108 km2 within a 10 fathom contour and 276 km2 within a 100 fathom contour (Rohmann et al. 2005). Reef health in Guam varies by geography; reefs on the southwestern part of the island are generally in poor condition, whereas reefs on the northern part of the island are in better condition. This geographical difference is likely due to increased development, public access to reefs, and river discharge at the southern part of the Island (WPRFMC 2009b). Figure 3.2-5 displays the percent cover of hard corals surrounding the islands of the MARA.

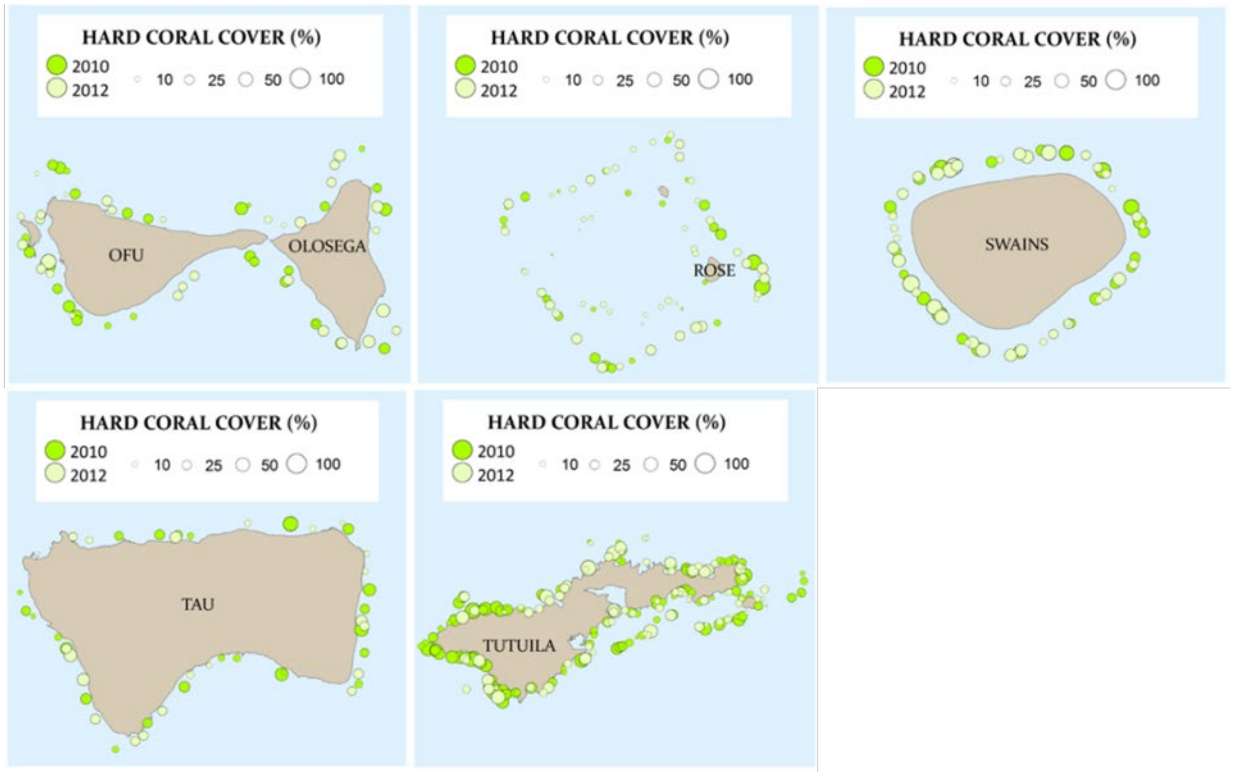


Source: PIFSC 2014a,b.

Figure 3.2-5 Percent of Hard Coral Cover Surrounding the Populated Islands of the MARA

Corals of the ASARA

The estimated area of potential coral reef at American Samoa is 53 km2 within a 10 fathom contour and 464 km2 within a 100 fathom contour (Rohmann et al. 2005). The coral reefs on the north side of the main island (Tutuila) and nearby Aunu‘u are in good condition. However, some areas of Tutuila have lower coral cover than elsewhere, likely due to increased sedimentation (Green 2002). Figure 3.2-6 displays the percent cover of hard corals surrounding the ASARA.

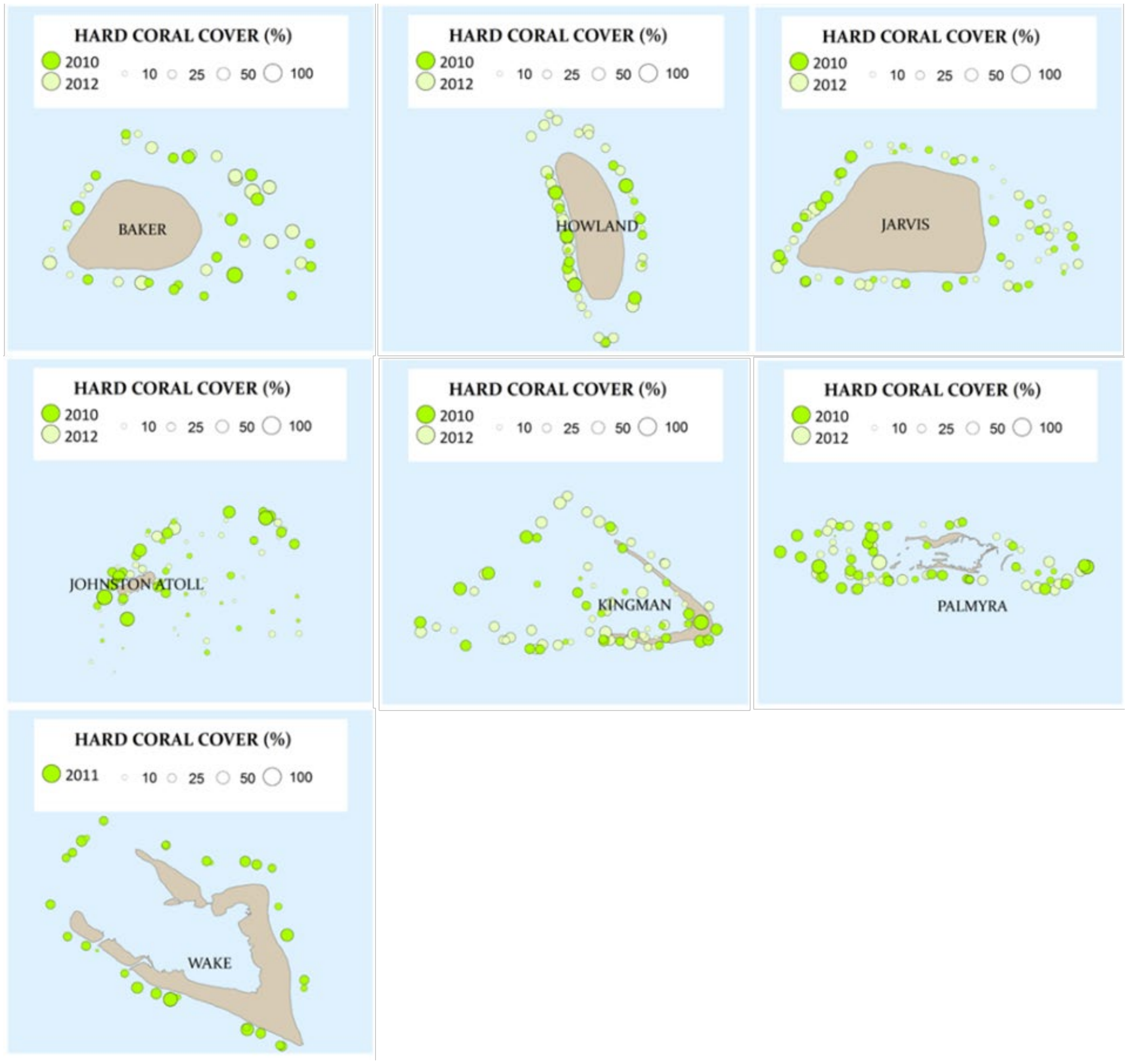


Source: Heenan et al. 2014.

Figure 3.2-6 Percent of Hard Coral Cover Surrounding the Populated Islands of the ASARA

Corals of the WCPRA

The estimated area of potential coral reef at the WCPRA is 253 km2 within a 10 fathom contour and 436 km2 within a 100 fathom contour (Rohmann et al. 2005). Coral reefs near the WCPRA are generally healthy and productive (WPRFMC 2009d). However, coral reefs around the islands of Baker, Howland, Jarvis, Kingman, and Palmyra are currently recovering from recurrent mass bleaching events that occurred around 2001 and 2010 (Maragos et al. 2008, Vargas-Ángel et al. 2011). Figure 3.2-7 displays the percent cover of hard corals surrounding the WCPRA.



Source: Heenan et al. 2014.

Figure 3.2-7 Percent of Hard Coral Cover Surrounding the Populated Islands of the WCPRA

3.2.5.3 Other Species

The following species in Table 3.2-11 are not listed as threatened or endangered under the ESA, nor are they regularly collected by PIFSC research surveys. However, these species may be encountered during PIFSC research surveys and caught in small numbers. Incidental catch of these species may also occur through trawl, hook-and-line, longline, trap, or gillnet surveys. All of the below species are coral reef ecosystem MUS PHCRT. Chambered nautilus were listed as threatened in 2018 (83 FR 48976). While chambered nautilus may be caught as bycatch in some Indo-Pacific deep-sea fisheries (i.e., in the Philippines, India, Papua New Guinea (82 FR 48948), the likelihood of PIFSC research incidentally catching chambered nautilus is considered extremely low based on the low volume of research, short duration and disperse nature of surveys.

Table 3.2-11 Other Invertebrate Species Found within the PIFSC Research Areas

Common Name	Scientific Name	HARA	MARA	ASARA	WCPRA
Kona crab	*Ranina ranina*	X	X	X	X
Deepwater shrimp	*Heterocarpus* spp.	X	X	X	X
Day octopus	*Octopus cyanea*	X	X	X	X
White-striped octopus	*Octopus orantus*	X	X	X	X
Green snails	*Turbo* spp.	X	X	X	-
Featherduster worm	Family Sabellidae	X	-	-	-
Sea cucumbers and urchins	Phylum Echinodermata	X	X	X	X
Black lipped pearl oyster	Pinctada margaritifera	X	X	X	X
Giant clam[1]	*Tridacna gigas*	-	X	X	X
Organpipe corals	*Tubipora* spp.	-	X	X	X
Lace corals	Family Stylasteridae	X	X	X	X
Hydroid corals	Family Solanderidae	X	X	X	X
Small and large coral polyps	Various species	X	X	X	X
Soft corals and gorgonians	Various species	X	X	X	X
Anemones	Order Actinaria	X	X	X	X
Soft zoanthid corals	Order Zoantharia	X	X	X	X
Sea snails	*Trochus* spp.	X	X	X	X
Sea slugs	Opistobranhcs	X	X	X	X
Other bivalves	Various species	X	X	X	X
Other crustaceans	Various species	X	X	X	X
Sea squirts	Tunicates	X	X	X	X
Sponges	Porifera	X	X	X	X
Segmented worms	Various species	X	X	X	X
Seaweed	Various algae species	X	X	X	X
Limpets	*Cellana sp.*	X	X	X	-

[1]Species status reviews are ongoing for seven of ten clam species proposed to be listed as threatened or engendered under the ESA. For more information, please see 82 FR 28946.

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

Activities associated with fisheries research have several implications for the cultural, social, and economic environment potentially affected by PIFSC fisheries research. The following Sections describe the importance of select cultural resources in the study region (Section 3.3.1), background information regarding PIFSC (Section 3.3.2), commercial fisheries of Hawaiʻi (Section 3.3.3), non-commercial fisheries of Hawaiʻi (Section 3.3.4), fishing communities of Hawaiʻi (Section 3.3.5), economic aspects of commercial and non-commercial marine fisheries in American Samoa, Guam, and the Commonwealth of the Northern Marianas (Section 3.3.6), and PIFSC operations (Section 3.3.7).

3.3.1 Cultural Importance of Resources

Cultural resources may be defined as historic properties, landscapes, cultural items, archaeological resources, sacred sites, traditional knowledge, or collections of materials subject to protection under federal regulations. This section is provided as a brief overview of known cultural resources within the designated PIFSC research areas.

Marine resources are of cultural importance to many indigenous persons residing in the areas of interest. These areas include: the HARA, MARA, and the ASARA. Although the WCPRA is presently uninhabited (with the exception of permanent presence on Wake Atoll and occasional presence on Palmyra Atoll and Johnston Atoll), it too assumes importance to certain culture groups in the Pacific. Described below are ways in which people have traditionally interacted with marine resources in the various archipelagos, and any important cultural relationships that have developed over time in association with these resources. In addition to specific summaries of cultural resources within each research area, a brief overview of 19th century maritime commerce and World War II are included here as context for how these significant events have influenced this region in terms of cultural resources.

The most culturally important resource considerations associated with any island environments in the Pacific is the human relationship with marine life and use of marine resources for sustenance. Notably, three of the four resource areas covered within the PIFSC region are officially designated as "fishing communities, where said communities are defined as being substantially engaged in the harvest or processing of fishery resources to meet social and economic needs" (Allen and Bartram 2008). On April 19, 1999, NMFS approved identification of American Samoa, the Northern Mariana Islands, and Guam as fishing communities. The HARA is the only area in which the designation of fishing community was thought to be too general, and it was suggested that the agency work to identify smaller fishing communities within HARA and that each of the populated islands in the Hawaiian Archipelago be designated as fishing communities (Allen and Bartram 2008). The following sections outline the information used to identify culturally important resources within each of the PIFSC research areas.

3.3.1.1 19th Century Maritime Commerce

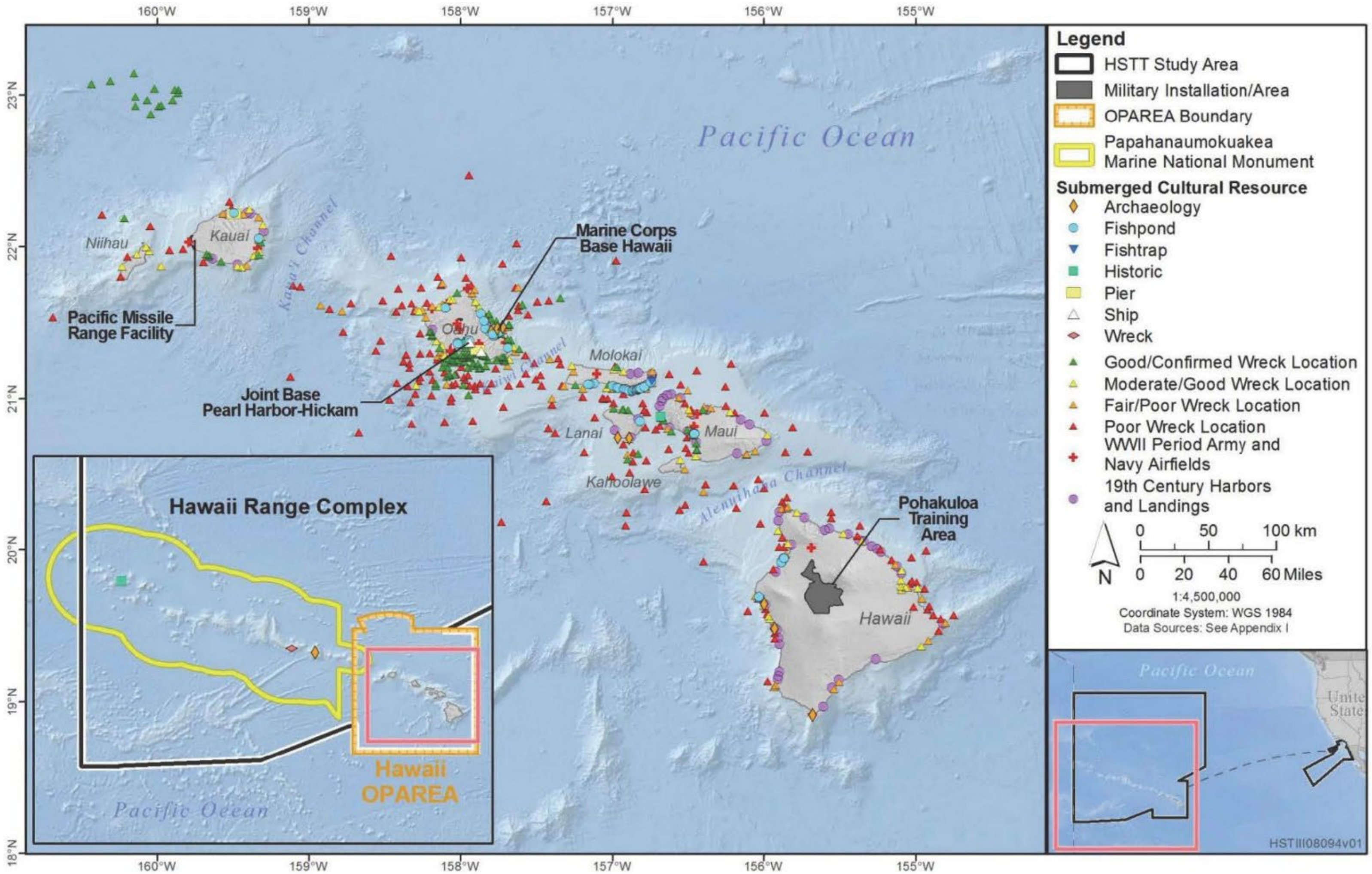
Hawaiʻi was an independent country until 1893 when Queen Liliuʻokalani was overthrown by American business leaders with the support of American military forces. In 1898, the Republic of Hawaiʻi was declared through annexation as a U.S. territory (Fung Associates 2011), a change that would result in dramatic effects with respect to cultural resources and socioeconomics. By the early 19th century, Hawaiʻi became the focus of many countries in terms of trade and commerce including, but not limited to, the United States, China, Russia, and countries within Europe. Hawaiʻi became increasingly important for seal hunting, whaling, sandalwood exports, and other products. Christian missionaries working throughout Hawaiʻi in the mid-1800's had profound effects on Hawaiian culture by discouraging Native cultural practices and languages (Fung Associates 2011). Western traders and missionaries who settled in the area often held roles in local government, having strong influence on the local cultural and socioeconomic communities through governance.

By the mid-19th century, the kingdom welcomed sailors and maritime commerce from around the world. Subsistence practices were frequently replaced with agriculture for coffee, sweet potatoes, pineapple, sugar, and rice. Young Hawaiians joined Japanese and Chinese whaling ships with the promise of earning a wage (Fung Associates 2011). Diseases unfortunately accompanied these international visitors, resulting in outbreaks of measles, smallpox, whooping cough, and others that Native Hawaiians had no resistance to. High mortality of Native Hawaiians due to these diseases encouraged Hawaiian monarchs to seek immigrants to help serve as local labor (Fung Associates 2011), further shifting the cultural identity of the region.

In the years leading up to WWII, the early 20th century Hawaiian economy was driven primarily by large-scale plantations for sugar, pineapple, and rice. A treaty between the Kingdom of Hawaiʻi and the United States, in 1886 resulted in an increase in U.S. military presence on the Islands. Naval and army bases were constructed by immigrant laborers, further diversifying local communities. Given their significance in terms of social influence, effects on demographics and sheer size, military installations have become a large part of the cultural heritage and recognized historic properties in the Pacific Islands region.

3.3.1.2 World War II

Prior to WWII, the United States had amplified their military presence in the Pacific Islands and Hawaiʻi. The attack on Pearl Harbor on December 7, 1941, was obviously a turning point in the history of the world and this region in particular. WWII left behind a large cultural footprint as well as numerous historic properties that have since become registered with the National Historic Preservation Office under the NHPA. By the end of WWII, the U.S. military controlled over 400,000 of Hawaiʻi's four million acres (Fung Associates 2011). Cultural resources are scattered throughout this region in the open ocean, along shore and in harbors including Pearl Harbor (U.S. Navy 2018). Submerged historic resources primarily consist of pre-war resources such as cargo ships, commercial fishing vessels, whaling boats, recreational boats, and Native Hawaiian sites such as fishponds. War-era submerged historic resources include war ships, sunken vehicles, aircraft and harbor and shoreline structures (U.S. Navy 2018). Figure 3.3-1 shows the known submerged cultural resources around Hawaiʻi (U.S. Navy 2018). Pearl Harbor is listed under the National Historic Register as a National Historic Landmark due to the abundance of submerged cultural resources from WWII in the harbor. Records through 2013 list 356 items on the National Register of Historic Places (NRHP) and National Landmarks Program for Hawaiʻi. Of these, two shipwrecks from WWII include the USS Utah and USS Arizona, and Pearl Harbor (National Archives Catalog Accessed November 25, 2019). The whaleship Two Brothers is located in the Papahānaumokuākea Marine National Monument and is also listed in the National Register (82 FR 32870).



Source: U.S. Navy 2018

Figure 3.3-1 Known Submerged Cultural Resources Near the Hawaiian Islands

3.3.1.3 Hawaiian Archipelago Research Area (HARA)

Traditionally, every aspect of life in Hawai‘i was influenced by the natural surroundings of the island environment. Polynesian voyagers discovered the Hawaiian Islands, and their descendants have now inhabited the islands for thousands of years. Indigenous Hawaiians are known as kanaka maoli. The system of beliefs embraced by many kanaka maoli holds that everything, whether in the sky, land, or sea is la‘a or sacred. Within the traditions of the ancient Hawaiians fishing, fishponds, and agricultural zones provided food for ali‘i (royalty) and commoners alike. Fishponds were a particularly important component of the ancient food production system, as was gleaning along the reef and shoreline, and fishing in the nearshore zone and deep sea. Fishing, small-scale agriculture and use of fishponds, remain culturally important practices for many indigenous Hawaiians today.

Many marine resources retain cultural importance among contemporary Hawaiians. These include a wide variety of fish species, sea turtles, sharks, rays, and other creatures. Some species assume particular importance as ‘aumakua, or family gods. These take on the shape of animals, including sharks, octopus, cowries, and other creatures of sea and land.

Green, hawksbill, and olive ridley sea turtles are the subjects of rich traditional importance throughout the Pacific islands, including Hawai‘i. The eggs, red meat, and viscera of sea turtles were eaten and esteemed by native inhabitants for many centuries (NMFS and USFWS 1998a). The shell and bones of the hawksbill sea turtle were used for a wide variety of ornamental and practical uses, including tools (Johannes 1986). Modern laws preclude harvest of turtles in Hawai‘i, but interest in the traditional pursuit and consumptive use of the creatures continues to be expressed by many indigenous residents. Additional information regarding the cultural importance of sea turtles in the Pacific Islands can be found in Tauto’o-Bartley et al. (1993), Balazs (1982, 1983a, 1983b, 1985), Hiatt (1951), Johannes (1981), Lessa (1962), Tobin (1952), and Tobin et al. (1957), among others.

The nature of relationships between humans and sharks varies depending on geographic location in the HARA, the species or type of shark, and the context in which the descriptions are made (NOAA 2012d). Sharks have long been revered as influential spirits by Native Hawaiians. Sharks have also been fished for food, to acquire teeth for weapons and tools, and skin for drumheads and ceremonial uses (Taylor 1993 as cited in NOAA 2012d). Additional information regarding the historical and cultural importance of sharks within the HARA can be found in Taylor (1993).

In addition to the cultural role of marine resources, many ocean and coastal sites are of cultural and historic importance to Native Hawaiians. There are also a variety of marine protected areas in the HARA, several of which include provisions that allow for traditional use of marine resources (see Section 3.1.2.3). The Papahānaumokuākea MNM is particularly important, and some 140 archaeological sites have been documented around the Monument. The islands of Nihoa and Mokumanamana, both within Papahānaumokuākea MNM, are listed on the NRHP (NOAA 2008). A wide variety of submerged cultural artifacts and properties have been identified around the HARA. These include: heiau (ancient Hawaiian temples or shrines), other prehistoric sites, historic shipwrecks, downed airplanes, and various other historic sites. There can be no doubt that additional cultural resources have yet to be found and would likely be documented in various nearshore zones around the islands probably buried above the high tide line.

3.3.1.4 Mariana Archipelago Research Area (MARA)

The MARA includes the CNMI and the Territory of Guam. Initial human occupation of the region occurred at least 3500 years ago after skilled mariners discovered the region during voyages of unprecedented distance. Fishing hooks, spear points, sinkers, lures, and the remains of a variety of fish species have been recovered from archeological sites around the region. This is indicative of extensive human reliance on the region's marine resources following initial colonization (Amesbury and Hunter-Anderson 2003, Amesbury 2006).

A Jesuit mission was established in the Marianas in 1668, initiating a long period of social change among descendants of the original seafaring settlers. These descendants were known as Chamorro, a term deriving from the indigenous chamorri, meaning "of high caste." Typhoons and tsunami events in the Caroline Islands led the indigenous seafaring people known as Refaluwasch to immigrate to the Mariana Archipelago during the early 19th century. Sometimes called Carolinians, members of this culture group migrated primarily to Saipan, where they continue to perpetuate a unique Micronesian language and way of life. Contemporary residents of Chamorro and Refaluwasch ancestry retain certain traditional values and concepts relating to the marine environment. In the context of fishing and community life, such values are expressed in ways that include extensive consumption and sharing of seafood in extended family settings, with special emphasis on consumption of seafood during religious festivals, weddings, funerals, christenings, and various holidays.

The Guam NWR and the Marianas Trench MNM are the principal marine protected areas in the MARA. (NOAA 2013a) Both areas are of cultural importance to indigenous and other residents of the region and provide important opportunities for traditional fishing activities and related cultural practices. A 2018 United Nations Educational, Scientific and Cultural Organization (UNESCO) publication (Forrest and Jeffrey 2018), acknowledged that not many underwater cultural heritage investigations in Micronesia (including Guam) have been conducted and as such, the number and locations of potential underwater cultural resources around Guam are not well known. Much of the effort to identify these resources has focused more broadly on WWI resources in Asia-Pacific (Monfils et al. 2006 as cited in Forrest and Jeffrey 2018).

3.3.1.5 American Samoa Archipelago Research Area (ASARA)

Islands in the Samoa Archipelago were discovered and settled by Polynesian voyagers at least 3,000 years ago (Kirch 2000). Fishing and small-scale agricultural pursuits sustained the settlers throughout many centuries across the Samoa Islands. The eastern islands would eventually be administered as a U.S. Territory. The western islands are now known as the Independent State of Samoa. As has been the case for many centuries, harvest and distribution of marine resources have traditionally been organized through hierarchical political arrangements in village settings across the islands. Strong adherence to traditional social and cultural norms and pursuit and consumptive use of seafood have long been central aspects of Fa'a Samoa or the Samoan way of life. Localized management of marine resources is particularly important in this context; this is typically accomplished through direct oversight of fishing activities near the village in question. Nearshore and coral reef fisheries are of fundamental sociocultural and dietary importance for many American Samoans. It has become clear that establishment of marine protected areas in the region requires the extensive involvement of local community leaders (Levine and Allen 2009).

The Rose Atoll MNM is of cultural importance to indigenous and other residents of American Samoa and also provides important opportunities for traditional fishing activities and related cultural practices. For example, the atoll is known to Samoans, who have periodically visited over the past millennium, as "Nuʻu O Manu" ("Village of seabirds"). It is believed that Polynesians have harvested at Rose Atoll for millennia and several species, including the giant clam, were used for cultural celebrations and events (74 FR 1577).

In 2007, NOAA's ONMS completed an initial inventory of maritime heritage documents to support management of Fagatele Bay NMS and overall conservation and preservation efforts in American Samoa of maritime heritage resources (Van Tilburg 2007). Known maritime heritage resources that have been documented offshore in the marine environment around American Samoa include shipwrecks, WWII aircraft, and marine/coastal natural resources associated with legends and folklore of American Samoa; other maritime heritage resources are also documented on land. Ten identified historic shipwrecks are known to be lost in American Samoan waters, the earliest dating to 1828 (Van Tilburg 2007). There are also more contemporary shipwreck sites, reflecting the fishing history in the area (primarily longlining), consisting of both large and small vessels. There were 43 naval aircraft reported as ditched or crashed in waters around American Samoa, most in the vicinity of Tutuila, however none have been located. Traces of debris from a famous commercial aircraft (the Panamerican Flying Clipper) have also been located around Tutuila. Twenty known marine and coastal legend-type sites are also known (Van Tilburg 2007).

Van Tilburg (2011) summarized discussions during the 2011 Asia-Pacific Regional Conference on Underwater Cultural Heritage that according to available sources, 39 ships are known to have gone missing in American Samoa waters, then of which may date back to the early 19th and 20th century. Fagatele Bay sanctuary in American Samoa is also the first location to be included for cultural heritage resources in the ONMS "Climate Smart Sanctuary" effort to better understand potential effects of climate change on cultural resources (Van Tilburg 2011). Upon review of records in the NRHP, there is one shipwreck in Talofofo Bay, Guam, Aratama Maru, a Japanese ship that was listed in the register in 1988

(National Archives Catalogue; https://catalog.archives.gov/id/131517999; Accessed April 14, 2021).

3.3.1.6 Western and Central Pacific Research Area (WCPRA)

As described in Section 3.1.1.4, the WCPRA consists of Johnston, Palmyra, and Wake Atolls; Kingman Reef; and Baker, Howland, and Jarvis Islands. Midway Atoll (in the HARA), Johnston Atoll, and Wake Atoll are of strategic significance to U.S. military forces.

Although the islands and atolls of the WCPRA are remote from large population centers, each has been important to humans over the millennia. Archaeologists have discovered a variety of prehistoric structures, stone paths, and pits on exposed lands across this remote region. There is also evidence of human activity during the historic era, including basic exploration, extraction of guano for fertilizer, whaling, pirating, and various military actions. Jarvis and other islands were strategically colonized during WWII, but the settlements were eventually abandoned. The USFWS and the Department of the Army now manage natural resources on the various islands and atolls (see Section 3.1.2.3). On September 25, 2014, the Pacific Remote Islands MNM was expanded from 50 nm to 200 nm for Jarvis Island, Wake Atoll, and Johnston Atoll. This expansion of

Monument boundaries to the full extent of each EEZ has the potential to affect pelagic fishing activities in the region, most of which are conducted by the Hawai‘i-based longline fleet.

3.3.2 PIFSC Region Background

PIFSC is headquartered in Honolulu, Hawai‘i, and has field offices located in Pago Pago, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands. The Pacific Islands Region's jurisdiction includes activities in both domestic and international waters, with a focus on managing fisheries based off Hawai‘i, American Samoa, Guam, the CNMI, and the PRIAs (Kingman Reef; Howland, Baker, and Jarvis islands; and Johnston, Midway, Palmyra, and Wake atolls) (NOAA 2013c). Federal fisheries in the western Pacific region are managed by the WPRFMC and NMFS under five FEPs. In addition to management oversight provided by the WPRFMC and NMFS, pelagic fish species such as bigeye and yellowfin tunas are also managed by two regional fishery management organizations. The WCPFC is active in the western and central Pacific Ocean, and the IIATTC is active in the eastern Pacific Ocean. Species under the purview of the WCPFC and IATTC migrate across international boundaries and require coordinated management between countries with fishing interests in the Pacific Ocean (NMFS 2012).

PIFSC conducts field and laboratory research to help conserve and manage the region's living marine resources in compliance with the MSA, the MMPA, and the ESA. The 1996 amendments to the MSA require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007). The MSA states:

> *Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

NMFS conducts community studies and develops statistical methodologies and economic models for identifying and describing communities substantially engaged in fishing. This information is ultimately utilized by fishery managers, whose decisions balance the needs of a variety of fisheries communities and users. PIFSC research surveys occur both inside and outside the U.S. EEZ, and span across multiple ecological, physical, and political boundaries (NOAA 2014e).

As discussed in Chapter 1, NOAA participates in the LME approach to marine resources management. Sixty-six LME’s have been identified around the world’s coastal margins. PIFSC research activities occur in the Insular Pacific-Hawaiian LME. Briefs have been developed about each LME that typify the regions (Sherman and Kempel 2009). One of the five modules considered in the LME management model are socioeconomic metrics. Indexes have been developed to analyze marine activities and management. These include estimates of industrial activity, including shipping and oil; aquaculture, and tourism. A socioeconomic index, which represents a region’s economic and institutional resources available to manage LME resources, has been developed, and is shown in Table 3.3-1 (Hoagland and Jin 2006). In general, a higher Marine Industry Activity Index indicates an increased management requirement, and a higher socioeconomic index indicates higher levels of resources available to manage the LME.

Table 3.3-1 Pacific-Hawaiian Large Marine Ecosystems Ranked by Socioeconomic Index

Large Marine Ecosystem (LME)	World Rank	Socioeconomic Index	Fishery & Aquaculture Index	Tourism Index	Ship and Oil Index	Marine Industry Activity Index
Insular Pacific-Hawaiian	16	93.9	17.438	57.893	43.969	41.448

Source: Hoagland and Jin 2006

Pacific Island fishing communities are dependent on or engaged in a variety of commercial and non-commercial fisheries. PIFSC conducts community studies about cultural traditions, local knowledge, and socioeconomic values associated with marine resource use and conservation in Pacific Island communities and thereby generates sufficient information with which to evaluate the social and economic impacts of management options and regulatory decisions on all segments of society. Research is conducted by the Socioeconomics Program (NOAA 2014e).

The Socioeconomics Program undertakes numerous studies to examine and document fishing community characteristics. For example, the group reported baseline socioeconomic and fishing information with regard to Guam in 2008, (Allen and Bartram 2008), American Samoa in 2009 (Levine and Allen 2009), and the CNMI in 2012 (Allen and Amesbury 2012). NMFS also provides Fishing Communities of the United States (NMFS 2009) which estimates community engagement and dependence on managed fisheries around the nation. Factors included in the estimations include commercial market conditions, non-commercial fishing expenditures and levels of participation, key species, and community profiles. The profiles are developed using data regarding participation in commercial and non-commercial fisheries, residence patterns of the fishermen, the distribution of processing and support sector facilities, and various other information.

3.3.3 Commercial Fisheries of Hawai‘i

Fisheries Economics of the United States 2012 analyzed data for Hawai‘i through 2012 (NMFS 2014b). The commercial fisheries vary from shore-based algae (limu) harvesting by hand, to large vessel-based fisheries, such as the high seas pelagic longline fishery (Western Pacific Fishery Information Network [WPFIN] 2013a). Commercial fishing (i.e., selling catches or providing charter fishing services) in Hawai‘i requires purchasing an annually renewable commercial marine license.

In 2011, there were 4,096 licensed commercial fishers in the Main Hawaiian Islands (WPFIN 2013a). Fishermen earned a total of $92 million from the commercial harvest in 2012, landing over 29 million lb of finfish and shellfish. Tunas comprised 73 percent of landings revenue ($67 million) as well as 63 percent of total landings (19 million lb). Swordfish ($6.7 million), mahimahi ($4.3 million), moonfish ($2.9 million), and marlin ($2.4 million) also contributed to landings revenue. Lobsters commanded the highest ex-vessel price in 2011, with an average annual price of $10.39 per lb. (NMFS 2014b). Table 3.3-2 shows landings and revenue data of bigeye tuna for 2007 to 2012 for the Hawai‘i area.

In 2018, Hawai‘i’s seafood industry generated $855 million in sales impacts, $262 million in income impacts, and approximately 11,000 full- and part-time jobs (NMFS 2014b). Table 3.3-3 shows Hawai‘i landings data. While not as high in poundage of fish and shellfish landed, the port of Honolulu ranks in the top tier of revenues among U.S. ports.

Table 3.3-2 Commercial Landings, Revenue, and Top Species for Hawai'i 2007–2019

All Species			Top Species					
Year	Estimated Pounds	Estimated Revenue ($)	Estimated Pounds	Estimated Revenue ($)	Average Price per Pound ($)	Top Species	Top Species Percent of All Species (Pounds)	Top Species Percent of All Species (Revenue)
HAWAI'I								
2007	28,819,000	75,754,000	12,856,900	41,992,494	3.45	Bigeye tuna	44.6%	55.4%
2008	30,563,300	85,149,600	13,353,600	49,701,652	3.12	Bigeye tuna	43.7%	58.4%
2009	26,831,300	71,248,600	10,738,400	39,378,278	2.68	Bigeye tuna	40.0%	55.3%
2010	27,845,700	83,571,100	12,937,600	50,463,011	3.12	Bigeye tuna	46.5%	60.4%
2011	29,327,500	91,883,950	12,855,100	53,091,060	2.92	Bigeye tuna	43.8%	57.8%
2012	30,977,100	112,422,200	13,947,500	64,648,558	3.30	Bigeye tuna	45.0%	57.5%
2013	32,304,500	107,856,900	15,659,200	66,043,177	3.39	Bigeye tuna	48.5%	61.2%
2014	33,352,700	101,289,900	15,920,800	60,668,485	3.27	Bigeye tuna	47.7%	59.9%
2015	36,492,200	111,009,500	18,673,400	70,845,925	3.72	Bigeye tuna	51.2%	63.8%
2016	34,813,000	118,098,500	17,522,400	72,281,432	3.67	Bigeye tuna	50.3%	61.2%
2017	37,173,900	116,394,200	16,968,600	64,749,432	3.9	Bigeye tuna	45.6%	55.6%
2018	35,390,500	118,724,600	15,947,300	66,413,007	4.13	Bigeye tuna	45.1%	55.9%
2019	34,664,800	109,657,000	16,469,300	63,495,405	4.64	Bigeye tuna	47.5%	57.9%

Note: values rounded to nearest 100

Source: ii Commercial Data Summary 2000-2020

Table 3.3-3 Hawai'i Landings 2006–2019

Year	U.S. Rank (by pounds.)	Port	Millions of Pounds	Millions of Dollars	US Rank (by dollars)
2006	38	Honolulu, HI	20.9	$54.60	4
2007	28	Honolulu, HI	24.2	$64.30	6
2008	29	Honolulu, HI	26	$73.30	5
2009	29	Honolulu, HI	22.3	$59.40	8
2010	31	Honolulu, HI	23.5	$71.60	9
2011	36	Honolulu, HI	22.8	$83.00	11
2012	34	Honolulu, HI	27.1	$101.10	5
2013	32	Honolulu, HI	29	$95	6
2014	27	Honolulu, HI	29	$88	6
2015	27	Honolulu, HI	32.3	$96.8	6
2016	26	Honolulu, HI	32.3	$106	6
2017	28	Honolulu, HI	34	$104	7
2018	27	Honolulu, HI	32	$106	6
2019	N/A	Honolulu, HI	28.9	$89.7	N/A

Source: NMFS 2014d,e; NMFS 2018a; http://www.oceaneconomics.org (Accessed April 13, 2021)

3.3.4 Non-Commercial Fisheries of Hawai‘i

Non-commercial fisheries of Hawai‘i include recreational, subsistence, and traditional fishing practices. In 2012, non-commercial anglers in Hawai‘i took an estimated 1.5 million fishing trips. Key non-commercial species included blue marlin, mahimahi, goatfishes, trevallys and other jacks, scad, skipjack tuna, smallmouth bonefish, snappers, wahoo, and yellowfin tuna. Scads (bigeye and mackerel) were the most frequently harvested species group (608,000 fish). As is typical in Hawai‘i, the vast majority of recreationally captured fish are ultimately consumed rather than released (NMFS 2014b).

NMFS estimates non-commercial fishing activity based on a variety of data sources. For Hawai‘i, data are partially derived from mail and phone surveys, with contacts sampled from saltwater and freshwater fishing licenses. NMFS uses an input-output economic model to generate metrics for assessing the contributions of fishing to the economy as per expenditures related to marine non-commercial fishing. These impacts are shown in Table 3.3-4 and summarized below.

Total angler expenditures on recreational fishing in Hawai‘i were $120 million in 2017. Recreational fishing in Hawai‘i contributed approximately 1,093 full-time and part-time jobs to the state’s economy, generating $145 million in output (sales). Approximately $48,756 of expenditures were from private boats while $71,698 in expenditures were from shore-based fishing in 2017.

Table 3.3-4 Total Economic Impacts Generated from Recreational Fishing in

	Expense ($1,000)	Economic Contribution		
		Employment (Jobs)	Income ($1,000)	Value Added ($1,000)
Hawai‘i	$145,918	1,093	$44,918	$80,750

Source https://www.fisheries.noaa.gov/national/sustainable-fisheries/fisheries-economics-united-states (Accessed April 20, 2021)

3.3.5 Fishing Communities of Hawai‘i

NMFS has identified each of the main inhabited islands as fishing communities (NMFS 2009). These include Hawai‘i (2010 pop. 185,079), Kaua‘i (pop. 66,921), Lana‘i (pop. 3,135), Maui (pop. 144,444), Moloka‘i (pop. 7,345), Ni‘ihau (pop 170), and O‘ahu (pop. 953,207) (US Census 2010, 2012). Certain fishing activities are somewhat localized in sub-areas of the islands. Per capita income for the United States was $27,915 by 2011, and $29,203 for the state. The poverty rate for the United States in 2011 was 14.3 percent, and in the state of Hawai‘i, it was 10.2 percent. The overall unemployment rate for the state was 6.4 percent, as compared to 9.6 nationwide. Demographics vary widely across the islands, however. Although there is some overlap in the data between island and county statistics, it is evident that the poverty rate on the Island of Hawai‘i reaches 15.8 percent. Per capita income on Kaua‘i and Maui surpass $60,000, while the island of Hawai‘i is $25,573 (US Census 2012).

Honolulu is the home port for the Hawai‘i-based longline fleet, the most wide-ranging and productive commercial fleet in the U.S. Pacific Islands. The longline fleet is divided into two fisheries: the shallow-set and deep-set. The shallow-set fishery targets swordfish near the ocean surface, while the deep-set targets bigeye and yellowfin tunas. The shallow-set fishery has approximately 18 participants, while the deep-set fishery has approximately 128 participants (79 FR 77919). Fishing comprises a relatively small component of the state's total economy but is critically important in an absolute sense to participating individuals and families. Distinctions between commercial and non-commercial are sometimes indiscernible, as commercial fishing licenses are inexpensive, allowing fishers to sell part of their catch. Charter fishing and related forms of recreation contribute to the state's tourism economy. Non-commercial fishing is an important part of the Hawaiian culture and sharing of seafood among family and friends are particularly important local traditions (NMFS 2009).

3.3.6 Economics and Fisheries of the U.S. Insular Areas

3.3.6.1 American Samoa

American Samoa is an unincorporated territory of the United States. The territory is located 2,300 miles southwest of Hawaiʻi. It is made up of seven islands: Tutuila, Aunuʻu, the Manuʻa group (Taʻu, Olosega, and Ofu), Rose Island, and Swains Island. Tutuila is the largest island (Levine and Allen 2009). The 2010 population of the territory was 55,519 persons, with an unemployment rate of 9.2 (US Census 2012).

American Samoa's economy is driven in large part by the American Samoan government, which receives various subsidies and grants from the U.S. government, and a tuna cannery on the main island of Tutuila. Tuna canning is the largest private-sector source of employment in American Samoa, and it drives many aspects of the economy. Until 2009, Star-Kist Samoa, the largest tuna cannery in the world, produced more than 60 percent of American Samoa's canned tuna, while Chicken of the Sea produced the remaining 40 percent (Levine and Allen 2009). On September 30, 2009, Chicken of the Sea closed its American Samoa cannery. In January 2015, Tri-Marine International opened a new cannery in American Samoa (Pacific Islands Development Program 2015).

Pago Pago is home port for a fleet of large commercial vessels operating outside the American Samoa EEZ. These vessels deliver albacore to the region's canneries. The territory is exempt from the Nicholson Act, which prohibits foreign ships from landing catches in U.S. ports. American Samoa products can also enter the United States duty-free if less than 50 percent of market value is derived from foreign sources (Levine and Allen 2009).

During 2011, fisheries monitoring programs identified 40 active commercial fishing vessels in American Samoa—36 homeported on Tutuila and 4 in the Manuʿa Islands. Many of these vessels participated in more than one fishery, and 27 of the Tutuila boats (including 23 vessels which were over 50 feet in length) did at least some longlining. Of the 40 total boats, 20 participated in the troll and bottomfish fisheries and 3 were used in other forms of fishing activity, including spearfishing. Essentially all of the longlining was based out of Tutuila, where the majority of the catch was offloaded to the cannery (WPFIN 2013b). For 2011, commercial fishers landed 7,395,871 lbs. of fish, generating revenue of $8,737,679. The catch was dominated by albacore tuna, which accounted for 5,098,823 lbs. and $5,943,777 in revenue (WPFIN 2013b).

Tourism plays a limited role in the American Samoa economy. Nearshore fishing is undertaken largely for purposes of subsistence. Extensive fish and shellfish are harvested by local residents from reef areas adjacent to the island villages (Levine and Allen 2009). As in Hawaiʻi, cultural, subsistence, and recreational forms of fishing can be difficult to clearly distinguish.

3.3.6.2 Commonwealth of the Northern Mariana Islands (CNMI)

The CNMI is a group of 14 islands in the western Pacific Ocean that is recognized as an unincorporated territory in political union with the United States, as described in the covenant (Public Law 94-241) that was enacted March 24, 1976. In 2010, the CNMI had a population of 53,883 persons and an unemployment rate of 8.1 percent (US Census 2012). Saipan, Tinian, and Rota in the southern arc are the largest islands in CNMI, followed by Pagan and Agrihan in the northern arc. The southern islands are much more densely inhabited. The U.S. EEZ surrounding CNMI covers 292,712 square miles. The CNMI EEZ abuts Guam's EEZ to the south and Japan's EEZ to the north (Allen and Amesbury 2012).

The chief domestic commercial fishery of CNMI is mainly a small boat, troll fishery. Most of the boats are 12- to 24-ft, outboard-powered, runabout-type vessels that make trolling trips of generally a day or less in duration. A few larger boats have been used in recent years for bottomfishing around the islands north of Saipan. A small charter fleet also exists. Trolling is the most common fishing method, but bottomfishing and reef fishing are also popular. Reef fishes make up a major portion of the total commercial catch and are an important component of the local diet. The majority of the domestic catch is consumed locally (WPFIN 2013c) Commercial fishers landed 217,092 lbs. of fish, with revenues of $503,821. The largest catch was skipjack tuna, at 58,420 lbs. and $113,308 in revenue (WPFIN 2013c).

The most frequently caught fish around Saipan in 2010 were reef-associated (caught by 54 percent of the anglers), followed by shallow-water bottomfish (23 percent) and reef invertebrates such as octopus, shellfish, and crabs (14 percent). The median monthly catch was 40 lbs. per person. Saipan anglers reported that 70 percent of their catch was consumed by themselves and immediate family, with another 20 percent consumed by extended family and friends. Only 8 percent of the catch was sold, not surprising given that the anglers had social and cultural reasons for fishing, rather than economic motivations (Allen and Amesbury 2012).

3.3.6.3 Guam

Guam is the southernmost island of the Mariana Archipelago. It has been an unincorporated U.S. territory since 1898. Although it is the largest island in Micronesia, Guam is only 209 square miles. The EEZ is approximately 82,400 square miles and lies adjacent to the CNMI and Federated States of Micronesia EEZs.

Guam's economy has been dominated by tourism and the U.S. military (Allen and Bartram 2008). The 2010 population of Guam was 159,358 persons. The 2012 unemployment rate was 8.2 percent (US Census 2012).

Fishing activities on Guam occur in both the nearshore and pelagic zones. Offshore fishing typically involves 1 or 2-day troll and bottomfish trips. These usually originate from one of the three principal harbors located on the west coast and southern tip of the island. Inshore fishing is usually conducted without the use of a boat and consists mostly of nearshore casting, throw-netting, and spearfishing. There are three sources of fish in Guam's commercial market: (1) full-time commercial fishers; (2) part-time commercial fishers; and (3) subsistence or recreational "expense" fishers who frequently sell portions of their catch to help defray costs. Licenses are not required to sell fish on Guam, nor are there any reporting requirements for those selling fish (WPFIN 2013d).

While commercial fisheries have made a relatively minor contribution to Guam's economy, the area historically has functioned as a major point of seafood transshipment and resupply (Allen and Bartram 2008). Guam commercial fishers landed 265,483 lbs. of fish and shellfish in 2011, with revenues of $677,765. The largest catch by weight was mahi mahi, at 53,649 lbs., with revenues of $118,238. Parrotfishes, at 37,247 lbs., with revenues of $120,584, brought in more revenue than any other catch (WPFIN 2013d).

The people of Guam, including various immigrant communities, continue to depend on fishing and locally caught seafood to reinforce and perpetuate cultural traditions such as community sharing of food (Allen and Bartram 2008).

3.3.7 PIFSC Operations

Research-related spending directly generates jobs and income, and benefits businesses in the private economy by expenditures on research-related equipment. PIFSC is headquartered in Honolulu, Hawai‘i. PIFSC is responsible for scientific research on living marine resources that occupy marine and estuarine habits of the western Pacific Ocean. The PIFSC annual budget from fiscal year 2010-2012 averaged about $29.2 million and supported a staff of 222 researchers, technical personnel, and administrative employees, including a mixture of federal and non-federal staff (Pooley 2013).

PIFSC research contributes to local economies through operational support of NOAA vessels and contracted vessels (fuel, supplies, crew wages, shoreside services), operational costs of research support facilities (utilities, supplies, services), and employment of researchers who live in nearby communities.

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4.1 INTRODUCTION AND ANALYSIS METHODOLOGY

This chapter presents an analysis of the potential direct and indirect effects of the alternatives on the physical, biological, and social environments consistent with Section 1502.16 of the CEQ NEPA regulations (40 CFR Part 1500) and 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). Four alternatives have been brought forward for detailed analysis (see Chapter 2):

- The No Action/Status Quo Alternative, where fisheries and ecosystem research programs conducted and funded by PIFSC would be performed as they were over the past 5 years. This is considered the No Action Alternative for ongoing programs under NEPA.
- The Preferred Alternative, where PIFSC would conduct some new research activities and implement new protocols intended to mitigate impacts to protected species in addition to those described under the Status Quo Alternative.
- The Modified Research Alternative, where PIFSC would conduct fisheries and ecosystem research with scope and protocols modified to minimize risks to protected species.
- The No Research Alternative, where PIFSC would no longer conduct or fund fieldwork in marine waters for the fisheries and ecosystem research considered in the scope of this PEA.

In addition to a suite of fisheries and ecological research conducted or funded by PIFSC as the primary federal action, the first three alternatives would also include promulgation of regulations and subsequent issuance of an LOA under Section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, taking of marine mammals as the secondary federal action.

As was discussed in Chapter 1 of this PEA, the NMFS is fundamentally a science-based agency, its primary mission being the stewardship of living marine resources through science-based management. The first three alternatives evaluated in this PEA would enable PIFSC to collect scientific information that otherwise would not be fully replaced by other sources, while the fourth alternative considered would not enable the collection of such information and data essential for the science-based management of living marine resources. In NMFS view, the inability to acquire such scientific information would ultimately imperil the agency's ability to meet its mandate to manage living marine resources. Similar concerns apply specifically to the conservation and management of protected species, their habitats, and other marine ecosystem components. However, several plausible scenarios (such as federal budget cuts, legal actions against NMFS, or natural disasters affecting PIFSC facilities) could potentially result in the discontinuation or severe curtailment of the PIFSC fisheries and ecosystem research activities for a period of time. The No Research Alternative therefore allows NMFS to examine the effects on the human environment of discontinuing federally funded fisheries and ecosystem research in the PIFSC research areas.

4.1.1 Impact Assessment Methodology

The authors of the sections in this chapter are subject matter experts. They developed a discussion of the effects of each alternative on each resource type based on best professional judgment;

relying on the collective knowledge of other specialists in their respective fields, and the body of accepted literature.

The impact assessment methodology consists of the following steps:

1. Review and understand the proposed action and alternatives (Chapter 2).
2. Identify and describe:
   a. Direct effects that would be "caused by the action and occur at the same time and place" (40 CFR § 1508.8(a)), and
   b. Indirect effects that would be "caused by the action and (would occur) later in time or farther removed in distance but are still reasonably foreseeable" (40 CFR § 1508.8(b)).
3. Compare the impacts to the baseline conditions described in Chapter 3 and rate them as major, moderate, or minor. In order to help consistently assess impacts and support the conclusions reached, the authors developed a criteria table that defines impact ratings for the resource components (Table 4.1-1). The criteria provide guidance for the authors to place the impacts of the alternatives in an appropriate context, determine their level of intensity, and assess the likelihood that they would occur. Although some evaluation criteria have been designated based on legal or regulatory limits or requirements (see description of criteria for marine mammals below), others are based on best professional judgment and best management practices. The evaluation criteria include both quantitative and qualitative analyses, as appropriate to each resource. The authors then determine an overall rating of impacts to a given resource by combining the assessment of the impact components.

As described in Section 1.4, the reason an EA is developed is to determine whether significant environmental impacts could result from a proposed action and to inform the decision about whether an EIS needs to be developed. If no significant impacts are discovered, NMFS can document its decision on the proposed action with a FONSI. The assessment methodology described in this section is consistent with NAO 216-6A, which provides guidance on how the agency should make determinations of significance in NEPA documents.

Table 4.1-1 Criteria for Determining Effect Levels

Resource Components	Assessment Factor	Effect Level		
		Major	Moderate	Minor
Physical Environment	Magnitude or intensity	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	> 10% of project area (widespread)	5-10% of project area (limited)	0-5% of project area (localized)
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

Resource Components	Assessment Factor	Effect Level		
		Major	**Moderate**	**Minor**
Biological Environment	Magnitude or intensity	Measurably affects population trend	Population level effects may be measurable	No measurable population change
		For marine mammals, M&SI greater than or equal to 50% of PBR[1]	For marine mammals, M&SI injury between 10% and 50% of PBR	For marine mammals, M&SI less than or equal to 10% of PBR
	Geographic extent	Distributed across range of a population	Distributed across several areas identified to support vital life phase(s) of a population	Localized to one area identified to support vital life phase(s) of a population or non-vital areas
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Social and Economic Environment	Magnitude or intensity	Substantial contribution to changes in economic status of region or fishing communities	Small but measurable contribution to changes in economic status of region or fishing communities	No measurable contribution to changes in economic status of region or fishing communities
	Geographic extent	Affects region (multiple states)	Affects state	Affects local area
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

1 PBR.

4.1.2 Impact Criteria for Marine Mammals

The impact criteria for the magnitude of effects on marine mammals have been developed in the context of two important factors derived from the MMPA. The first factor is the calculation of PBR for each marine mammal stock. The MMPA defined PBR at 16 U.S.C. § 1362(20) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR was intended to serve as an upper limit guideline for anthropogenic mortality for each species. Calculations of PBR are stock-specific and include estimates of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the stock (e.g., whether the stock is listed under the ESA or depleted under the MMPA). NMFS and USFWS are required to calculate PBR (if possible) for each stock of marine mammals they have jurisdiction over and to report PBR in the annual marine mammal stock assessment reports (SARs) mandated by the MMPA. The PBR metric has been used extensively to assess human impacts on marine mammals in many commercial fisheries involving M&SI and is a recognized and acceptable metric used by NMFS OPR in the evaluation of commercial fisheries incidental takes of marine mammals in U.S. waters as well as for other sources of mortality such as ship strikes.

The second factor is the categorization of commercial fisheries with respect to their adverse interactions with marine mammals. Under Section 118 of the MMPA, NMFS must classify all U.S. commercial fisheries into one of three categories based on the level of marine mammal M&SI that occurs incidental to each fishery, which it does in the List of Fisheries (LOF) published annually. Category III fisheries are considered to have a remote likelihood of or no known incidental M&SI of marine mammals. Category II fisheries are those that have occasional incidental M&SI of marine mammals. Category I fisheries are those that have frequent incidental M&SI of marine mammals. A two-tiered classification system is used to develop the LOF, with different thresholds of incidental M&SI compared to the PBR of a given marine mammal stock.

However, the LOF criteria is primarily used for managing commercial fisheries based on their actual levels of marine mammal M&SI and is not necessarily designed to assess impacts of projected takes on a given marine mammal stock. Because the analysis of direct impacts of PIFSC research on marine mammals in this PEA is based on projected takes rather than actual takes, we use a similar but not identical model to the LOF criteria.

In spite of some fundamental differences between most PIFSC research activities and commercial fishing practices, it is appropriate under NEPA to assess the impacts of incidental takes due to research in a manner similar to what is done for commercial fisheries for two reasons:

- PIFSC research activities are similar to many commercial fisheries in the fishing gear and types of vessels used, and
- PIFSC research plays a key role in providing the scientific data that are used by managers to regulate commercial fisheries.

As part of the NEPA impact assessment criteria (Table 4.1-1), if the projected annual M&SI of a marine mammal stock from all PIFSC fisheries and ecosystem research activities is less than or equal to 10 percent of PBR for that stock, the effect would be considered minor in magnitude for the marine mammal stock, similar to the LOF's Category III fisheries that have a remote likelihood of M&SI with marine mammals with no measurable population change. Projected annual M&SI from PIFSC research activities between 10 and 50 percent of PBR for that stock would be moderate in magnitude for the marine mammal stock, similar to the LOF's Category II fisheries that have occasional M&SI with marine mammals where population effects may be measurable. Projected annual M&SI from PIFSC research activities greater than or equal to 50 percent of PBR would be major in magnitude for the marine mammal stock, similar to the LOF's Category I fisheries that have frequent M&SI with marine mammals which measurably affect a marine mammal stock's population trend. Note that NEPA requires several other components to be considered for impact assessments (see Table 4.1-1); the magnitude of impact is not necessarily the same as the overall impact assessment in a NEPA context.

In the MMPA LOA application, PIFSC estimated takes for each marine mammal stock are grouped by gear type (e.g., trawl gear and longline gear) with the resulting take request not apportioned by individual research activities (e.g., by survey). This precludes impact analysis at the individual activity or project level within the PEA.

The contribution of PIFSC research activities to overall impacts on marine mammals will be aggregated with past, present, and reasonably foreseeable future impacts on marine mammals from commercial fisheries and other factors external to PIFSC research activities in the Cumulative Effects analysis in Chapter 5. NMFS will report all sources of M&SI in the annual marine mammal SARs, including any incidental M&SI takes that may occur from any of the FSCs. The cumulative effects analysis will use the same impact assessment criteria and thresholds as described in Table 4.1-1, only they will be applied to collective sources of M&SI and other types of impacts on marine mammals.

4.1.3 Impact Criteria for Cultural Resources

PIFSC fisheries and ecosystem research activities have the potential to affect cultural resources both directly and indirectly. This section identifies possible impacts of PIFSC fishery research on cultural resources as outlined under the proposed alternatives.

Section 106 of the NHPA requires that NMFS identify cultural resources that may be impacted by a federal undertaking, and seeks to protect those resources that are listed, or are eligible for listing, on the NRHP. The NHPA regulations at 36 CFR Part 800 identify a consultative process to determine site eligibility, to evaluate potential impacts, and to identify impact avoidance or mitigation actions. PIFSC initiated the Section 106 process on April 29, 2014 with the SHPOs and NHOs to identify historic properties of religious or cultural importance that may be affected by the proposed alternatives within the Area of Potential Effects (APE).

The APE for this project encompasses the marine waters of the Pacific Island Region (i.e., the waters around the State of Hawai‘i, the CNMI, Guam, American Samoa, and the PRIA including the high seas) as outlined in Section 3.1. The APE includes the open ocean waters between the islands listed above as well as the near-shore waters. However, the APE does not include any uplands or beach areas above the high tide line as none of the research activities subject to this PEA takes place in these areas (see Figure 3.1-2). For example, the activities of the Marine Debris Research and Removal Survey primarily target derelict fishing gear in-water and attached to the reef, though it can include marine debris that has washed ashore but located below the high tide line. Access to the marine waters would be from existing ports, docks, and boat ramps. To date, NMFS has received one response from a stakeholder in Guam and no additional historic properties of religious or cultural importance were identified within the APE. Cultural resources have been described here as either historic or contemporary. A historic cultural resource refers to significant sites listed on the NRHP as well as potential shipwrecks, burial sites, or fishponds of past documented cultural importance that could be affected. Contemporary cultural resources refer to more currently practiced cultural traditions typically in relation to the human relationship with marine resources and may have a basis in historic cultural practices.

4.2 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 1—NO ACTION/STATUS QUO ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 1 – the No Action/Status Quo Alternative on the physical, biological, and social environment. Under this Alternative, fisheries research programs conducted and funded by PIFSC would be performed as they have been over the previous five years. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all Resource Components evaluated under Alternative 1 is presented below in Table 4.2-1.

Table 4.2-1 Status Quo Alternative Summary of Effects

Resource	Physical Environment	Special Resource Areas and EFH	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
SECTION #	**4.2.1**	**4.2.2**	**4.2.3**	**4.2.4**	**4.2.5**	**4.2.6**	**4.2.7**	**4.2.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.2.1 Effects on the Physical Environment

Section 3.1.1 describes the physical environment within the PIFSC research area. This section describes the effects that PIFSC fisheries and ecosystem research activities may have on the physical environment. The potential effects of fisheries research activities on the physical environment would vary depending on the types of survey gear and other equipment used, but could generally include:

- Physical damage to benthic (seafloor) habitat
- Changes in water quality

4.2.1.1 Physical Damage to Benthic (Seafloor) Habitat

Physical damage to benthic habitat under the Status Quo Alternative could result from the deployment of stationary bottom-contact gear, and to a lesser extent as a result of SCUBA survey operations near coral reefs and coral coring. The Status Quo Alternative also has the beneficial effect of removing derelict fishing gear from the marine environment through activities of the Marine Debris Research and Removal Survey.

Bottom-contact fishing gear and instruments historically used in PIFSC fishery research activities includes lobster traps, hook-and-line bottomfishing, RAMP photo-transects and stereo-video instruments (e.g., BRUVs, BotCam) that temporarily touch or rest directly on the seafloor. In addition, ARMS, ADCPs, BMUs, CAUs, STRs, HARPs, PUCs, RAS, SEAFET/SAMIs, and EARs are either temporarily fixed or anchored to the benthic substrate (Table 2.2-1; also see Appendix A for description of gear types). Temporary anchors (i.e., weights) are used for the BotCam and HARP. These anchors are either two links of three-inch-diameter steel anchor chain, approximately 25-lb. steel plates, or concrete masonry blocks. Under rare circumstances, these anchors are not recovered with the instrument. Deployment of stationary bottom-contact gear could result in furrowing and smoothing of small areas of the seafloor, as well as the displacement of rocks and boulders (including coral skeletons), and such damage can increase with multiple contacts in the same area (Morgan and Chuenpagdee 2003; Stevenson et al. 2004). For all of these gear types, direct physical disturbance is typically limited to the point of anchorage or footprint of the gear. The footprint of a single lobster trap is approximately 0.75 m^2 and consists of a 0.98 x 0.77 x 0.30-m molded polyethene cage. The footprint of a BRUV is approximately 0.05 m^2 and consists of a 12 mm diameter galvanized steel pipe in a rectangular shape of 1.26 x 0.86 m. The footprint of RAMP visual surveys, including transect lines and photo-transects, is limited to a few cm^2 per sampling location. ARMS and ADCPs are secured to the substrate using stainless steel stakes or two 81 x 8 x 5-cm weights each. BMUS and CAUs are attached to a single 1.25 x 30-cm stainless steel stake and installed into the substrate while avoiding corals. STRs are each anchored with two 3-lb. coated weights and strapped to a dead portion of the reef with cable ties. PUCs are anchored in weighted milk crates on a dead portion of reef. SEAFETs/SAMIs are similarly deployed with weighted anchors on a dead portion of reef. Weights and anchors associated with bottom-contact fishing gear may cause localized impacts to benthic habitat and can physically damage fragile structure producing organisms such as corals (Macdonald et al. 1996, Eno et al. 2001). However, given the small area affected by stationary bottom-contact fishing gear, the geographic extent of impacts would be limited to less than 0.01 percent of the project area and would therefore be considered localized according to the criteria for determining effects levels, provided in Table 4.1-1.

PIFSC does not use bottom trawl or dredge equipment for any of its research programs under the Status Quo Alternative, and therefore, the impacts to physical habitat that could result from the use of bottom trawl or dredge equipment would not occur in the PIFSC research areas as a result of this alternative.

In general, physical damage to the seafloor would recover within several months through the action of water currents and natural sedimentation. PIFSC fishing gear accidentally lost while conducting surveys could damage benthic substrate, though the direct and indirect effects of lost PIFSC gear such as monofilament and braided polypropylene line on benthic substrates would likely be minor due to the minimal amounts of line typically lost during research (see discussion about potential impacts to corals in Section 4.2.7.1).

Impacts to epifauna, including removal or disturbance of corals and other organisms that produce structure, are discussed in section 4.2.7- Effects on Invertebrates. The removal or disturbance of such structure producing organisms would result in some direct and indirect impacts to the physical environment in the areas where PIFSC collects these organisms or deploys equipment that comes into contact with the seafloor. However, as described in Section 4.2.7, the overall direct and indirect impacts resulting from removal or disturbance of structure organisms would be minor in magnitude and would involve less than 0.01 percent of the overall project area dispersed over a large geographic area. Although impacts to slow-growing organisms could take several months to recover, the frequency of such impacts would be occasional (or rare) and any resulting impacts to the physical environment would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.2.1.2 Changes in Water Quality

Fishing gear that contacts the seafloor could increase the turbidity of the water by resuspending fine sediments and benthic algae from the seafloor. Resuspension of fine sediments and turnover of sediment could also result in localized increases in the concentrations of dissolved organic material, nutrients, and trace metals in seawater near the seafloor (Stevenson et al. 2004).

Likewise, potentially adverse effects to benthic habitats resulting from discharge of contaminants from vessels used during research surveys are possible, but unlikely. If such effects were to occur, they would be infrequent, temporary, and localized. All NOAA and ocean-going vessels are subject to the regulations of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, (1973), as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six Annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (International Maritime Organization [IMO] 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). NOAA vessels and vessels contracted for the performance of PIFSC fisheries and ecosystem research activities are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and contained quickly. Oil spill prevention training and equipment may be more variable on small boats and contracted fishing vessels used in research, although all vessels are required to comply with U.S. Coast Guard regulations on spills. Potential effects on the physical environment resulting from discharged or spilled materials are not gear type dependent and would be negligible to minor throughout the PIFSC research areas.

4.2.1.3 Conclusion

The effects of the Status Quo Alternative on the physical environment include potential changes to benthic habitat and changes in water quality near the seafloor. The geographic extent of any physical impacts to benthic habitats caused by PIFSC fisheries research activities would be limited to less than one one-hundredth of one percent of the total area in each of the four PIFSC research areas, and therefore would be considered minor in magnitude. These effects would certainly occur under the Status Quo Alternative. In general, physical damage to the seafloor would recover within several months. Impacts to slow-growing organisms that produce structure could take longer to recover, however the magnitude of such impacts would be very small given the minimal footprint of bottom-contact gear used by PIFSC and the mitigation measures in place to protect reef habitats. The potential for bottom-contact gear accidentally lost during a survey exists, but it is a remote possibility given the types of gear used. Adverse effects on water quality through accidental contamination from research activities are possible, but unlikely. If such effects were to occur, their intensity, extent, duration, and frequency would be minor. Other effects on water quality could result from the temporary resuspension of sediments and benthic algae; such impacts would be minor in magnitude, temporary in duration, and would be limited to areas near the seafloor.

The overall effects of the Status Quo Alternative on the physical environment would be minor in magnitude, dispersed over a large geographic area, and short-term or temporary in duration. In general, any measurable alterations to benthic habitat would recover within several months through the action of water currents and natural sedimentation. Overall impacts would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.2.2 Special Resource Areas and EFH

Section 3.1.2 describes the special resource areas that occur in the same geographic areas as the PIFSC fishery research activities. This section describes the general types of effects that PIFSC fishery research activities under the Status Quo Alternative may have on the following categories of special resource areas:

- EFH and HAPC
- MPAs and NMSs
- International MPAs.

4.2.2.1 EFH and HAPC

Section 3.1.2.1 describes the areas designated as EFH within the PIFSC research areas. EFH applies to federally managed marine species in both state and federal jurisdictional waters throughout the range of the species within U.S. waters. Where a species' range extends beyond U.S. waters, EFH stops at the boundary. As described in Section 3.1.2.1, EFH includes hard bottom structures underlying the waters and associated biological communities. These biological communities include corals, seagrass, algae, and mangroves. Effects to these biological communities under the Status Quo Alternative are evaluated in Section 4.2.7.

EFH are identified in FMPs and implemented by NMFS to facilitate long-term protection of EFH through conservation and management measures. There are five current FMPs for areas within the PIFSC research region. HAPC are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. Table 3.1-2 summarizes the EFH and HAPC designations by MUS in the Pacific Islands Region. The combined EFH includes all bottom habitats to a depth of 400 m and the water column to a depth of 1,000 m between the shoreline and outer limit of the EEZ.

PIFSC does not employ bottom trawl or dredge equipment within the HARA, MARA, ASARA, or WCPRA and the magnitude and geographic extent of direct impacts to EFH benthic habitat from other bottom-contact research gear would be minor according to the criteria in Table 4.1-1 (see discussion in Section 4.2.1). Given the small areas affected by PIFSC research activities within EFH and component HAPC areas, effects would be considered localized in geographic extent. Potential effects on EFH / HAPC from PIFSC research activities are also expected to be temporary in duration or short-term. Under the Status Quo Alternative, the overall effects of fisheries research on EFH would be considered minor adverse according to the criteria in Table 4.1-1.

Direct and indirect effects of PIFSC research activities on biological resources within EFH and component HAPC areas are most accurately captured in the assessments of species groups, which are evaluated in Sections 4.2.3-4.2.7.

4.2.2.2 Marine Protected Areas

Under the Status Quo Alternative, PIFSC research activities have the potential to affect MPAs both directly and indirectly. As described in Section 3.1.2.3, MPAs within the PIFSC region include: U.S. MNMs; U.S. NMS; U.S. National Parks; U.S. NWRs; Department of Defense NDSAs as well as State and Territorial MPAs. Details of MPAs located within the U.S. EEZ, can be found in Section 3.1.2.4 or on the List of National System Marine Protected Areas (NOAA 2013a). In addition, many foreign and international MPAs exist in the central and western Pacific; however, the MPAs in this region only encompass a small fraction of the area where PIFSC research surveys are conducted (see Section 3.1.2.3 and 3.1.2.4).

MPAs vary widely in the level and type of legal protection afforded to the sites' natural and cultural resources and ecological processes. Considering the wide range of conservation goals and varying degrees of legal protection associated with individual MPAs in the PIFSC research areas (see Section 3.1.2.4), it is impractical to assess the impacts of PIFSC research activities to those areas on a case-by-case basis. Locations of sampling sites are often randomized, varying from year to year, and impacts of research surveys within particular MPAs would vary substantially over space and time. In general, the impacts to each of the MPAs under the Status Quo Alternative are a subset of the impacts to specific physical, biological, and socioeconomic resources that are addressed in the resource specific sections of this PEA.

Potential impacts to the below MPAs include the introduction of diseases to coral reef organisms and the spread of invasive species. Mitigation measures intended to mitigate adverse interactions with protected species described in Section 2.2.1.5 would also mitigate adverse interaction between invasive species and MNMs. These measures include procedures to disinfect and clean equipment, gear, and small boats used in the field. Additionally, anti-fouling paint will be applied to the hull and bottom of NOAA vessels every two years.

U.S. Marine National Monuments

MNM are MPAs with special national significance, designated by Presidential Proclamation to set aside lands and waters of the United States for protection, and requires no public process. Four MNMs are located within the Pacific Islands Region (Figure 3.1-3) and include: Papahānaumokuākea MNM; Rose Atoll MNM; Marianas Trench MNM; and the Pacific Remote Islands MNM. As described in Section 3.1.2.3.1, the four MNM encompass marine water and submerged lands within the PIFSC research areas.

As part of the establishment of these MNM, the monuments contain conservation measures, restrictions of certain activities, and establishment of Reserve Preservation Areas around some islands, atolls, and banks where consumptive or extractive uses are prohibited. The Papahānaumokuākea MNM, which is currently co-managed by NOAA, USFWS, and the State of Hawai‘i, has specific permitting requirements that need to be met before research activities can occur. The Monument permitting criteria is set forth in Proclamation 8031 and Monument Regulations at 50 CFR Part 404.11. Monument findings and review criteria must be met by applicants to ensure their proposed activities are consistent with Proclamation 8031 and the goals of the Monument Management Plan (https://www.papahanaumokuakea.gov/management/mp.html). The three other monuments were created in 2009 and management is shared between NOAA and USFWS as described in the proclamations. Unlike Papahānaumokuākea MNM, permits are not required for scientific exploration or research activities conducted by or for the Secretaries of Interior or Commerce in monument waters.

Under the Status Quo Alternative, PIFSC would conduct some research activities in monument areas, sanctuaries, or refuges; however, the research activities would be limited, minimally invasive, and extractive sampling would not occur to any considerable extent. Under Alternative 1 research activities occurring within the MNMs would be minimal. Possible PIFSC surveys conducted within the MNMs would include the RAMP surveys in nearshore areas using non-invasive survey techniques at randomized locations, as well as life history or other limited specimen collections of fish. The possibility of such surveys occurring within the MNMs is small, and any research activities occurring within these MNMs would meet established conservation measures and restrictions for the location. The Secretary of Commerce, through NOAA, has the primary management responsibility regarding management of marine areas and may permit certain scientific research efforts within the monuments. For all of the areas, fishery-related activities seaward from the 12-nm refuge boundaries out to the 50-nm monument boundary, and to the 200-nm boundary around Jarvis Island, Johnston Atoll, and Wake Atoll, are managed by NOAA. Regarding overlapping of federal jurisdictions, it should be noted that all Federal Monument regulations and restrictions are to be dominant over any other existing federal withdrawal, reservation, or appropriation (NOAA 2015).

Potential direct and indirect impacts of research activities under the Status Quo Alternative would be small but measurable and would be considered minor to moderate in intensity. Impacts would be important in context as they would affect protected resources. The duration of such impacts would be temporary due to the transient nature of the impacts and short duration of research activities. The geographic extent of the impacts would be local to regional depending on the extent of RAMP surveys within MPA boundaries. As previously stated, RAMP survey locations are selected randomly, and can potentially occur within MPAs. Under Alternative 1 such activities would be minimally extractive and would occur infrequently. The overall impacts to MNMs under the Status Quo Alternative would be negligible to minor and beneficial due to the survey data collected from PIFSC research surveys providing the scientific basis for fisheries management in the region.

U.S. National Marine Sanctuaries

National Marine Sanctuaries are MPAs with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities. Within the PIFSC research areas there are two designated NMS, and include the Hawaiian Islands Humpback Whale NMS, and American Samoa NMS. Section 304(d) of the NMSA requires interagency consultation between the NOAA ONMS and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource." Sanctuary consultation requires the federal action agency to submit a "sanctuary resource statement," which describes the agency action and its potential effects on sanctuary resources. Sanctuary resource statements are not necessarily separate documents prepared by the federal agency and may consist of documents prepared in compliance with other statutes such as the NEPA. The following analysis describes the potential effects of PIFSC research activities under the Status Quo Alternative on each of the potentially affected NMS within the PIFSC research areas and provides the requisite information for a sanctuary resource statement pursuant to section 304(d) of the NMSA. Please see Section 1.3 regarding Section 304(d) consultation as well as Section 4.3 for information on consultation and an analysis of potential effects of the Preferred Alternative under NMSA.

As described in Section 3.1.2.3.2, management of NMSs has been delegated to NOAA's ONMS by the Secretary of Commerce in accordance with NMSA. As part of the establishment of the

NMSA, the sanctuaries adhere to conservation measures, restrictions of certain activities, and the prohibition of consumptive or extractive uses.

The purpose of NMSs is to protect specific marine species and their habitat, develop conservation management plans for the protection of marine resources, and also to manage human uses within the sanctuaries. As part of the management process for the sanctuaries, a management plan is used as a guiding document for conservation and management of marine resources. However, the sanctuaries management plan and designation document do not provide for the management of fishing operations (NOAA 2002). Regulations governing access and uses within the Hawaiian Islands Humpback Whale NMS can be found in 15 CFR Part 922 Subpart Q and J.

Several PIFSC fisheries research surveys occur partially within the boundaries of the NMSs within the PIFSC research areas, including sampling of pelagic stages of insular fish species; determining spawning dynamics of highly migratory species; marine debris research and removal; coral reef benthic habitat mapping; deep coral and sponge research; insular fish life history survey and studies; the RAMP; the cetacean ecology assessment; the Kona integrated ecosystem assessment cruise; bottomfish surveys; insular fish abundance estimation comparison surveys; gear and instrument development and field trials; lobster surveys; and some surface night-light sampling. Research and survey activities are discussed in more detail in Table 2.3-1.

The potential effects on NMSs resulting from PIFSC research under the Status Quo Alternative are similar or the same as those discussed for physical, biological, and socioeconomic resources elsewhere in this PEA. These effects primarily involve potential adverse interactions with protected species, and the risk of accidental spills or contamination from vessel operation. While survey activities may occur within NMSs, these activities would have *de minimus* impacts on benthic habitats within sanctuaries because PIFSC does not use bottom-contact trawl equipment or other mobile bottom-contact research equipment within the sanctuaries. Stationary bottom-contact equipment that could potentially influence benthic habitat within NMSs are described in section 4.2.1. PIFSC does not conduct extractive sampling of fish or invertebrates in the water column within sanctuary boundaries. RAMP surveys could potentially occur within the NMSs and would occur in nearshore areas, generally with non-invasive survey techniques. The site selection process for these surveys is randomized so the possibility of such surveys occurring within the NMSs is variable. However, if these surveys were to occur, they may include extractive sampling of corals within sanctuary boundaries but any such samples, if collected, would be very small (4 cm in diameter) and very small in number. Impacts would be limited to small geographic areas and would be temporary in duration. Impacts would dissipate rapidly upon completion of the research activity. Overall, the effects of Alternative 1 on biological populations, habitats, and biogeochemical cycles within NMSs would be of low intensity and limited due to the short duration of the surveys.

Near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment could result in temporary impacts to pelagic habitat within NMSs. Presence of pelagic sampling equipment may result in short-term disturbance or displacement of pelagic species within NMS. The duration of impacts to pelagic habitats within NMSs would generally not extend beyond the duration of the research activity. Effects of surveys on populations of individual species occurring within NMS are addressed in the species-specific sections of this report.

PIFSC survey activities within NMS may result in adverse interactions with protected species, including marine mammals. Adverse interactions with marine mammals may include disturbance from vessels and active acoustic equipment and incidental take. Historically there have been limited amounts of interactions with protected species during research activities. Therefore, similar levels of interaction with protected species would be expected to result from the PIFSC research activities included under the Status Quo Alternative. Mitigation measures intended to mitigate adverse interactions with protected species are described in Section 2.2.1.

U.S. National Parks

National Park designations within the PIFSC research areas are located in nearshore areas or inland from the coast. Currently, most PIFSC research activities do not occur in nearshore locations, nor within National Park boundaries, and therefore, potential impacts to National Parks from the suite of research activities proposed under the Status Quo Alternative would be limited.

The NPS has jurisdiction over several National Parks and Historic Sites in the Pacific Islands Region that include marine waters within the scope of analysis. National Historic Parks within the PIFSC region are focused on preserving important cultural and historical sites, but within certain park's boundaries, ecologically important coral reefs and seagrass beds can potentially be found. The National Park Service manages these waters as MPAs however, some research activities and fishing are allowed through their permitting process. Any potential direct or indirect impacts from the activities proposed under the Status Quo Alternative would be minor in intensity, temporary in duration, common in context, and localized to only those near-shore areas influenced by PIFSC research activities. If limited PIFSC survey activities occur in National Parks under the Status Quo Alternative, the overall potential impacts to National Parks within the PIFSC research areas would be negligible to minor.

U.S. Fish and Wildlife Refuges

As described in Section 3.2.2.3, there are nine individual NWRs throughout the Pacific Islands Region. The USFWS's primary objective with designated refuges is to conserve and manage fish, wildlife, and plant resources and habitats for the benefit of present and future generations. In many instances, designated NWRs occur within the boundaries of MNMs and in these instances, the regulations in place for MNMs supersede Refuge regulations.

Under the Status Quo Alternative, PIFSC research activities within the Pacific Islands Region NWRs would include the sampling of the pelagic stages of insular fish species and the spawning dynamics of highly migratory species (with the exception of Hawaiian Islands, Rose Atoll, and Midway NWRs); marine debris research and removal; coral reef benthic habitat mapping; deep coral and sponge research; insular fish life history survey and studies; the RAMP; the cetacean ecology assessment; and some surface night-light sampling. Insular fish abundance estimation comparison surveys would also occur in the Hawaiian Islands NWR, and lagoon ecosystem characterization would occur within the Palmyra Atoll and Wake Atoll NWRs.

Potential impacts from all surveys conducted within U.S. NWRs would be the same as those described for the MNMs and NMS. Under the Status Quo Alternative, direct and indirect impacts from PIFSC research activities within the refuge or on refuge regulations would continue at current levels and would be minor in intensity as only a small number of resources would be affected and the changes in resource character would be small, but potentially measurable. Impacts could occur to protected resources and therefore the impacted resources are considered important in context. Impacts would be localized and temporary in duration, with the majority of research activity occurring away from the NWRs. Overall, the impacts to NWRs under the Status Quo Alternative would be minor.

State and Territorial MPAs

In addition to federally managed MPAs, there are a variety of local territories and state MPAs in the PIFSC research areas. As described and listed in Section 3.1.2.3, specific state and territorial MPAs within the PIFSC research area include Hawaiian MPAs as well as MPAs within American Samoa, Guam, the CNMI, and foreign or international locations. Most of these MPAs are small in size relative to the Marine National Monuments. Under the Status Quo Alternative, PIFSC research activities that occur within the listed state and territorial MPAs are limited and include nearshore surveys such as coral reef benthic habitat mapping and the randomized RAMP surveys.

PIFSC survey activities within state and territorial MPAs may result in impacts to special resources in the MPAs, but in most cases such impacts would be minimal. Interactions with special resource habitats may include disturbance from vessels and incidental take of protected species, but historically PIFSC fisheries research survey activities have not resulted in any takes of protected resources within MPA boundaries. This situation would be expected to continue under the Status Quo Alternative. Mitigation measures intended to mitigate the effects of interactions with protected species are described in Section 2.2.1 of this document.

Of the state and territorial MPAs, various MLCDs have been established to help conserve and replenish marine resources. As described in Section 3.1.2.3, eleven MLCDs have been established in Hawaiʻi, as well as various Fishery Management Areas, with both being managed by the State of Hawaiʻi DNLR DAR. Potential impacts of PIFSC research activities to these MCLDs and FMAs would be minimal due to most research activities happening away from the shoreline. Overall, direct and indirect impacts to state and territorial MPAs under the Status Quo Alternative would be the same or similar to those of federally managed MPAs, but to a lesser extent due to the smaller number of research activities that occur within these MPAs.

4.2.2.3 Conclusion

PIFSC survey activities provide essential information related to the science-based management, conservation, and protection of living marine resources and ecosystem services within these areas. The information developed from PIFSC research activities is essential to the development of a broad array of fisheries, habitat, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities. Science-based management of marine resources supported by PIFSC research activities included under the Status Quo Alternative would therefore result in beneficial effects on MPAs within the PIFSC research areas.

Potential adverse effects on special resource areas and EFH resulting from PIFSC research activities are expected to be localized in area or extent, short-term or temporary in duration, and result in no measurable changes to the physical environment. The overall direct and indirect effects of the Status Quo Alternative on special resource areas and EFH are therefore considered minor adverse according to the criteria described in Table 4.1-1.

4.2.3 Effects on Fish

This section describes the effects of PIFSC fisheries and ecosystem research activities under the Status Quo Alternative on fish species in the PIFSC research areas of the HARA, MARA, ASARA, and WCPRA. The Status Quo Alternative includes PIFSC fisheries and ecosystem research as it has occurred over the past five years. The potential effects of research vessels, survey gear, and other associated equipment on fish species found in the research areas would include:

- Mortality from fisheries research activities
- Contamination from discharges
- Disturbance and changes in behavior due to sound sources

4.2.3.1 Mortality from Fisheries Research Activities

Direct mortality of fish could occur as a result of various fisheries and ecosystem research activities proposed under the Status Quo Alternative. Fish are caught in a variety of gear types, some of which involve experimental tests of gears designed to reduce incidental catch of non-target species or protected species. These surveys provide important data to determine biomass estimates, reproductive potential, and distribution of fish stocks, which are necessary for fisheries managers to maintain healthy populations and rebuild overfished or depressed stocks. PIFSC also conducts surveys to provide indices of juvenile abundance that are used to identify and characterize the strength of year classes before fish are large enough to be harvested by commercial or non-commercial fisheries. Stock assessments based on accurate abundance and distribution data are essential to developing effective management strategies.

The majority of fish affected by PIFSC research projects are caught and killed during the below surveys:

- Surface Night-Light Sampling Survey
- Mariana Resource Survey
- Insular Fish Life History Survey and Studies
- Longline Gear Research, Marlin Longline, and NWHI Surveys (discontinued surveys)

The capture rate of fish species in research surveys varies substantially within each research area, with higher numbers in samples from some areas and very low or no individuals collected in other samples. This variability in catch is used to determine species abundance and distribution. Concentrations of biomass and species richness depend on topographic features, water temperature and salinity, prey availability, and other habitat characteristics. Other PIFSC surveys (see Table 2.2-2) have a wide variety of research objectives. Some, such as video camera projects and SCUBA surveys, have no catch of fish. For these surveys, mortality and effects on fish species are non-existent.

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring these relative effects is difficult because there are many species for which total biomass estimates have fairly large confidence intervals so comparisons would also have a large range of relative uncertainty. For the purpose of assessing the magnitude of mortality effects in this PEA, the amount of fish caught in PIFSC research is compared to two different metrics, depending on the species being reviewed. One is the comparison of research catch to commercial and recreational ACL. ACL requirements were implemented in the 2006 reauthorization of the Magnuson-Stevens Act as a standardized method to track and prevent overfishing. ACLs represent the maximum amount that non-commercial and commercial fishers are allowed to catch of a species or species group during a pre-determined time period (usually a calendar year). ACLs are generally calculated to be less than the level of catch that a population can sustain prior to being declared overfished, which makes ACLs a useful metric for comparing PIFSC research catch to overall population strength.

However, ACLs are not required for all species. NMFS has not specified ACLs for most pelagic species because they are subject to international fishing agreements or have life cycles of less than a year (e.g., mahimahi). For these species, estimates of the amount caught in commercial and non-commercial fisheries are sometimes available. Non-ACL commercial and non-commercial harvest limits are also generally set at a fraction of theoretical stock biomass so the magnitude of research catches relative to overall population levels would be much less than what is indicated in the comparisons with landings. This PEA does not attempt to analyze the effects of research mortality on each of the hundreds of species caught in the various surveys. Rather, to demonstrate the effects of research mortality on fish stocks, it analyzes only the effects on species that are caught most frequently in the surveys (average annual catch over 100 lbs.) or those that are overfished.

In comparison to commercial fisheries-related mortality, mortality due to research activities occurs in small areas, with less intense effort, and sampling is usually not repeated in the same area, in contrast to commercial fisheries that focus primarily on areas of fish concentrations.

4.2.3.2 Disturbance and Changes in Behavior Due to Sound Sources

There are several mechanisms by which noise sources from research activities could potentially disturb fish and alter behavior, including the physical movement of marine vessels and fishing gear through the water, gear contact with the substrate, and operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research.

Noise from active acoustic devices used on vessels conducting fisheries research could potentially affect fish. The LOA application (Appendix C of the 2015 Draft PEA, Section 6.2) describes the types of acoustic devices used on PIFSC research vessels. Fish with a swim bladder (or other air bubble) that is near, or connected to, the auditory structures likely have the best hearing sensitivity among fish, with a presumed functional hearing range of approximately 200 hertz to 10 kilohertz (Mann et al 2001). These types of fish are likely to detect acoustic devices, but only if they are relatively near the source. Because vessels are usually moving while using acoustic gear, the source of potentially disturbing sounds would be localized and the behavioral response of fish would likely be limited to temporary avoidance behavior.

Globally, approximately 25,000 fish species have a swim bladder (or other air cavity) that is not near the ear. These species probably detect some pressure from large physical disturbances of the water or vessel traffic, but functional hearing is most likely in the 30 hertz to 500 hertz range (Popper and Fay 2011) and higher frequency acoustic devices used in research are unlikely to be audible. Any acoustical effect that is audible and that would cause avoidance disturbance, would be minor in intensity, occur over a local geographic extent, and the duration would be temporary. Cartilaginous fish, such as sharks and rays, do not have swim bladders, so this impact would not apply to scalloped hammerheads, oceanic whitetips or giant manta rays, the only ESA-listed fish species that could be encountered during PIFSC research.

Commercial vessel and fishing gear noise, and recreational vessel noise are common components of background (ambient) noise in the marine environment. At present, there are thousands of commercial fishing, transport vessels, and recreational vessels in the project areas that contribute to background vessel noise.

Potential disturbance and acoustic masking effects from research vessel noise under the Status Quo Alternative would likely be geographically localized, minimal in magnitude, and temporary in duration; this type of effect would be considered minor adverse for all fish species according to the impact criteria in Table 4.1-1.

4.2.3.3 Contamination from Discharges

Discharge from vessels, whether accidental or intentional, include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to fish exposed to the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008, NOAA 2010c).

All NOAA vessels and PIFSC vessels are subject to the regulations of MARPOL 73/78 (1973), as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and contained quickly.

Discharge of contaminants from PIFSC vessels is possible, but unlikely to occur in the near future. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to fish would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of fish would therefore be considered minor adverse.

As the potential effects of discharges, regulations governing discharges and the likelihood of discharges are universal throughout the PIFSC research areas, this type of potential effect on fish will not be discussed further in this analysis.

4.2.3.4 ESA-listed Species

The ESA-listed fish species in the project area listed as threatened or endangered under the ESA include the scalloped hammerhead shark, oceanic whitetip shark and giant manta ray. As discussed in Section 3.2.1.1, there are six DPSs for the scalloped hammerhead shark, two of which occur in the PIFSC region: the Central Pacific DPS (not ESA-listed) and the Indo-West Pacific DPS (threatened) (79 FR 38214) (see Figure 3.2-1 in Section 3.2.1).

Only four scalloped hammerhead sharks have been caught by PIFSC under the Status Quo Alternative, all of which belonged to the non-ESA-listed Central Pacific DPS. Furthermore, all four of these captures were released alive with no resulting mortality. None of these scalloped hammerhead sharks were caught in PIFSC mid-water trawl surveys. Given the lack of historical takes under the Status Quo Alternative, the potential for future takes is considered small and unlikely to affect the population of any ESA-listed scalloped hammerhead shark. As reported in Benaka et al. (2019), based on 2014 data, fishery bycatch estimates were 10.94 M lb. for the Hawai‘i Deep-Set Fishery, 604,251 lb. for the Hawai‘i Shallow-Set Fishery and 752,135 lb. for the American Samoa Deep-Set Fishery. Bycatch of oceanic whitetip sharks in commercial fisheries were rare based on the ratios of bycatch of this species in relation to the frequency of the catch (Benaka et al. 2019). Similar bycatch ratios were reported for 2015 (Benaka et al. 2019). Based on this information and considering the relatively low volume of research when compared to commercial fisheries, bycatch of oceanic whitetip sharks in PIFSC research is considered low. The effects of the Status Quo Alternative on these species are therefore considered minor adverse based on the criteria in Table 4-1.1.

Demand for manta ray gills and other manta ray parts in Asian markets is the most significant threat for this species. Available data reviewed by Oliver et al. (2015 as cited in (Miller and Klimovich 2017) revealed that manta rays comprised the highest proportion of ray bycatch (specifically Giant manta rays) in the purse-seine fisheries in the Indian Ocean (especially the Eastern Pacific Ocean). Bycatch in longline, trawl or gillnet fisheries was not large in any ocean basin (Miller and Klimovich 2017). U.S. bycatch of manta rays from fisheries operating primarily in the central and western Pacific Ocean, includes the U.S. tuna purse seine fisheries, Hawai‘i-based DSLL fisheries for tuna, and American Samoa pelagic longline fisheries. Estimates of *M. birostris* (i.e., Giant manta rays) bycatch in the U.S. tuna purse seine fishery (1.69 mt in 2015) (Secretariat of the Pacific Community, unpublished data, 2016), Hawai‘i-based DSLL fisheries (0.20 mt in 2013), and American Samoa pelagic longline fisheries (0.32 mt in 2013), are low and therefore impacts on the giant manta ray are likely to be minimal (Miller and Klimovich 2017). Considering the distribution and volume of PIFSC research is much lower than commercial fisheries, giant manta rays are not likely to be caught incidentally as bycatch during PIFSC surveys. However, if any are incidentally caught they would be tagged. For this reason, no effects on this species from PIFSC research under the Status Quo are anticipated.

4.2.3.5 Target and Other Fish Species

<u>Mortality from Fisheries Research Activities in the HARA</u>

Table 4.2-2 provides the average annual catch (by weight) of the most frequently caught and retained fish species under the Status Quo from PIFSC research surveys in the HARA. Most surveys only record the number of each species of fish and not weight. For a rough estimate of caught weight from these surveys, average or maximum weights were derived from a variety of sources (Brodziak 2012; Fishbase.org; Hawai‘i DAR 2014a; Williams and Ma 2013). These average annual research catches are compared to the most recently available ACLs or to commercial landings for those species without a currently established ACL. As discussed in Section 3.2.1.2, fishery-caught species within WPRFMC jurisdiction are grouped into MUS or a “multi-species complex” for which ACLs are set. Catch is therefore managed as a complex, in total, not by individual species.

For all research areas, research data is necessary for monitoring the status of stocks of conservation concern and to determine if management objectives for rebuilding those stocks are being met. Fisheries managers typically consider the estimated amount of research catch from all projects along with other sources of mortality (e.g., bycatch in other fisheries, predation) before setting commercial fishing limits to prevent overfishing of stocks or to help overfished stocks rebuild. The amount of fish that are likely to be caught in various research projects is often estimated and incorporated into the fishery management process during annual reviews of research proposals, which would continue to occur in the future under the Status Quo Alternative. These annual reviews would also determine whether the proposed projects were consistent with the NEPA analysis presented in the PEA or whether additional NEPA analysis was required (see Section 2.3.5).

Table 4.2-2 indicates that, while mortality to fish species is a direct effect of the PIFSC HARA surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations for these species. In all cases, research catch in the HARA represents much less than one percent of the ACL or commercial catch. For all target species in the HARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed

Table 4.2-2 Estimated Fish Caught under the Status Quo Alternative Compared to ACLs or Commercial Catch in the HARA

Species	Stock Status[A]	Stock Complex	Average PIFSC catch per year under Status Quo (lbs.)	2014 ACL (lbs.)[B]	2013 Commercial catch (lbs.)[C]	Average PIFSC catch compared to ACL or Commercial Catch (percentage)
Blue shark ***(Prionace glauca)***	Not overfished	Pelagic MUS	597	N/A	138,423	0.43%
Amberjack ***(Seriola spp.)***	Not overfished	Hawaiʻi Bottomfish MUS	292	193,423[D]	N/A	0.15%
Brown speckled eel (*Gymnothorax steindachneri*)	Unknown	Hawaiʻi CHCRT	238	142,282[D]	N/A	0.17%
Red snapper ***(Etelis carbunculus)***	Not overfished	Hawaiʻi Deep 7 Bottomfish MUS	212	346,000[D]	N/A	0.06%
Sea bass ***(Epinephelus quernus)***	Unknown	Hawaiʻi Deep 7 Bottomfish MUS	190	346,000[D]	N/A	0.05%
Undulated moray ***(Gymnothorax undulates)***	Unknown	Hawaiʻi CHCRT	189	142,282[D]	N/A	0.13%
Broadbill swordfish ***(Xiphias gladius)***	Not overfished	Pelagic MUS	120	N/A	2,332,850	<0.01%

Species	Stock Status[A]	Stock Complex	Average PIFSC catch per year under Status Quo (lbs.)	2014 ACL (lbs.)[B]	2013 Commercial catch (lbs.)[C]	Average PIFSC catch compared to ACL or Commercial Catch (percentage)
Silky shark *(Carcharhinus falciformis)*	Unknown	Pelagic MUS	102	N/A	138,423	0.07%
Striped marlin *(Tetrapturus audax)*	Subject to overfishing, overfished	Pelagic MUS	30	N/A	983,440	<0.01%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. 2014 ACL information from WPRFMC.

C. Commercial catch information compiled by Hawai‘i DAR and the Western Pacific Fishery Information Network. Available online: http://www.pifsc.noaa.gov/wpacfin/hi/dar/Pages/hi_data_3.php

D. This species is included in a MUS; catch is managed as a complex, in total, not by individual species. The ACL stated is for all species in the specified MUS.

Mortality from Fisheries Research Activities in the MARA

Table 4.2-3 provides the average annual catch (by weight) of the most frequently caught and retained fish species under the Status Quo from PIFSC research surveys in the MARA. Most surveys only record the number of each species of fish and not weight. For a rough estimate of caught weight from these surveys, average or maximum weights were derived from a variety of sources (Brodziak 2012; Fishbase.org; Hawai‘i DAR 2014a; Williams and Ma 2013). These average annual research catches are compared to the most recently available ACLs.

Table 4.2-3 indicates that, while mortality to fish species is a direct effect of the PIFSC MARA surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations for these species. In most cases, research catch in the MARA represents much less than one percent of the ACL. For bicolor parrotfish, the average annual research catch is approximately 2.58 percent, respectively. While this catch represents a higher percentage of the ACL compared to other species, they still represent a very small fraction of the total population. For all target species in the MARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed

Table 4.2-3 Estimated Fish Caught under the Status Quo Alternative Compared to ACLs in the MARA

Species	Stock Status[A]	Stock Complex	Average PIFSC catch per year under Status Quo (lbs.)	2014 ACL (lbs.)[B,C]	Average PIFSC catch compared to ACL (percentage)
Longtail snapper (*Etelis coruscans*)	Not overfished	MARA Bottomfish MUS	581	294,800[D]	0.20%
Bicolor parrotfish (*Scarus rubroviolaceus*)	Unknown	MARA CHCRT	351	32,433[D]	1.08%
Orangespine unicornfish (*Naso lituratus*)	Unknown	MARA CHCRT	255	77,586[D]	0.33%
Black jack (*Caranx lugubris*)	Not overfished	MARA Bottomfish MUS	180	294,800[D]	0.06%
Red snapper (*Etelis carbunculus*)	Not overfished	MARA Bottomfish MUS	138	294,800[D]	0.05%
Yellowtail snapper (*Pristipomoides auricilla*)	Not overfished	MARA Bottomfish MUS	115	294,800[D]	0.04%
Silver jaw jobfish (*Aphareus rutilans*)	Not overfished	MARA Bottomfish MUS	108	294,800[D]	0.04%
Bluefin trevally (*Caranx megalampys*)	Unknown	MARA CHCRT	103	66,889[D]	0.16%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. 2014 ACL information from WPRFMC.

C. ACLs are listed separately for the CNMI and Guam. The ACL stated is combined for both regions to represent all of the MARA.

D. This species is included in a MUS; catch is managed as a complex, in total, not by individual species. The ACL stated is for all species in the specified MUS.

Mortality from Fisheries Research Activities in the ASARA

Table 4.2-4 provides the average annual catch (by weight) of the most frequently caught and retained fish species under the Status Quo from PIFSC research surveys in the ASARA. Most surveys only record the number of each species of fish and not weight. For a rough estimate of caught weight from these surveys, average or maximum weights were derived from a variety of sources (Brodziak 2012; Fishbase.org; Hawai‘i DAR 2014a; Williams and Ma 2013). Table 4.2-2 compares these average annual research catches to the most recently available commercial landings.

Table 4.2-4 indicates that, while mortality to fish species is a direct effect of the PIFSC ASARA surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations for these species. In all cases, research catch in the ASARA represents much less than one percent of the commercial catch. For all target species in the ASARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed

Table 4.2-4 Estimated Fish Caught under the Status Quo Alternative Compared to ACLs or Commercial Catch in the ASARA

Species	Stock Status[A]	Stock Complex	Average PIFSC catch per year under Status Quo (lbs.)	2014 ACL (lbs.)	2013 Commercial catch (lbs.)[B]	Average PIFSC catch compared to Commercial Catch (percentage)
Yellowfin tuna (*Thunnus albacares*)	Not Overfished	Pelagic MUS	480	N/A	901,323	0.05%
Wahoo (*Acanthocybium solandri*)	Unknown	Pelagic MUS	183	N/A	198,325	0.09%
Blue marlin (*Makaira mazara*)	Not Overfished	Pelagic MUS	120	N/A	67,557	0.18%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. Available online: https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. Commercial catch information compiled by American Samoa DMWR and the Western Pacific Fishery Information Network. Available online: http://www.pifsc.noaa.gov/wpacfin/as/Pages/as_data_menu.php

Mortality from Fisheries Research Activities in the WCPRA

Table 4.2-5 provides the average annual catch (by weight) of the most frequently caught and retained fish species under the Status Quo from PIFSC research surveys in the WCPRA. Most surveys only record the number of each species of fish and not weight. For a rough estimate of caught weight from these surveys, average or maximum weights were derived from a variety of sources (Brodziak 2012; Fishbase.org; Hawai‘i DAR 2014a; Williams and Ma 2013). These average annual research catches are compared to the most recently available commercial landings.

Table 4.2-5 indicates that, while mortality to fish species is a direct effect of the PIFSC WCPRA surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations for these species. In most cases, research catch in the WCPRA represents much less than one percent of the commercial catch. For two species, thresher and silky sharks, the average annual research catch is approximately 1.05 percent and 2.31 percent, respectively. While this represents a higher percentage of the commercial catch compared to other species, they still represent a very small fraction of the total population. For all target species in the WCPRA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed.

Table 4.2-5 Estimated Fish Caught under the Status Quo Alternative Compared to Commercial Catch in the WCPRA

Species	Stock Status[A]	Stock Complex	Average PIFSC catch per year under Status Quo (lbs.)	2012 Commercial catch (lbs.)[B]	Average PIFSC catch compared to Commercial Catch (percentage)
Yellowfin tuna (*Thunnus albacares*)	Not Overfished	Pelagic MUS	1,650	2,610,273	0.06%
Silky shark (*Carcharhinus falciformis*)	Unknown	Pelagic MUS	102	4,409	2.31%
Thresher sharks (*Alopias* spp.)	Unknown	Pelagic MUS	300	28,660	1.05%
Bigeye tuna (*Thunnus obesus*)	Subject to overfishing, not overfished	Pelagic MUS	540	11,375,853	<0.01%
Broadbill swordfish (*Xiphias gladius*)	Unknown	Pelagic MUS	120	2,008,411	0.01%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. Available online: https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. Commercial catch information from the Pelagic Fisheries of the Western Pacific Region 2012 Annual Report. Available online: http://www.wpcouncil.org/wp-content/uploads/2013/03/2012-Pelagics-Annual-Report_9-21-2014.pdf

4.2.3.6 Conclusion

PIFSC fisheries research conducted under the Status Quo Alternative could have effects on commercially and non-commercially targeted species, and non-managed fish species through mortality, disturbance, and changes in habitat.

No ESA-listed fish species have been caught by PIFSC under the Status Quo Alternative. Although four scalloped hammerhead sharks were incidentally caught, these belonged to the non ESA-listed Central Pacific DPS. All four of these captures were released alive with no resulting mortality and were not caught during mid-water trawl surveys.

For most species targeted by commercial fisheries and managed under Fishery Management Plans, mortality due to research surveys and projects is much less than one percent of ACLs or commercial harvest and is considered to be minor in magnitude for all species. For species which exceed one percent of ACLs or commercial harvest, catch is still small relative to the population of each species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. Furthermore, only life history studies retain fish for otoliths and gonads; all other fish are sent back overboard. Disturbance of fish and benthic habitats from research activities would be temporary and minor in magnitude for all species. As described above, the potential for accidental contamination of fish habitat is considered minor in magnitude and temporary or short-term in duration. The overall effects of the Status Quo Alternative on target fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-2.

In contrast to these adverse effects, PIFSC research also provides long-term beneficial effects on managed fish species throughout the Pacific Islands Region through its contribution to sustainable fisheries management. Data from PIFSC research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by PIFSC research programs effects are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries and ecosystem research, provide the basis for monitoring changes to the marine environment important to fish populations.

4.2.4 Effects on Marine Mammals

Section 3.2.2 describes the marine mammals that are likely to overlap with fishery research activities in the four PIFSC research areas: HARA, MARA, ASARA, and WCPRA. This section describes the potential effects of PIFSC research activities on marine mammals under the Status Quo Alternative, including the mitigation measures that have been implemented in the past to reduce those effects (see Table 4.1-2 and Section 4.1.3 for the criteria used in the effects analysis discussed in this section). Because the secondary federal action considered in this PEA is the promulgation of regulations and subsequent LOA under Section 101(a)(5)(A) of the MMPA, this section provides more information and analysis for effects on marine mammals than is presented for the analysis of effects on other resources, consistent with the needs of the MMPA authorization process.

The potential effects of research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment on marine mammals include:

- Disturbance and behavioral responses due to acoustic equipment
- M&SI due to ship strikes
- M&SI due to interaction with research gear
- Changes in food availability due to research survey removal of prey
- Contamination from discharges

The first part of the analysis in this section provides information regarding the mechanisms for these different types of effects. It also provides an analysis of some effects common to all four research areas. For some types of effects, the level of impact is similar for all species of marine mammals and the analysis is not repeated in the following subsections.

The second part of the analysis provides information regarding the effects of PIFSC research activities on marine mammal species, including information needed for the MMPA authorization process. An application for promulgation of regulations and issuance of an LOA (referred to as the LOA application) for incidental take of marine mammals must include estimates of the numbers of animals that may be taken by M&SI, harassment that has the potential to injure (Level A harassment takes), and harassment that has the potential to disturb (Level B harassment takes). The PIFSC LOA application only concerns the Preferred Alternative because that is PIFSC's proposed action. However, the analysis of takes in the LOA application is based on a similar scope of research activities as the Status Quo Alternative (a few projects would not be continued and a few new projects would be added under the Preferred Alternative) and is therefore helpful in describing the potential effects of the Status Quo Alternative. For those marine mammal species where the effects of the Status Quo are considered the same or very similar to the Preferred Alternative, analysis provided in the LOA application is summarized and referenced in this section. Where the scope of activities differs between the Status Quo and Preferred Alternatives, the analysis of effects from the LOA application are summarized and referenced in the Preferred Alternative (Section 4.3.4). The following analysis focuses on the types of research gear most likely to have adverse interactions with marine mammals.

4.2.4.1 Disturbance and Behavioral Responses due to Acoustic Equipment

Several mechanisms exist by which research activities have the potential to disturb marine mammals and alter behavior, including the physical presence of marine vessels and fishing gear combined with operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research. The impacts of anthropogenic noise on marine mammals have been summarized in numerous articles and reports including Richardson et al. (1995), National Research Council (2005), and Southall et al. (2007). Marine mammals use hearing and sound transmission to perform vital life functions. Sound (hearing and vocalization/ echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. Introducing sound into their environment could disrupt those behaviors. The distances to which anthropogenic sounds are audible depend upon source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the marine mammal (Richardson et al. 1995).

In assessing potential effects of noise, Richardson et al. (1995) suggested four criteria for defining acoustic zones of influence:

1. Zone of audibility – the area within which the marine mammal might hear the sound. Marine mammals, as a group, have functional hearing ranges of 10 hertz (Hz) to 180 kHz, with highest sensitivities to sound near 40 kHz (Ketten 1998, Kastak et al. 2005, Southall et al. 2007).
2. Zone of responsiveness – the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound depend on: 1) acoustic characteristics of the noise source; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995, Southall et al. 2007). Temporary behavioral effects, however, often merely show that an animal heard a sound and may not indicate lasting consequences for exposed individuals (Southall et al. 2007). Recent analysis of potential causes of a mass stranding of 100 typically oceanic melon-headed whales (Peponocephala electra) in Madagascar in 2008 implicate a mapping survey using a high-power 12 kHz multi-beam echosounder as a likely trigger for this event. Although the cause is equivocal and other environmental, social, or anthropogenic factors may have facilitated the strandings, the authors determined

the multi-beam echosounder the most plausible factor initiating the stranding response, suggesting that avoidance behavior may have led the pelagic whales into shallow, unfamiliar waters (Southall et al. 2013).

3. Zone of masking – the area within which the noise may interfere with an animal's detection of other sounds, including communication calls, prey sounds, or other environmental sounds.
4. Zone of hearing loss, discomfort, or injury – the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. NMFS considers exposure of marine mammals to this level of sound to be Level A harassment and has regulated some industrial and military activities to reduce the risk of such exposures.

The factors that may affect the response of a marine mammal to a given noise cannot be determined ahead of time. Therefore, during the MMPA authorization process, in lieu of having this information, NMFS uses a standardized noise level to help determine how many animals may be disturbed (harassed) by a given activity. NMFS currently uses a sound threshold of 160 decibels (dB) referenced to one micro pascal (re 1μPa), for the types of sound produced by the active acoustic sources considered here, to determine the onset of behavioral harassment for marine mammals (Level B harassment takes) (NMFS 2014f). Any animal exposed to impulse noises above this level is assumed to respond in a way consistent with the definition of a behavioral "take" under the MMPA, although NMFS acknowledges that some marine mammals may react to sounds below this threshold or may not react to sounds above this threshold.

PIFSC has been using a variety of sonar and other acoustic systems during its research cruises to characterize marine habitats and fish aggregations and to monitor gear deployments. This acoustic equipment sends pulses of sound into the marine environment which provide data as the sounds reflect back to the ship and are recorded (see Appendix A). The sounds produced by the predominant acoustic equipment used by PIFSC range from 30-200 kHz and from 190 dB to 237 dB re 1μPa (Appendix C of the 2015 Draft PEA, Section 6.2). The LOA application (Appendix C of the 2015 Draft PEA, Section 7.2) categorized these acoustic sources based on operating frequency and output characteristics. Category 1 active acoustic sources include short range echosounders and ADCPs. These have output frequencies >300 kilohertz (kHz), are generally of short duration, and have high signal directivity. Category 2 active acoustic sources include various single, dual, and multi-beam echosounders, devices used to determine trawl net orientation, and current profilers of lower output frequencies than category 1 sources. Output frequencies of category 2 sources range from 18 to 200 kHz, have short ping durations, and are usually highly directional for mapping purposes.

Although these acoustic systems have been used for years and may have been a source of disturbance for nearby marine mammals, no direct observations of disturbance have been documented, primarily because any such disturbance, if it occurred, would have taken place under water. For animals at the surface, it is very difficult to determine whether observed changes in behavior were caused by a given sound source or by the physical presence of the vessel. In many cases, it is likely to be a combination of visual and acoustic components that cause a disturbance. It may also be difficult to determine if an animal has actually changed its behavior to avoid a disturbance or if it is moving for other reasons (e.g., to pursue nearby prey). For these reasons, there have been no records or documentation of how many animals may have been disturbed by vessels and/or acoustic equipment during PIFSC research cruises.

NMFS regulations for implementing the MMPA distinguish between Level B harassment that causes behavioral changes in the affected marine mammals and Level A harassment that has the potential to cause injury. Animals exposed to intense sounds may experience reduced hearing sensitivity for some period of time following exposure. This change in hearing threshold is known as noise induced threshold shift (TS). The amount of TS incurred is influenced by the amplitude, duration, frequency content, temporal pattern, and energy distribution of the noise (Richardson et al. 1995, Southall et al. 2007). It is also influenced by the characteristics of the animal, such as the hearing range of the species, behavior, age, history of noise exposure, and health. The magnitude of TS generally decreases over time after noise exposure and if it eventually returns to zero, it is known as a temporary threshold shift (TTS). If the TS does not return to zero after some time (generally on the order of weeks), it is known as a permanent threshold shift (PTS). Sound levels associated with the onset of TTS are generally considered to be below the levels that will cause PTS, which is considered to be an auditory injury.

The *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (NMFS 2018b). The guidance uses marine mammal hearing groups defined by Southall et al. (2007) with some modifications. The 2018 revised NMFS Technical guidance continues to be used for defining regulatory thresholds for calculating incidental takes of marine mammals under the MMPA.

Southall et al. (2007) assessed the potential for discrete sound exposures to produce a TTS or PTS in marine mammals and concluded that, for the kinds of relatively brief exposures associated with transient sounds, such as the active acoustic sources used by PIFSC for research, received sound pressure levels in the range of approximately 180-220 dB re 1µPa are required to induce the onset of TTS levels for most pinnipeds and odontocete cetaceans. Southall et al. (2007) also provided some frequency weighting functions for different marine mammal groups to account for the fact that impacts of noise on hearing depend in large part on the overlap between the range of frequencies in the sound source and the hearing range of the species. Based on the Southall et al. (2007) results, Lurton and DeRuiter (2011) modeled the potential impacts (PTS and behavioral reaction) of conventional echosounders on marine mammals. They estimated PTS onset at typical distances of 10 to 100 m for the kinds of acoustic sources used in fisheries surveys considered in this PEA. Lurton and DeRuiter (2011) also emphasized that these effects would very likely only occur in the cone ensonified below the ship and that behavioral responses to the vessel at these extremely close ranges would very likely influence the probability of animals being exposed to these levels.

Animals are likely to avoid a moving vessel, either because of its physical presence or because of behavioral harassment resulting from exposure to the sound produced by active acoustic sources. It is unlikely that animals would remain in the presence of a harassing stimulus, absent some overriding contextual factor. Because of this likely avoidance behavior, as well as the source characteristics, intermittent pulsing, and narrow cones of ensonification, PIFSC has determined that the risk of animals experiencing repetitive exposures at the close range or of the duration necessary to cause PTS is negligible. PIFSC therefore does not anticipate causing any Level A harassment by acoustic sources of marine mammals and the LOA application includes no such take estimates. Therefore, the potential for Level A harassment of marine mammals by acoustic sources will not be discussed further in this PEA.

However, PIFSC anticipates that the use of active acoustic equipment in its research activities could cause Level B harassment of marine mammals. In its LOA application for the Preferred Alternative (Appendix C of the 2015 Draft PEA), PIFSC estimates the numbers of marine mammals that may be exposed to sound levels of 160 dB or above due to the use of acoustic sonars during research cruises (Level B harassment takes). The LOA take estimates do not include baleen whales because the operating frequencies of PIFSC acoustic sources only go down to 30 kHz, which is above the hearing range of baleen whales (Southall et al. 2007, Figure 4.2-1). While empirical hearing threshold data are not available for mysticetes, modeled data indicate hearing sensitivities range from tens of Hz to approximately 20 kHz (Cholewiak et al. 2017).

The LOA application used the operational conditions and scope of work conducted in the past 5 years to estimate what may occur in the future under the Preferred Alternative. The Preferred Alternative would eliminate five longline projects; however, similar research continues to be conducted and funded by PIRO through commercial fisheries partners. Any incidental takes resulting from this research are authorized under sections of the MMPA dealing with commercial fisheries and any incidental takes resulting from this research are considered to be a result of the commercial fishery; these potential takes are therefore not considered in the analysis of the Preferred Alternative in this chapter. The impacts of such surveys are included in the cumulative impacts analysis (Chapter 5).

As explained in the LOA application (Appendix C of the 2015 Draft PEA), the take estimates attempt to quantify a very dynamic situation that has a great deal of unavoidable uncertainty regarding the propagation of sound in the water and the distribution of marine mammals over very large areas. Estimating the ensonified zone of sound generated by sonar gear and its propagation through water is complicated, especially considering that these sound sources are moving (on a vessel) through waters of different depths and properties (e.g., salinity, temperature) as well as varying bathymetric profiles, all of which affect sound transmission. The LOA application details the assumptions that were made about the source levels and acoustic properties of sonar pulses, the directionality of the sound, and propagation/attenuation properties that were used to calculate an ensonified zone considered loud enough to harass marine mammals. One part of the PIFSC Level B harassment take calculation used a model of sound propagation from typical sonar equipment used during research to estimate the shape and dimensions of a typical ensonified zone ≥ 160 dB re 1 μPa, which was multiplied by the distance research ships travel with active sonar gear, to derive an estimated total volume ensonified to the Level B harassment take guidelines.

Another aspect of this Level B harassment take estimation process, subject to large uncertainty, is the distribution and abundance of marine mammals in the area. No species is distributed evenly throughout its range; they are typically patchy in distribution with strong seasonal variations and preferences for certain zones within the water column. Although some preferred habitats and general distributions are known, there is no way to know exactly how many animals will be in any area at any point in the future. Therefore, the estimation process uses the average density of each species within the different research areas to estimate how many animals may be affected within the ensonified volume. One refinement that has been built into the Level B harassment take model is the categorization of each marine mammal species according to its typical dive depth range, which affects the size of the ensonified zone they may be exposed to. The estimation process is admittedly subject to great uncertainty and there is no way to assess how "realistic" these estimates are in terms of the number of animals that would be disturbed by the activity. However, the development of the Level B harassment take model was conservative in the sense that assumptions were made that would tend to overestimate the size of the ensonified volume and the number of animals affected (Appendix C of the 2015 Draft PEA, Section 6.2). The estimated take numbers of different species in the different research areas were calculated for the five-year authorization period and take into account the typical schedule of conducting major surveys in the different research areas on alternate years, with the HARA being covered on a more frequent basis than the other areas.

This PEA (and the LOA application attached as Appendix C of the Draft PEA published in November 2015) must also assess what the likely biological effects may be for these estimated Level B harassment takes by acoustic sources. The LOA application (Draft PEA Appendix C, Section 7.2) provides an analysis of the potential effects of acoustic equipment used in PIFSC research on marine mammals (and other species). The analysis in this PEA is a summary of the LOA application analysis and will be provided in the subsections on cetaceans and pinnipeds because of their different hearing ranges and frequencies used for communication, which determines what the effects of different acoustic equipment might be. This effort to examine the biological importance of acoustic disturbance requires knowledge about whether animals can perceive the sonar signals, their potential reactions to various types of sounds, and the conditions under which particular sound sources may lead to biologically meaningful effects (i.e., interference with feeding opportunities, critical social communication). Unfortunately, many key aspects of marine mammal behavior relevant to this discussion are very poorly known. Most of the data on marine mammal hearing and behavioral reactions to sounds comes from relatively few captive, trained animals and likely does not reflect the diversity of behaviors in wild animals. Some behavioral reactions, if they occur in one or more species, could substantially reduce the numbers of animals exposed to high sound levels (e.g., swimming away from an approaching ship before sound levels reach the 160 dB level). Industrial projects such as seismic exploration for oil and gas and pile driving in relation to coastal developments are typically required to monitor marine mammal behavioral responses in relation to percussive industrial sounds, but there have been few efforts to document behavioral responses to acoustic equipment commonly used in fisheries research.

4.2.4.2 M&SI due to Ship Strikes

The Pacific Islands Region includes shipping lanes, active ports, and vessel traffic. Vessel collisions with marine mammals, or ship strikes, can lead to death by massive trauma, hemorrhaging, broken bones, or propeller wounds (Knowlton and Kraus 2001). Large whales, such as fin whales, are occasionally found draped across the bulbous bows of large ships upon arriving in port. Massive propeller wounds can be immediately fatal. If more superficial, the whales may survive the collisions (Silber et al. 2010). Jensen and Silber (2004) summarized large whale ship strikes world-wide and found that most collisions occurred in the open ocean involving large vessels. Commercial fishing vessels were responsible for four of 134 records (3 percent), and one collision (0.75 percent) was reported for a research vessel. Vessel speed appears to be a key factor in determining the frequency and severity of ship strikes, with the potential for collision increasing at ship speeds of 15 kts and greater (Laist et al. 2001, Vanderlaan and Taggart 2007). In the relatively few recorded cases of ship strikes at speeds below 15 kts, the chance of mortality declines from approximately 80 percent at 15 kts to approximately 20 percent at 8.6 kts (Vanderlaan and Taggart 2007).

Prior to work published by Bradford and Lyman (2015, 2019), most human-caused injuries were not reported in total M&SI estimates in Hawai'i. Reports of human-caused injuries to whales are now coordinated by the Pacific Islands Region Marine Mammal Response Network and the Hawaiian Islands Entanglement Response Network. In 2017, there were 12 reports of human-caused injuries to cetaceans including four vessel collisions with entanglement of seven humpbacks with marine debris or fishing gear and one pantropical dolphin entangled in marine debris (Bradford and Lyman 2019). In 2011, a research vessel, also not affiliated with PIFSC fisheries and ecosystem research, struck a breaching whale while traveling at 26 kts. The whale was observed for some time following the incident and did not show signs of injury; in accordance with NMFS' criteria for assessing injury, the injury was categorized as serious and assigned a value for PBR of 0.20 (Bradford and Lyman 2015). However, PIFSC is not requesting any take due to ship strikes as it is assumed that these events were rare occurrences that are very unlikely to occur in the next 5 years and that little can be done to mitigate the chances of a future occurrence other than the standard monitoring and avoidance procedures already in place.

The State of Hawai'i passed legislation regulating the speed of its high-speed interisland ferry as well as putting mitigation measures in place, such as marine mammal observers, requiring the use of night vision equipment and bow mounted cameras to detect whales, a 500-m safety zone, and limiting the discharge of wastewater (Seattle Times 2007). Reducing the co-occurrence of whales and vessels may be the only sure way to reduce ship strikes, but this is not always feasible (Silber et al. 2010).

Transit speeds during PIFSC fisheries and ecosystem research cruises vary from 6-14 kts, but average 10 kts. Vessel speed during active sampling is typically 2-4 kts, due to sampling design, but these much slower speeds essentially eliminate the risk of ship strikes.

Given the relatively slow speeds of research vessels, the presence of bridge crew watching for obstacles at all times (including marine mammals), and the small number of research cruises, ship strikes with marine mammals during the research activities described in this PEA would be considered rare in frequency, localized in geographic scope, and unlikely to occur within the next 5 years. The potential for PIFSC fisheries research vessels to cause M&SI to any cetaceans or pinnipeds due to ship strikes are considered minor adverse throughout the four PIFSC research areas using vessel types and protocols currently in use. Since ship strikes are unlikely to occur, this potential effect of research will not be discussed further in the analysis that follows.

4.2.4.3 M&SI Due to Interaction with Research Gear

Entanglement and capture in fishing gear is a significant source of human-caused M&SI for some marine mammals. Although not always as immediately fatal as ship strikes, entanglements can lead to prolonged weakening or deterioration of an animal (Knowlton and Kraus 2001). This is particularly true for large whales; small whales, dolphins, porpoises, and pinnipeds are more likely to die when entangled.

Commercial and non-commercial fisheries in the Pacific Islands regions covered in this PEA with known bycatch of marine mammals include those using pelagic longlines, other hook-and-line gears, gillnets, traps and pots, and trawls (Carretta et al. 2015). Further details regarding specific fisheries and marine mammal bycatch will be discussed when considering cumulative effects

(Section 5.5). Several of these gear types are employed during PIFSC fisheries research surveys, including midwater trawls and longline gears as well as instruments that are attached to floats and anchors by lines that may entangle marine mammals (Appendix A).

The 1994 amendments to the MMPA tasked NMFS with establishing monitoring programs to estimate M&SI of marine mammals incidental to commercial fishing operations and to develop Take Reduction Plans (TRPs) in order to reduce commercial fishing takes of strategic stocks of marine mammals below PBR. The False Killer Whale TRP was finalized in 2012 to reduce the level of M&SI of false killer whales in Hawaiʻi-based longline fisheries for tuna and billfish (77 FR 71260). Regulatory measures in the False Killer Whale TRP include gear requirements, prohibited areas, training and certification in marine mammal handling and release, and posting of NMFS-approved placards on longline vessels. PIFSC does not conduct fisheries and ecosystem research with longline gear within any of the exclusion zones established by the False Killer Whale TRP.

There is no documented history of marine mammals being injured or killed due to entanglement or other interactions with fishing gear during PIFSC fisheries and ecosystem research activities. Under the Status Quo Alternative, PIFSC has implemented a set of mitigation measures to reduce the risk of interacting with marine mammals (and other protected species) during fisheries and ecosystem research, as described in Section 2.2.1.

Most of the mitigation measures rely on visual monitoring and detection of marine mammals near the vessel or fishing gear. There are many variables that influence the effectiveness of visual monitoring at any one time, including the lighting, sea state, and the capabilities of the person assigned to watch. Therefore, it is impossible to determine an overall measure of effectiveness and quantify how many animals may have been avoided with visual monitoring, as compared to having no monitors. It is also difficult to scientifically determine the effectiveness of gear modifications because potential interactions would occur underwater and out of sight. The value of implementing some mitigation measures is therefore based on general principles and best available information, even if their effectiveness at reducing takes has not been scientifically demonstrated.

The MMPA authorization process requires the applicant (PIFSC) to estimate how many marine mammals may be captured or entangled in the future under the proposed set of conditions. As is the case for Level B harassment takes by acoustic sources, the LOA application (Appendix C of the 2015 Draft PEA, Section 6.1) describes the methodology used to estimate the species and numbers of animals that may be taken by M&SI during future research, conducted under the Preferred Alternative. Since there have been no takes of marine mammals during PIFSC fisheries and ecosystem research in the past, the LOA application requests M&SI takes for the five-year authorization period on the basis of analogy with take in commercial and non-commercial fisheries using gears similar to those used in research. This methodology has been used in order to account for a conservative amount of potential take in the future.

The LOA application estimates of take are based on the scope of research and mitigation measures proposed under the Preferred Alternative. However, as was the case with the Level B harassment take analysis, the estimates of M&SI takes in the LOA application are relevant to the discussion of effects from the Status Quo Alternative because they are based on a similar level of research effort in the same areas and with the same gears used during the Status Quo; the estimated future takes in research gears described in the LOA will be reported in this section as potential effects of conducting future research under the Status Quo Alternative. Gear types and other scientific equipment that have no history of takes or adverse interactions with marine mammals and are very unlikely to result in takes in the future (e.g., small-mouthed nets designed to sample plankton and larval fish, CTD rosettes, ROVs), are not discussed further in this PEA.

4.2.4.4 Changes in Food Availability due to Research Survey Removal of Prey

Prey of marine mammals varies by species, season, and location and, for some marine mammals, is not well documented. There is some overlap in prey of marine mammals in the Pacific Islands Regions and the species sampled and removed during PIFSC fisheries and ecosystem research surveys although removals of species commonly eaten by marine mammals are relatively low.

Prey of sei whales and blue whales are primarily zooplankton, which are sampled in minute quantities by PIFSC fisheries research, so the likelihood of research activities changing prey availability is negligible. Humpback whales do not feed within the PIFSC region of fisheries and ecosystem research, so there is no effect. There may be some minor overlap with sperm whale prey (squid), but this is expected to be minor due to the very small amounts of squid removed through fisheries and ecosystem research (i.e., hundreds of lbs.). There may be some minor overlap with monk seal prey and the RAMP Survey and Insular Fish Abundance Estimation Comparison Survey removals of a variety of reef fishes. For example, in the main Hawaiian Islands, the majority of coral reef fish sampling is at the periphery of monk seal foraging habitat and is a tiny fraction of what is taken by monk seals or by apex predatory fish or non-commercial fisheries (Sprague et al. 2013; Kobayashi and Kawamoto 1995). In the case of false killer whale consumption of tunas, mahi, and ono, there may be some minor overlap with research removals in the DSLL research. However, the removal by PIFSC fisheries and ecosystem research, regardless of season and location, is minor relative to that taken through commercial fisheries. For example, commercial fisheries catches for most pelagic species range from the hundreds to thousands of metric tons, whereas the catch in similar fisheries and ecosystem research activities typically range from the hundreds to thousands of lbs. in any particular year (see Sections 4.2.3 and 4.3.3).

In contrast to these minor adverse effects, PIFSC research also provides long-term beneficial effects on managed fish species throughout the Pacific Islands Region through its contribution to sustainable fisheries management, with associated beneficial effects on marine mammal prey species.

In summary, PIFSC fisheries research removals of marine mammal prey are minor in magnitude, highly localized, temporary in effect, and unlikely to affect the availability of prey to any marine mammals under the Status Quo Alternative.

4.2.4.5 Contamination from Discharges

Discharge from vessels, whether accidental or intentional, potentially includes sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to marine mammals in the vicinity of the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008).

All NOAA vessels and PIFSC chartered vessels are subject to MARPOL regulations of 1973/78, as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six annexes that cover the discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). Discharge of contaminants from PIFSC vessels is possible, but unlikely, and if it occurs, would be isolated in both time and location.

Discharge of contaminants from PIFSC vessels is possible, but unlikely to occur in the next 5 years. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to marine mammals would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination on marine mammals would therefore be considered minor adverse. As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges is universal across the three research areas, they will not be analyzed further in this PEA.

4.2.4.6 ESA-listed Species

The endangered marine mammal species in PIFSC research areas include false killer whale – MHI insular stock, sperm whale, blue whale, fin whale, sei whale, North Pacific right whale – eastern north Pacific stock, and Hawaiian monk seal.

Disturbance and Behavioral Responses due to Acoustic Equipment

The LOA application (Appendix C of the 2015 Draft PEA) includes calculations of the number of marine mammals that may be exposed to sound levels at or above 160 dBs from all active acoustic devices used during PIFSC fisheries and ecosystem research activities. Those calculations include a number of assumptions and elements with large variables over time and space (e.g., the densities of marine mammals, the propagation of sound under different conditions). PIFSC believes this quantitative approach benefits from its simplicity and consistency with current NMFS guidelines on estimating Level B harassment by acoustic sources but cautions that the resulting take estimates should be considered as overestimates of behavioral harassment from acoustic devices. The estimates are provided in Table 4.2-6 below, but a more complete discussion regarding the estimates can be found in Appendix C of the 2015 Draft PEA. The take numbers in Table 4.2-6 are for the five-year authorization period and take into account the typical schedule of conducting major surveys in the different research areas on alternate years, with the HARA being covered on a more frequent basis than the other areas. The likely impact on ESA-listed species from the different types of acoustic devices is discussed below.

The output frequencies of Category 1 active acoustic sources (short range echosounders, ADCPs) are >300 kHz and are generally short duration signals with high signal directivity (Appendix C of the 2015 Draft PEA, Section 6.2). The functional hearing range of baleen whales is 7 Hz-22 kHz, with highest sensitivity generally below 10 kHz, which is well below the frequency range of Category 1 sources, so they are less likely to be detected by blue, fin, sei, North Pacific right, or humpback whales (Figure 4.2-1). Sperm and false killer whales are in the mid-frequency hearing group with a range of 150 Hz-160 kHz, with highest sensitivity from 10-120 kHz. The functional underwater hearing range of pinnipeds is 75 Hz-75 kHz, with highest sensitivity from 1-30 kHz. The functional hearing ranges of these species also fall below the output frequency of Category 1 acoustic sources; effects are expected to be temporary, if they occur, and are considered minor adverse (see Figure 4.2-1).

Category 2 active acoustic sources (various single, dual, and multi-beam echosounder devices used to determine trawl net orientation and several current profilers) have predominant frequencies of 38-200 kHz that are of short duration and are usually highly directional. These are unlikely to be heard by most baleen whales but are within the range of hearing for sperm and false killer whales. Most Category 2 acoustic sources are also not likely to be audible to most pinnipeds. If detected, short term avoidance is the most likely response, which would tend to reduce the exposure of animals to high sound levels (Appendix C of the 2015 Draft PEA, Section 7.2).

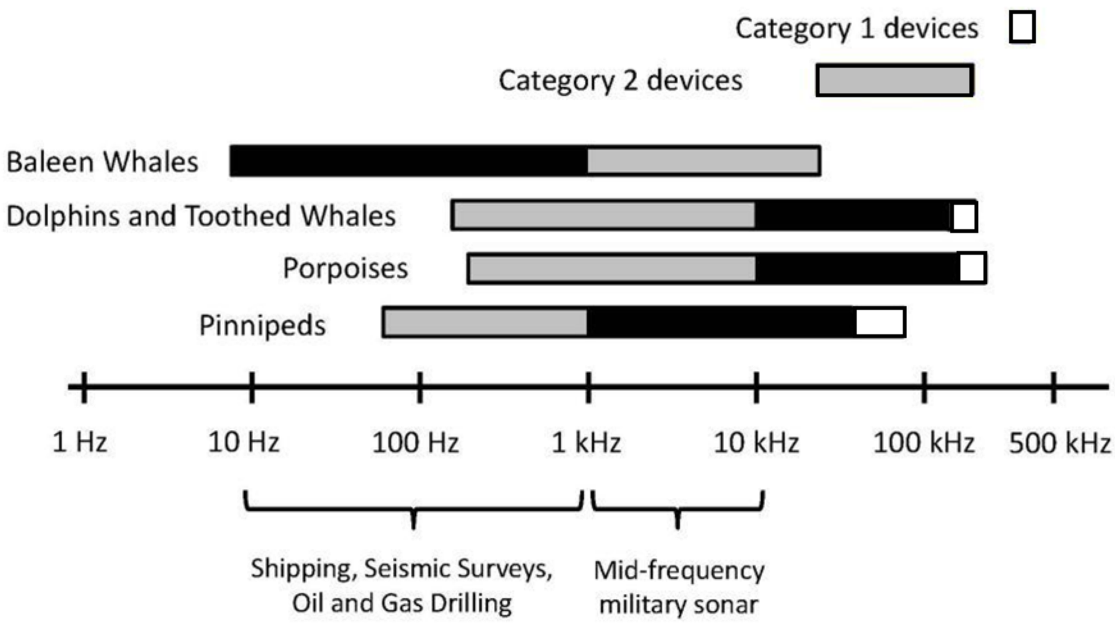

Figure 4.2-1 Typical Frequency Ranges of Hearing in Marine Mammals

Figure 4.2-1 shows hearing range for different marine mammal groups (gray and black bars) relative to the frequency outputs of the two categories of acoustic devices used in PIFSC fisheries and ecosystem research (yellow bars), as identified in Appendix C of the 2015 Draft PEA, Section 6.2. Black bars indicate the most sensitive hearing ranges of different marine mammals. Brackets indicate frequency ranges of several industrial sound sources as well as U.S. Navy mid-frequency active sonar for comparison. Data on hearing ranges is from Southall et al. (2007) and modified from DON (2008b).

The anticipated effects of active acoustic sources used during PIFSC fisheries research on threatened and endangered marine mammals is likely to occur infrequently, although they may occur over a large geographic area. Most of the frequencies are well above detection ranges for ESA-listed baleen whales, while Category 2 output overlaps with the hearing range of sperm and false killer whales. To date, there have been no reports or anecdotal observations of sounds from PIFSC research activities disturbing or causing behavioral changes in threatened or endangered species.

Vessel noise may affect large whales through masking of biologically important sounds, particularly for low frequency baleen whales (Clark et al. 2009). The biological significance of masking from vessel noise has not been demonstrated with empirical evidence for any species, but presumably the effects could include a decreased ability to detect sounds used in communication, predator avoidance, and orientation within their environment. However, the relatively small number of PIFSC research vessels is likely to only result in minimal and temporary effects from acoustic masking, as vessels pass through an area (Appendix C of the 2015 Draft PEA, Section 7.2).

The potential effects from the use of active acoustic devices during research activities would be small in magnitude, short-term in duration, and although they would be dispersed over a wide geographic area and certain to occur under the Status Quo Alternative, the overall impacts of acoustic disturbance to ESA-listed marine mammals throughout the PIFSC research area are likely to be minor adverse.

Note that take estimates of baleen whales are not provided due to the lack of overlap in their hearing range with the operating frequencies of PIFSC acoustic sources.

Table 4.2-6 PIFSC Estimated Five-year Level B Harassment Takes by Active Acoustic Gear for Each PIFSC Research Area

Species	HARA	ASARA	MARA	WPCRA	Total All Areas
Pantropical spotted dolphin	490	214	271	221	1196
Striped dolphin	525		74	237	836
Spinner dolphin	210	44	120	105	479
Rough-toothed dolphin	623	272	38	281	1214
Bottlenose dolphin	189	82	3	85	359
Risso's dolphin	1148		30	500	1678
Fraser's dolphin	442		252	199	893
Melon-headed whale	74		51	34	159
Melon-headed whale- Kohala stock	30				30
Pygmy killer whale	91		2	41	134
False killer whale	145	8	159	107	419
False killer whale- MHI insular	218				218
False killer whale- NWHI	339				339
Short-finned pilot whale	1931	836	227	841	3835
Killer whale	1	1	1	1	4
Sperm whale	451	195	175	197	1018
Pygmy sperm whale	705		416	307	1428
Dwarf sperm whale	1730	749	1020	754	4253
Blainville's beaked whale	208		123	91	422
Cuvier's beaked whale	73	31	43	32	179
Deraniyagala's beaked whale				32	32
Longman's beaked whale	753			328	1081
Unidentified *Mesoplodon*	458				458
Unidentified beaked whale	283	123	167	123	696

Species	HARA	ASARA	MARA	WPCRA	Total All Areas
Hawaiian monk seal	79				79
Total all stocks	11,199	2,556	3,172	4,515	21,442

Disturbance and Behavioral Responses due to Proximity of Researchers

In addition to Level B take from acoustic disturbance, PIFSC seeks authorization of Level B harassment takes in the HARA due to the physical presence of researchers near haulouts used by Hawaiian monk seals (sandy beaches, rocky outcroppings, exposed reefs). During the RAMP coral reef monitoring surveys, PIFSC research involves nearshore diving, small boat work, and shallow water sampling. For example, during the RAMP coral reef monitoring surveys virtually all of the islands and atolls in the HARA are circumnavigated by small boats (usually with divers in the water) once during the year. This circumnavigation is an approximation because the specific sampling locations are chosen based on a random sampling protocol. In addition, nearshore and shore-based research to assess and remove marine debris (primarily derelict fishing gear) is conducted at many locations where Hawaiian monk seals may be present. Often, when removing marine debris from shallow-water coral reefs, fish hiding in the debris may be flushed out and thus attract monk seals in the vicinity. PIFSC scientists are very aware of this situation and take precautions to avoid and minimize the chance of inadvertently disturbing monk seals, including reconnaissance of all beaches before approaching in skiffs or on foot (see mitigation procedures detailed in Section 2.2.1). However, there are numerous locations where Hawaiian monk seals may be resting adjacent to vegetation, or just emerging from the water onto the beach, and would not be immediately visible and where the options for alternate passage may be limited. Combined with the fact that this population is expanding in some PIFSC regions and that pinnipeds may haul out in new locations on a regular basis, it is essentially impossible for researchers to completely avoid disturbing monk seals as they travel around to conduct research.

Based on the locations of known haulouts (Baker and Johanos 2004, PIFSC 2014 a, b), PIFSC estimates the minimum population estimate for the Hawaiian monk seal population at about 1,182 animals. Not all of these seals haul out at the same time or at the same places, and therefore it is difficult to predict if any monk seals will be present at any particular research location at any point in time. Therefore, the only way to estimate the amount of Level B harassment would be to approximate the number of seals hauled out at any point in time across the HARA and the probability that a researcher would be close enough to actually disturb the seal.

The best estimate for the number of monk seals hauled out at any point in time is approximately one-third of the total population (Parrish et al. 2000). Therefore, assuming that all seals have an equal probability of hauling out anywhere in the archipelago, one-third of 1,182 is approximately 400 individual monk seals. Given that the two surveys with the highest probability of disturbing seals (i.e., RAMP, Marine Debris Research and Removal) systematically circumnavigate all the islands and atolls when they are conducted, we could estimate the annual maximum number of Level B harassment takes as 800, during years when these activities are conducted. Over the course of 5 years, this would be approximately 4000 potential disturbances if all the surveys took place every year at every location across the HARA. However, RAMP surveys occur in the HARA approximately twice every 5 years and Marine Debris Research and Removal Surveys are rarely funded to a level that would support complete circumnavigation of the HARA each year. In addition, sometimes during RAMP surveys the location of marine debris are identified (and recorded), thus precluding the need for marine debris identification later (only removal). Therefore, the approximately 4000 potential disturbances over 5 years could be reduced by two-fifths to approximately 1600 potential disturbances over five years. Furthermore, not all small boat operations during these surveys are close enough to the shoreline to actually cause a disturbance (e.g., a seal may be hauled out on a beach in a bay but the shallow fringing reef may keep the small boat from getting within half a mile from shore). In addition, the researchers implement avoidance and minimization measures while carrying out the surveys. The approximately 1600 potential disturbances could realistically be reduced through avoidance or sheer geographical separation by one half. Therefore, the PIFSC is requesting 800 Level B disturbances of Hawaiian monk seals due to the physical presence of researchers in the HARA over the five-year authorization period.

M&SI due to Interaction with Research Gear

There have been no entanglements or takes of ESA-listed marine mammals in PIFSC fisheries research from NOAA vessels or NOAA chartered vessels. Table 4.2-7 includes estimates of the number of marine mammals that may be caught in research gear with resulting M&SI takes based on takes in analogous commercial fisheries using gear similar to gear used in PIFSC fisheries and ecosystem research.

PIFSC is requesting one M&SI take due to potential entanglement take for sperm whales (Hawaiʻi stock), which are ESA-listed and depleted under the MMPA. PIFSC is requesting one take in longline gear over the five-year authorization period (Table 4.2-7). The request is based on documented takes of this species in commercial longline fisheries. The requested takes are well below 10 percent of PBR for each species (Table 4.2-7) and would be considered minor in magnitude according to the impact criteria described in Table 4.1-1. Given the mitigation measures in place to minimize potential interactions with marine mammals (Section 2.2.1), including the use of monitoring and the move-on rule for longline research, PIFSC considers taking sperm whales in fisheries and ecosystem research gear to be low risk and the take request represents a conservative estimate of potential take. These takes, if they occurred, would likely be rare events and would have minor adverse impacts on each stock according to the impact criteria described in Table 4.1-1.

PIFSC considered the risk of interaction with marine mammals for all the research gears and instruments it uses but did not request incidental takes in research gears other than midwater trawls, longline, and instrument deployments. There is evidence that Hawaiian monk seals (and bottlenose dolphins) occasionally pursue fish caught on various hook-and-line gears (depredation of fishing lines) deployed in commercial and non-commercial fisheries across Hawaiʻi (Nitta and Henderson 1993). This depredation behavior, which is documented as catch loss from the hook-and-line gear, may be beneficial to the marine mammal in providing prey but it also opens the possibility for the marine mammal to be hooked or entangled in the gear. PIFSC gave careful consideration to the potential for including incidental take requests for marine mammals in bottom handline (bottomfishing) gear although it has not had any marine mammal interactions in the past while conducting research with bottomfishing gear in the MHI.

Fisheries in state waters are not observed by independent, trained monitors and therefore few data exist on interactions with marine mammals. A recently published preliminary summary of self-reported catch loss data from the State of Hawaiʻi Commercial Marine License reporting system indicates that the number of catch loss incidents by monk seals and dolphins in the MHI may be increasing but is still relatively rare (Boggs et al. 2015). The authors of the summary emphasize that the data received only cursory treatment and should not be viewed as comprehensive.

The population of monk seals in the MHI is relatively small (minimum abundance estimate in 2011 of 138 seals), but it is growing at approximately 6.5 percent per year (Caretta et al. 2015). No M&SI of monk seals have been attributed to the MHI bottomfish handline fishery (Caretta et al. 2015). However, the same report (Caretta et al. 2015) notes: "In 2012, 16 Hawaiian monk seals were observed hooked, four of which died as a result of ingesting hooks. The remaining 12 were non-serious hookings, although 5 of these would have been deemed serious had they not been mitigated by capture and hook removal. Several incidents involved hooks used to catch ulua (jacks, Caranx spp.)." The hook-and-line rigging used to target ulua are typical of shoreline fisheries that are distinct from the bottomfishing gear and methods used by PIFSC during its fisheries and ecosystem research. Although there are some similarities between the shoreline fishery and the bottomfishing gear used by PIFSC (e.g., circle hooks), the general size and the way the hooks are rigged (e.g., baits, leaders, weights, tackle) are typically different and probably present different risks of incidental hooking to monk seals. Ulua hooks are generally much larger circle hooks than PIFSC uses because the targeted ulua are usually greater than 50 lbs. in weight. Shoreline fisheries (deployed from shore with rod and reel) also typically use "slide bait" or "slide rigs" that allow the use of live bait (small fish or octopus) hooked in the middle of the bait. If a monk seal pursued this live bait and targeted the center of the bait or swallowed it whole, it could get hooked in the mouth. PIFSC research with bottomfishing gear uses pieces of fish for bait that attract bottomfish but not monk seals. Monk seals could be attracted to a caught bottomfish but, given the length of the target bottomfish (averaging approximately 14 inches long; Boggs, personal communication), it is unlikely that a monk seal would be physically capable of swallowing the whole fish and therefore bites and tears at the caught fish (i.e., shreds the body of the fish while feeding). The risk of monk seals getting hooked on bottomfishing gear used in PIFSC research is therefore less than the risk of getting hooked on shoreline hook-and-line gears which are identified in the marine mammal stock assessment report (Caretta et al. 2015).

Given the mitigation measures the PIFSC intends to implement for bottomfishing research under the Preferred Alternative (see Section 2.3.1.3), PIFSC has concluded that the risk of marine mammal interactions with its research bottomfishing gear is not high enough to warrant an incidental take request for marine mammals in that gear in the LOA application. PIFSC intends to document potential depredation of its bottomfish research gear (catch loss) in the future, and increase monitoring efforts when catch loss becomes apparent, in an effort to better understand the potential risks of hooking to monk seals and other marine mammals.

This table summarizes the PIFSC M&SI (due to entanglement) take request of marine mammal stocks by gear type (all areas combined). Instrument deployments involve moorings and floating instruments or other lines that may cause entanglements. All population estimates and PBR values are from the most recent stock assessment reports (Carreta et al. 2015, Allen and Angliss 2015). Note that PBR is an annual measure of mortality while the LOA application estimates potential takes for the five-year period. The requested takes are shown as average annual M&SI takes that can be compared with PBR. The "undetermined dolphin" takes are assigned to each dolphin species for impact assessment purposes.

Table 4.2-7 Requested Number of Potential M&SI Marine Mammal Takes due to Gear Interactions during PIFSC Fisheries and Ecosystem Research

Common Name – Stock	Minimum Population Estimate	PBR	Potential M&SI Take Average per Year – All Research Areas Combined (total for five-year period)				
			Trawl Gear	Longline Gear	Instrument Deployment	Total Average Take Request – All Gears and Research Areas Combined	Total Annual Take Request as % of PBR Requested
Beaked whale, Blainville's – Hawaiʿi stock	1,088	11		0.2 (1)		0.2 (1)	1.8%
Beaked whale, Cuvier's – Hawaiʿi pelagic stock	1,142	11.4		0.2 (1)		0.2 (1)	1.8%
Bottlenose dolphin – Hawaiʿi pelagic stock	3,755	38	0.2 (1)	0.2 (1)	0.2 (1)	0.6 (3)	1.6%
Bottlenose dolphin – all stocks except above			0.2 (1)		0.2 (1)	0.4 (2)	NA
False killer whale – Hawaiʿi pelagic stock or unspecified stock [A]	935	9.4		0.2 (1)		0.2 (1)	2.1%
Humpback whale – Central North Pacific stock [B]	7,890	82.8		0.2 (1)	0.2 (1)	0.4 (2)	0.5%
Kogia spp. (Pygmy and dwarf sperm whale – Hawaiʿi stocks)	Unknown	Undetermined		0.2 (1)		0.2 (1)	NA
Pantropical spotted dolphin – all stocks [C]	11, 508	115	0.2 (1)	0.2 (1)	0.2 (1)	0.6 (3)	0.5%
Pygmy killer whale – Hawaiʿi stock	2,274	23		0.2 (1)		0.2 (1)	0.9%
Risso's dolphin – Hawaiʿi stock	5,207	42		0.2 (1)		0.2 (1)	0.5%

Common Name – Stock	Minimum Population Estimate	PBR	Potential M&SI Take Average per Year – All Research Areas Combined (total for five-year period)				
			Trawl Gear	Longline Gear	Instrument Deployment	Total Average Take Request – All Gears and Research Areas Combined	Total Annual Take Request as % of PBR Requested
Rough-toothed dolphin – Hawaiʿi stock	4,581	46	0.2 (1)	0.2 (1)	0.2 (1)	0.6 (3)	1.3%
Rough-toothed dolphin – all stocks except above				0.2 (1)	0.2 (1)	0.4 (2)	NA
Short-finned pilot whale – Hawaiʿi stock	8,782	70		0.2 (1)		0.2 (1)	0.3%
Sperm whale – Hawaiʿi stock [D]	2,539	10.2		0.2 (1)		0.2 (1)	2.0%
Spinner dolphin, all stocks [E]	355	3.3	0.2 (1)		0.2 (1)	0.4 (2)	12.1%
Striped dolphin, all stocks	15,391	154	0.2 (1)	0.2 (1)		0.4 (2)	0.3%

A – Strategic stock based on total M&SI exceeding PBR. PIFSC fisheries and ecosystem research would not occur within the ranges of other false killer whale stocks. "Unspecified stock" only occurs on the high seas. Takes are not from the ESA-listed MHI Insular DPS

B – Request for take by potential entanglement in instrument deployment lines based on Bradford and Lyman (2015).

C – Information presented only for Hawaiʿi pelagic stock, which is the only stock with estimates of population and PBR.

D – Listed as endangered under the ESA.

E – Information presented only for the Oʻahu/ "4-Islands Region" stock, which is the smallest stock for which population and PBR estimates are available. This is used to provide the most conservative impact assessment.

4.2.4.7 Other Cetaceans

This section describes impacts to non-ESA-listed cetaceans occurring within the PIFSC research areas (see species listed in Table 4.2-6 and Table 4.2-7).

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed for ESA-listed species above. Table 4.2-6 provides summaries of the numbers of each species that could be taken by acoustic disturbance during PIFSC research activities in PIFSC research areas. See Appendix C of the 2015 Draft PEA for a discussion about the derivation and concerns about the accuracy of these estimates. The likely impact on cetaceans from the different types of acoustic devices is discussed below.

The mid-frequency odontocetes have a functional hearing range of 150 Hz to 160 kHz, with highest sensitivity from 10-120 kHz. The high-frequency odontocetes have a functional hearing range of 200 Hz to 180 kHz, with highest sensitivity from 10-150 kHz. The output frequencies of Category 1 active acoustic sources (>300 kHz) are above the functional hearing range of baleen whales and cetaceans in the mid- and high-frequency hearing groups (Figure 4.2-1). Because they would not be able to hear them, cetaceans are not expected to be affected by Category 1 sound sources (Appendix C of the 2015 Draft PEA, Section 6.2).

Category 2 active acoustic sources produced by the EK60 (one of the predominant sources [38kHz]) are unlikely to be heard by baleen whales. Other Category 2 sources are within the range of hearing for various odontocetes, especially the high frequency hearing beaked whales and dwarf and pygmy sperm whales. Some of these devices are used on trawl nets during fishing so their use is intermittent, localized, and directional, and they are deployed on moving sources. The sounds could be loud to cetaceans in close proximity to the sound source but physical damage is unlikely, although TTS could occur if animals remained close to the source (tens to a few hundred meters) for prolonged periods (Appendix C, Section 6.2). The short duration of most research tows (< 30 minutes) should minimize that likelihood. If detected, short term avoidance is the most likely response (Appendix C of the 2015 Draft PEA, Section 6.2).

Potential disturbance from active acoustic equipment used during research would not have any measurable effect on the population of any cetacean and would therefore be considered minor in magnitude. Such disturbance is likely to occur wherever survey vessels use the equipment, but cetaceans would only be close enough to a vessel to be affected on a rare or intermittent basis and any behavioral changes would be temporary. The overall impact of active acoustic sound sources on non-ESA-listed cetaceans throughout PIFSC research areas is therefore considered to be minor adverse according to the criteria in Table 4.1-2.

M&SI Due To Interactions with Research Gear

There has been no history of marine mammal takes in fisheries and ecosystem research gears by PIFSC research activities. Measures to mitigate the risk of adverse interactions with marine mammals are described in Section 2.2.1. The PIFSC LOA application (Appendix C of the 2015 Draft PEA) includes estimates of the potential number of marine mammals that may interact with research gear based on documented takes of species taken in analogous commercial fisheries, e.g., those operating in similar areas and using similar gear types (Table 4.2-7). Note that the LOA application does not request authorization to take all species of marine mammals that occur in the PIFSC research areas; only those species listed in Table 4.2-7 are considered to have a reasonable risk of adverse interactions with gear used for PIFSC fisheries and ecosystem research. PIFSC considers these estimates to be greater than what is likely to occur in the future, especially given the fact that none of these species have been taken in research gears in the past, the relatively small level of fishing effort during PIFSC fisheries and ecosystem research, and the mitigation measures in place to reduce potential interactions.

The take request includes takes of cetaceans in midwater trawl gear (Cobb or Isaacs-Kidd midwater trawls), longline gear, and by entanglement during instrument deployments (Table 4.2-7). For all gear types and stocks requested, the requests are for the minimal amount, one animal over the five-year authorization period, although a number of stocks are requested in more than one gear. For almost all of these stocks, the total requested level of take from all gears, if it occurred, would be less than ten percent of PBR and would be considered minor in magnitude for each stock. The exception is for spinner dolphins. The combined take of two spinner dolphins (one in midwater trawl and one in instrument deployments) would be 12.1 percent of the O‘ahu/“4-Islands Region” stock’s PBR if both takes occurred on this one stock and this level of take would be considered to be moderate in magnitude. However, since the request is for all stocks due to the spatial extent of the research, the uncertainty of stock boundaries, and possibility of encountering individuals from undescribed stocks, the impact would be more likely to be spread across more than one stock of spinner dolphin and the resulting impact would likely be of smaller magnitude.

PIFSC is requesting one take over the five-year authorization period for a humpback whale that might get entangled in lines used to deploy research instruments (lines connecting floats and anchors, moorings, or instruments deployed over the side of a vessel). This take request is based on documented entanglement of humpback whales in lines associated with various gears using floats and anchors.

There are several species for which the stock structure throughout the PIFSC research area has not been determined (e.g., bottlenose dolphin) or for which abundance and PBR values have not been determined. The impact of potential takes from these stocks relative to PBR is therefore not available.

PIFSC considered the risk of interaction with marine mammals for all the research gears it uses but did not request incidental takes in research gears other than trawls, longline, and instrument deployments. There is evidence that bottlenose dolphins occasionally pursue fish caught on various hook-and-line gears (depredation of fishing lines) deployed in commercial and non-commercial fisheries across Hawaiʽi (Boggs et al. 2015). However, PIFSC has concluded that the risk of marine mammal interactions with its research bottomfishing gear is not high enough to warrant an incidental take request for marine mammals in that gear in the LOA application (see section 4.2.4.6 above). PIFSC intends to document potential depredation of its bottomfish research gear (catch loss) in the future, and increase monitoring efforts when catch loss becomes apparent, in an effort to better understand the potential risks of hooking to bottlenose dolphins and other marine mammals.

Conclusion

The potential direct and indirect effects of PIFSC research activities on marine mammals have been considered for each of the four PIFSC research areas (HARA, MARA, ASARA, and

WCPRA) and for all gear types used in research under the Status Quo Alternative. Given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse.

All species may be exposed to sounds from active acoustic equipment used in PIFSC research in the four research areas, although several acoustic sources are not likely audible to many species. Those that are audible would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through a given area. The potential for temporary threshold shifts in hearing is low for high frequency cetaceans (e.g., dolphins) and very low to zero for other species, particularly low frequency cetaceans (e.g., Mysticetes). The potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and temporary duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all species throughout the PIFSC research areas.

PIFSC has never caught, hooked, or had marine mammals entangled in its fisheries research gear. However, incidental takes of marine mammals have occurred in commercial and non-commercial fisheries in the same areas as PIFSC research occurs and using gears similar to those used in research. PIFSC has used information on these analogous fisheries to make estimates of marine mammals that may be incidentally taken during future fisheries and ecosystem research. These M&SI takes due to entanglement include one ESA-listed species (sperm whales) and 15 non-listed cetacean species, primarily by research using longline gear but also including research with midwater trawl gear and instrument deployments (potential entanglement in mooring lines or other lines). For almost all stocks for which PBR has been determined, the requested takes, if they occurred, would represent less than ten percent of PBR and would be considered minor in magnitude. The exception is for spinner dolphins. If all of the requested takes for spinner dolphin occurred on the Oʻahu / “4-Islands Region” stock, the takes would be 12.1% of PBR for this stock and would be considered moderate in magnitude.

Given the mitigation measures implemented under the Status Quo Alternative, the relatively small amount of fishing effort involved in PIFSC research, and the lack of takes in the past, PIFSC does not anticipate that the level of requested takes will actually occur in the future. The overall impact of the potential takes of these species, if they occurred, would be considered minor to moderate adverse according to the criteria described in Table 4.1-1.

PIFSC also uses bottomfishing hook-and-line gear, bongo nets, baited traps, SCUBA gear, and other scientific instruments in the course of conducting fisheries and ecosystem research (Table 2.2-1) that are not considered to present reasonable risks of incidental takes of marine mammals and for which no take requests have been made in the LOA application.

In addition to Level B harassment takes for many species through acoustic disturbance, PIFSC is requesting Level B harassment takes for Hawaiian monk seals due to the physical presence of researchers in nearshore waters and beaches. Given the protocols for monitoring and avoiding interactions with monk seals, these potential takes would likely result in only temporary disturbance of small numbers of monk seals and adverse impacts would be minor.

The overall effects of the Status Quo Alternative on marine mammals would be minor to moderate in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.2.5 Effects on Birds

Section 3.2.3 describes the populations of birds that are likely to overlap with PIFSC fishery research activities in the HARA, MARA, ASARA, and WCPRA research areas. This section describes the effects of the Status Quo PIFSC research activities on seabirds. Seabirds occur throughout the year in all research areas concurrent with PIFSC research activities. The potential effects of research vessels, survey gear, and other associated equipment on seabirds include:

- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to survey removal of prey and discards
- Contamination or degradation of habitat

4.2.5.1 Injury and Mortality Due to Ship Strikes and Entanglement in Gear

There are several potential mechanisms for PIFSC research activities to cause injury or mortality to seabirds. Many seabirds are attracted to fishing vessels in order to forage on bait, offal, discards, and natural prey disturbed by the fishing operation. This attraction to fishing vessels creates the opportunity for birds to inadvertently collide with cables or lines and other structures on the vessel, or to become entangled in the fishing gear. Bird strikes on commercial fishing vessels are probably most numerous at night and during storms or foggy conditions when bright deck lights can cause the birds to become disoriented (NMFS 2004). However, such bird strikes are relatively rare and can be difficult to detect. There are no recorded instances of bird strikes resulting from PIFSC fisheries and ecosystem research activities (NOAA 2016). Birds could also be affected by land-based marine debris removal or anything close to shore (these birds have a tendency to fly out to small boats). Currently, there are no recorded instances of bird injury or mortality resulting from PIFSC fisheries and ecosystem research activities.

Marine mammal biologists working with the PIFSC Hawaiian monk seal research program experienced an unusual interaction with Laysan finch, an ESA-listed species endemic to Laysan Island, while camping and conducting monk seal research for extended periods of time on the island (USFWS 2014b). Laysan finch is a terrestrial species that is not likely to interact with marine research activities but it is apparently curious and regularly explores human encampments on the island. In May 2009, a small group of Laysan finches flew out to the NOAA Ship *Oscar Elton Sette*, which was transporting monk seal researchers from Laysan to other islands. Several of these birds flew down the smokestack and one bird perished. The birds may have been looking for food and water, which was scarce on the island. This incident was considered to be an anomaly (USFWS 2014b) and the potential for any such interactions with PIFSC fisheries and ecosystem research activities is considered remote.

Under the Status Quo Alternative, seabird injury or mortality could potentially occur as a result of ship strikes, however, based on the based on the infrequency of ship strikes in commercial fishing operations in the PIFSC research areas, and the absence of historic seabird injury or mortality resulting from PIFSC research activities, it is unlikely that any seabird mortality would occur as a result of ship strikes on PIFSC research vessels under the Status Quo alternative.

Mortality of seabirds in commercial fishing gear, especially longlines, is a major conservation concern for albatross, gulls, and other species that interact with commercial fishing vessels in the PIFSC research areas. Although it is possible for seabirds to interact with a wide range of fisheries and ecosystem research gear types, interactions between seabirds and pelagic longline gear have the potential to be particularly problematic. Diving birds are vulnerable to interaction with fishing gear near the surface as the gear is being deployed or retrieved. During the deployment (setting) and retrieval (hauling) of longline fishing gear, hooks and line may hook or entangle seabirds that attempt to take bait or catch. Seabirds are more likely to drown when the interaction occurs during setting because the weight of the gear can pull the bird underwater. Seabirds that feed in areas where PIFSC conducts research using longline gear include Laysan albatross (*Phoebastria immutabilis*), black-footed albatross (*P. nigripes*), shearwaters, fulmars, boobies, and the endangered short-tailed albatross (*P. albatrus*). The introduction of safe-handling procedures for seabirds and measures to mitigate seabird bycatch have greatly reduced the frequency of interactions with seabirds, particularly with Laysan albatross and black-footed albatross. In 2000, NMFS estimated 2,433 seabird interactions occurred in the Hawai‘i commercial longline fisheries. Implementation of seabird safe-handling and mitigation measures after 2004 significantly reduced annual interactions, so that in 2013, NMFS estimated 180 total interactions with seabirds, a decrease of over 92 percent relative to pre-mitigation levels (NOAA 2014e). Credit for this successful reduction in interactions is mostly due to the commercial fishermen, who understand and implement the seabird mitigation requirements. The requirements include mandatory training in seabird identification, seabird deterrent fishing gear and techniques, and special handling and release of incidentally-caught seabirds.

Under the Status Quo Alternative, PIFSC would continue to conduct surveys using longline gear as part of the Pelagic Longline Hook Trials, Longline Gear Research, and Marlin Longline survey programs. Because longline research would be conducted in conjunction with commercial fisheries, operational characteristics (e.g., branchline and floatline length, hook type and size, bait type, number of hooks between floats) of the longline gear in Hawai‘i, American Samoa, Guam, the Commonwealth of the Northern Marianas, or EEZs of the Pacific Insular Areas would adhere to the requirements based on regulations of the Western Pacific Regional Fisheries Management Council (75 FR 2262). These requirements include the use of weighted branchlines, blue-dyed bait, and strategic offal discard practices, which would decrease the potential for adverse interactions with seabirds.

Currently, there are no recorded instances of any bird mortalities resulting from fisheries and ecosystem research activities conducted and funded by PIFSC, and likewise, no mortalities would be expected to occur as a result of activities proposed under the Status Quo Alternative. It is possible that seabird mortality could occur as a result of ship strikes or interaction with fishing gear, but it is likely that such adverse interactions with seabirds would be rare and would affect small numbers of birds.

4.2.5.2 Injury or Mortality Due to Artificial Light Sources

Hawaiian petrels, Newell’s shearwaters, and band-rumped storm-petrels may traverse the action area at night. Outdoor lighting on research vessels could result in seabird disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights, may collide with fishing gear and structures or fall to the deck or into the water due to exhaustion. Downed seabirds are subject to increased mortality. Young inexperienced birds (fledglings) are particularly vulnerable. Any increase in nighttime lighting, particularly during each year's peak fallout period (September 15 through December 15), could result in seabird injury or mortality.

NOAA research vessel crew and officers have observed that seabirds rarely land on NOAA Ships and are only occasionally observed repeatedly circling ships at night. Both NOAA and NOAA-chartered vessels maintain minimal exterior lighting on respective research vessels and are required to follow specific lighting configurations mandated by the USCG (33 CFR 83). These lights are for navigational safety. Additional downward-focused deck lighting may be used during scientific operations to support the mission.

To minimize potential project impacts to seabirds during their breeding season, the use of lights and lighting intensity on vessels where PIFSC research activities are conducted would be minimized. To the extent possible, lights would be retrofitted to be fully shielded so the bulb can only be seen from below bulb height and only used when necessary. When fishing staff or researchers see seabird(s) flying in the ship's lights at night, the lights will be turned off, when feasible, to avoid adversely affecting the bird(s) and required navigation lights would remain on.

Based on the history of minimal interaction/observation of seabirds landing on, or circling both NOAA research and chartered vessels, and implementation of the aforementioned mitigation measures (e.g., minimizing use of lights at night, retrofitting vessel lighting to be fully shielded, turning off lights temporarily (when feasible) at night when seabirds are observed), the effects of artificial lighting are expected to be negligible.

4.2.5.3 Changes in Food Availability

Under the Status Quo Alternative, PIFSC fisheries and ecosystem research activities could potentially affect seabirds through changing the abundance or distribution of their prey species. A recent study (Cury et al. 2011) examined data from the past 45 years and all of the world's oceans and found that reductions in prey abundance (small fish and invertebrates) to below one third of the maximum documented biomass results in substantial declines in seabird reproductive success. This response was common to all seabird species and ecosystems examined in the Pacific, Atlantic, and Southern Oceans (Cury et al. 2011). Many factors influence the abundance and distribution of seabird prey and forage species, including oceanographic and weather fluctuations, and commercial fishing effort. Although it is difficult to demonstrate the indirect effects of fishing for other species and size classes on the availability of prey for seabirds, directed fishing on small schooling fish (e.g., sardines, anchovies) and invertebrates (e.g., krill) have played roles in driving seabird prey and forage populations below the "one third" limit in many areas (Cury et al. 2011).

Fisheries and ecosystem research activities proposed under the Status Quo Alternative may also have beneficial effects on seabirds by providing offal and discards as food for birds, representing sources of energy and nutrients that would otherwise be unavailable to birds. In some areas with intensive commercial fishing efforts, offal may provide a substantial portion of the total food consumed by scavenging species such as gulls (Tasker and Furness 1996). While scavenging may benefit individual birds, it also potentially places them in danger from entanglement and incidental interactions with fishing gear.

PIFSC fisheries and ecosystem research activities proposed under the Status Quo Alternative would remove very small quantities of potential food for seabirds. The dispersal of research effort over wide areas of sea and the relatively small number of research surveys over time makes it very unlikely that any measurable impacts to the abundance or distribution of seabird prey would occur as a result of research activities proposed under the Status Quo Alternative. This is especially true for the small size classes of fish and pelagic invertebrates favored by most seabirds because of their large biomasses and the minimal amounts taken in research samples (Sections 4.2.3 and 4.2.7). For the same reasons, the amount of food made available through research activities is unlikely to have more than temporary and highly localized beneficial effects on seabirds.

4.2.5.4 Contamination or Degradation of Habitat

For the same reasons described for fish (Section 4.2.3) and marine mammals (Section 4.2.4), potential effects on seabirds from accidental discharges of fuel or other contaminants from vessels engaged in PIFSC fisheries and ecosystem research activities are possible but unlikely. In the unlikely event that fuel, oil, or other contaminants are discharged, the volume of discharged material is likely to be small and the area of influence would be localized. Any potential effects to seabirds would be similarly short-term, localized, and would likely affect a small number of birds. The overall impact of accidental contamination of seabirds would therefore be considered minor adverse. This type of potential effect on seabirds will not be discussed further in this analysis.

One of the PIFSC research programs considered in this PEA involves the removal of derelict fishing gear from shallow waters and beaches where various seabirds may forage, rest, or breed. Given the potential for birds to become entangled in such gear, the removal of derelict gear has beneficial effects on seabirds, especially diving species.

4.2.5.5 Conclusion

The effects of PIFSC-affiliated fisheries and ecosystem research on seabirds include the potential for injury and mortality in fishing gear and ship strikes, changes in food availability, and contamination or degradation of habitat. There have been no reported captures of seabirds in PIFSC research gear or incidents of ship strikes in the past. Given the occurrence of seabird bycatch in commercial fisheries in the Pacific Islands Region, such effects could potentially occur in the future under the Status Quo Alternative but would likely be rare and minor in magnitude. For reasons similar to those described for marine mammals above, the overall risk of PIFSC fisheries research causing changes in food availability for seabirds or contamination in the marine environment is considered minor adverse, although there could be beneficial effects of derelict gear removal.

The overall effects on seabirds from PIFSC research activities under the Status Quo Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

4.2.6 Effects on Sea Turtles

Section 3.2.4 describes the populations of sea turtles that are likely to overlap with PIFSC fishery research activities in the HARA, MARA, ASARA, and WCPRA. This section describes the potential effects of PIFSC research activities on sea turtles under the Status Quo Alternative, including mitigation measures that have been implemented to reduce adverse effects.

Five species of sea turtles can be found within the PIFSC research areas: green, hawksbill, leatherback, loggerhead, and olive ridley sea turtles. All five species of sea turtles found in the

Pacific Islands research areas are listed as threatened or endangered under the ESA. Direct and indirect effects of PIFSC research activities on sea turtles may include:

- Disturbances and changes in sea turtle behavior due to physical presence and sound sources
- Injury or mortality due to ship or small boat strikes and gear interactions
- Changes in food availability due to survey removal of prey
- Contamination or degradation of sea turtle habitat

Mitigation measures implemented under the Status Quo Alternative are intended to reduce the potential for adverse interactions with sea turtles and are described in Section 2.2.1.

4.2.6.1 Disturbances and Changes in Behavior Due to Physical Presence and Sound Sources

There is a potential for research activities to negatively affect or disturb sea turtles and cause changes in behavior. Such effects could result from the physical presence of marine vessels and fishing gear, operational sounds from engines and hydraulic equipment, and active acoustic devices used for navigation and research.

Little is known about hearing in sea turtles, but the available information suggests that their underwater hearing capabilities are quite limited both in functional hearing bandwidth and in absolute hearing sensitivity. Electrophysiological studies on the acoustic sensitivity of the green sea turtle (*Chelonia mydas*) and loggerhead sea turtle (*Caretta caretta*) using auditory brainstem response techniques determined that the effective range of hearing of these species is within low frequencies (100 to 500 Hz) (Bartol and Ketten 2003) Additional data suggest that sea turtles probably have functional hearing sensitivity between about 100 Hz and 1.2 kHz (Ketten and Bartol 2005, Dow, Piniak, et al. 2012), which is well below the frequencies of active acoustic instruments used for PIFSC fisheries and ecosystem research (Appendix C of the 2015 Draft PEA, Section 6.2). Active acoustic instruments used by PIFSC for fisheries and ecosystem research generally operate at frequencies in the 18 – 200 kHz range, and the sounds generated by PIFSC active acoustic instruments are unlikely to be audible to sea turtles and therefore unlikely to have adverse effects on sea turtles. Based on the auditory capabilities of sea turtles, active acoustic sources used in PIFSC fisheries research operations are unlikely to be audible to sea turtles and therefore are unlikely to have adverse effects on sea turtles.

Sea turtles may be disturbed or displaced from their normal behavior or movements by passing vessels or fishing gear in the water. However, given the small number of research vessels and their dispersal over a wide area, behavioral disturbances resulting from PIFSC research activities proposed under the Status Quo Alternative would be isolated in geographic extent and short-term in nature, lasting only a few minutes as the research vessel passes. Such disturbances would not result in measurable changes to sea turtle foraging success or survival at the population level. Therefore, the effects would be minor adverse under the Status Quo Alternative using gear types and mitigation measures similar to those currently in use.

4.2.6.2 Injury or Mortality Due to Ship or Small Boat Strikes and Entanglement in Gear

The two main mechanisms for research activities to cause injury or mortality to sea turtles are ship or small boat strikes and entanglement in fishing gear. Sea turtles come to the surface to breathe, and also to rest, making them susceptible to ship strikes. However, there are no reported incidents of ship strikes with sea turtles by NMFS research vessels in the HARA, MARA, ASARA, or WCPRA research areas. As described in Section 2.2.1, vessel speeds are restricted on research cruises in part to reduce the risk of ship or small boat strikes with marine mammals and sea turtles. Transit speeds vary from 6 to 10 kts, but average nine kts. Vessel speeds during active sampling are typically between two and four kts due to sampling design, and these slower speeds are assumed to minimize the risk of collisions with sea turtles. During nearshore small boat activities the potential for accidentally striking a sea turtle is slightly higher. Green and hawksbill sea turtles generally forage close to shore around the shallow fringing reefs of the PIR. When sea turtles swim to the surface to breathe, it can be difficult to spot them, especially if the sea surface is choppy. Given the relatively slow speeds of research vessels, the presence of dedicated marine species observers during survey activities, and the relatively low density of research activities dispersed over wide areas in the HARA, MARA, ASARA, and WCPRA, collisions with sea turtles are unlikely to result from the research activities considered under the Status Quo Alternative. Therefore, the effects of collisions with sea turtles are considered minor adverse throughout the HARA, MARA, ASARA, and WCPRA under the Status Quo Alternative using vessel types and mitigation measures similar to those currently in use.

There are no reported incidents of sea turtle entanglement in gear during PIFSC fisheries and ecosystem research activities conducted in the HARA, MARA, ASARA, or WCPRA. The potential direct mechanisms of interaction would include capture or entanglement in various nets, collisions with mobile gear, and getting hooked by longline fishing gear. The potential indirect mechanisms of interaction would include capture or entanglement in research fishing gear or instruments (in particular, monofilament) that were accidentally lost during a survey and ended up on a reef that then interacted with a sea turtle later in time. Several factors may explain the lack of previous sea turtle interactions with PIFSC fisheries and ecosystem research equipment in the PIFSC research areas, including configuration of the fisheries and ecosystem research equipment employed by PIFSC and the type and size of hooks and the bait used for longline surveys, as well as the spatial distribution of sea turtles in the areas where research gear is deployed, which may be related to the presence of prey sources, seasonal migration patterns, and oceanographic features. Potential mechanisms for sea turtle interactions with longline gear include entanglement in lines and being caught by hooks as a result of depredation by sea turtles on the bait or caught fish. These types of adverse interactions could potentially result in serious injuries or mortalities to sea turtles. Loggerhead and leatherback sea turtles have been identified as being at particular risk of population decline as a result of incidental take by longline pelagic fisheries (Lewison et al. 2004). However, there have been no recorded incidents of sea turtle interactions with PIFSC research longline gear in the HARA, MARA, ASARA, or WCPRA. Based on the lack of previous sea turtle interactions with fisheries and ecosystem research equipment in the PIFSC research areas, it is not anticipated that any sea turtles would be captured during the research proposed under the Status Quo Alternative.

Under the Status Quo Alternative, operational characteristics (e.g., branchline and floatline length, hook type and size, bait type, number of hooks between floats) of the longline gear in Hawai‘i, American Samoa, Guam, the Commonwealth of the Northern Marianas, or EEZs of the Pacific Insular Areas would adhere to the requirements based on regulations of the WPRFMC (2014). Additionally, operational characteristics of longline research in non-WPRFMC areas of jurisdiction would adhere to the regulations of the applicable management agencies, including WCPFC, and IATTC. Given the lack of historical interactions under the same conditions, the potential for future interactions is considered small and unlikely to affect any populations of sea turtles. The potential effects of longline surveys on sea turtle populations are therefore considered to be minor adverse based on the criteria in Table 4.1-1.

Mitigation measures implemented under the Status Quo Alternative would be intended to reduce the potential for adverse interactions with sea turtles. Operational procedures and monitoring methods described in Section 2.1.1 would include visual scans for sea turtles and would preclude trawl and longline surveys in areas where turtles are observed. However, the efficacy of these mitigation measures may be limited by the fact that turtles in the water may be difficult to see. In summary, there have been no recorded incidents of sea turtle entanglement resulting from PIFSC fisheries and ecosystem research activities, and no reported interactions resulting in sea turtle mortality. Based on this information, there is potential for minor adverse effects to occur using gear types and mitigation measures currently in use; such effects would be rare and short-term in frequency and duration and would not result in measurable changes to sea turtle population levels in any of the PIFSC research areas.

4.2.6.3 Changes in food availability due to survey removal of prey and forage species

PIFSC fisheries and ecosystem research activities proposed under the Status Quo Alternative are unlikely to have substantial effects on the availability of prey and forage species for sea turtles in the HARA, MARA, ASARA, and WCPRA research areas due to the relatively low spatial density of research activities within the research areas, and the small amounts of prey and forage species removed as a result of PIFSC research activities. Western Pacific leatherback turtles (*Dermochelys coriacea*) forage seasonally on dense aggregations of jellyfish off the west coast of the United States (Graham 2009). All life stages consume gelatinous organisms such as jellyfish and tunicates (USFWS Biological Technical Publication, BTP-R4015-2012). Several species of jellyfish are frequently caught as a result of PIFSC fisheries research activities, however, due to the extremely high densities of jellyfish encountered in leatherback foraging areas and the small amounts of biomass removed by PIFSC fisheries and ecosystem research activities, the removal of jellyfish as a result of PIFSC research would have negligible effects on the availability of jellyfish as a food source for leatherback sea turtles. Likewise, disturbance or removal of small amounts of marine plants and grasses by PIFSC research activities are unlikely to have any measurable effects on forage availability for Hawaiian green sea turtles (*Chelonia mydas*), which are known to feed on sea grasses and seaweeds (i.e., *limu*) (McDermid et al. 2015).

4.2.6.4 Contamination or Degradation of Habitat

The only potential mechanisms for PIFSC research activities to cause contamination or degradation of sea turtle habitat would involve accidental spills and discharges. All NOAA vessels are subject to the regulations of MARPOL 73/78, as modified by the Protocol of 1978 (NOAA 2010b). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations would avoid or minimize the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). Discharge of contaminants from NOAA vessels and PIFSC chartered vessels is unlikely. Any contamination or degradation of sea turtle habitat resulting from PIFSC research activities proposed under the Status Quo Alternative would be isolated in both time and location and would not result in measurable changes to sea turtle populations in the HARA, MARA, ASARA, and WCPRA. No measurable changes in contamination or degradation of sea turtle habitat are expected to result from PIFSC research activities. Such effects are unlikely and are therefore considered to be minor adverse based on the criteria in Table 4.1-1.

4.2.7 Effects on Invertebrates

This section describes the general types of effects of the Status Quo Alternative on invertebrate species. Many of these invertebrate species comprise EFH as part of hard bottom structures underlying the waters and associated biological communities (e.g., corals). The potential effects of research vessels, survey gear, and other associated equipment on invertebrates include:

- Physical damage to infauna and epifauna
- Directed take of coral specimens
- Mortality from fisheries research activities
- Changes in species composition
- Contamination or degradation of habitat

4.2.7.1 Physical Damage to Infauna and Epifauna

Physical damage to infauna and epifauna under the Status Quo Alternative may occur during numerous PIFSC surveys through SCUBA operations, water sampling instruments, deployment of stationary bottom-contact gear, hook-and-line bottomfishing, marine debris removal, and coral coring. Infauna live in the seafloor or within structures that are on the seafloor and include clams, tubeworms, and burrowing crabs that usually construct tubes or burrows and commonly occur in deeper and subtidal waters. Epifauna, including mussels, crabs, starfish, sponges, and corals live on the surface of the seafloor or on structures on the seafloor such as rocks, reefs, pilings, or vegetation. They either attach to these surfaces or range freely over them by crawling or swimming. Fishing gear that contacts the seafloor can disturb infauna and epifauna by crushing them, burying them, removing them, or exposing them to predators, and thus can reduce complexity and species diversity (Collie et al. 2000, Morgan and Chuenpagdee 2003).

SCUBA operations related to surveys could potentially result in accidental contact between divers (fins or other diver gear) and coral, including ESA-listed species. However, the use of highly qualified divers, extensive dive training, and adherence to best practices designed to minimize unnecessary contact with live reef, diminish the likelihood of any potential incidental effects to coral.

Sea water samples are collected and analyzed for microbiological communities. When sea water is collected near the reef, the possibility exists that coral in the free-swimming larval state may inadvertently be captured. However, due to the relatively low abundance of protected coral species in the action area, the fact that high concentrations of larval coral occur only during infrequent spawning events, and the small volumes of sea water sampled, the intensity of impacts to any coral species resulting from the collection of seawater samples would be negligible.

Deployment of stationary bottom-contact gear includes a variety of equipment (see Table 2.2-1) with the potential to crush, bury, remove, or expose invertebrates, including ESA-listed corals. This gear is either deployed temporarily (30 minutes to 24 hours) or longer-term (1-3 years).

Temporary deployments include bottom traps, hook-and-line bottomfishing, photo-transects, stereo-video instruments (e.g., BRUVs, BotCam), and water samplers (PUCs and RAS) that rest directly on benthic substrate. These temporary deployments are done from the sea surface in ships or small boats and therefore there is uncertainty where the gear will land (i.e., sandy substrate versus hard reef). Certain types of branching or laminar corals would be slightly more vulnerable than massive or encrusting morphologies to bottom-contact gear because contact could cause protruding pieces of these corals to break off rather than just cause damage at the physical contact point. Longer-term deployments include ARMS, ADCPs, BMUs, CAUs, STRs, HARPs, carbonate instruments (SEAFETs/SAMIs), and EARs that are either fixed or anchored to the benthic substrate. For all of these gear types, physical disturbance is limited to the point of anchorage or footprint of the gear. Because these longer-term deployments are installed by skilled SCUBA divers, the potential for adverse impacts to infauna or epifauna is very small. HARPs are not always deployed by divers and are sometimes dropped in deep water with a small metal anchor. The deep water sites generally have a low density of epifauna or infauna and therefore survey gear is unlikely to have adverse impacts to infauna or epifauna.

The footprint of a single lobster trap is approximately 0.75 m^2 and consists of a 0.98 x 0.77 x 0.30-m molded polyethylene cage. The footprint of a BRUV is approximately 0.05 m^2 and consists of a 12 mm diameter galvanized steel pipe in a rectangular shape of 1.26 x 0.86 m. The footprint of BotCam is approximately 60 x 20 x 10 cm of steel anchor chain or steel plates, or 1 x 1 x 1 m of concrete blocks. The steel or concrete footprint of the BotCam is used to steady the stereo-video system during recording. Generally, the weights are recovered with the BotCam, however, if the weights get snagged on the substrate or otherwise cannot be recovered safely, then an acoustic release is used to recover the instrument and the weights are left on the seafloor. ARMS and ADCPs are secured to the substrate using stainless steel stakes or two 81 x 8 x 5-cm weights each. BMUS and CAUs are attached to a single 1.25 x 30-cm stainless steel stake and installed into the substrate while avoiding corals. STRs, PUCs, and SEAFETs/SAMIs are each anchored with two 3-lb coated weights and strapped to a dead portion of the reef with cable ties. Given the very small areas affected by these stationary bottom-contact gears (<0.01% of the project area), the extent of the impacts would be considered local and the magnitude of impacts would be considered minor. The steel, concrete, or coated steel weights are environmentally benign and would have a minor impact to infauna or epifauna. The concrete would slowly break down into smaller and smaller concrete pieces, while the steel would slowly rust. Given the small size, the weights and the unlikely event that a steel weight would be left on the seafloor, the addition of small amount of iron to the marine environment would be considered minor adverse.

Research fishing gear and instruments tethered to the surface can also accidentally be lost during surveys if it snags on the bottom and the line breaks. This gear (e.g., monofilament line, braided polypropylene line) can later end up getting caught on the fringing reefs that surround most of the islands. Once derelict fishing gear is caught on a reef, it begins a damaging cycle of: snagging coral colonies, dislodging pieces of coral heads during wave action, breaking free, and snagging a different part of the reef (Donohue et al. 2001, PIFSC 2010). The extent of adverse direct and indirect impacts will vary with the type and size of the derelict fishing gear. PIFSC does not use the most damaging types of gear (e.g., gill nets, bottom trawl nets).

During the Marine Debris Research and Removal Surveys, derelict fishing gear is cut, pulled, or both, off coral colonies. Using the protocol described in 2.2.1.5, the removal activities are designed to mitigate long-term adverse impacts to coral colonies. However, during removal activities, there are short-term and temporary adverse impacts when derelict fishing gear is removed. The impacts include breaking off pieces of coral that are sometimes impossibly entangled in nets and line, and then removing them from the marine ecosystem. The long-term beneficial impact of removing derelict fishing gear from the marine ecosystem is to provide the space and light necessary for the coral colonies to grow and avoid entangling other marine species in the future.

Physical damage from coral coring would be limited in size to the area affected by the 4 x 100-cm drill bit used for collection of coral cores. Cores would be collected only from coral colonies of sufficient size and in good health. After extracting the core, an exact fit cement plug and underwater epoxy would seal the hole created by removing the core, which would prevent invasion of the colony by bioeroding species and would facilitate coral tissue growth. These cement plugs provide a surface over which surrounding coral tissue can grow, and in many cases colonies show no sign of coring in the coral tissue within 6 months of extraction (PIFSC pers. comm. 2014). Therefore, physical damage from coral coring activities would be limited to small areas and would recover in a short period of time.

4.2.7.2 Directed take of Coral Specimens

Directed take of coral specimens under the Status Quo Alternative would occur during the Deep Coral and Sponge Research Survey and RAMP Survey (see Table 2.2-2).

The Deep Coral and Sponge Research Survey collects small pieces of coral for DNA samples, voucher specimens, and paleoclimate samples. DNA specimens are comprised of small pieces of coral less than 1 percent of the total colony size and a total weight of approximately 0.02 lbs. per year. Voucher specimens may consist of an entire coral branch and total less than 1.1 lbs. per year. Paleoclimate samples consist of the stem/branch close to the base of the coral and total less than 4.4 lbs. per year. No ESA-listed corals would be collected during the Deep Coral and Sponge Research Survey. Together, these coral samples comprise a small percentage of the total population of coral colonies.

The RAMP Survey collects up to 500 samples per year of corals (including ESA-listed species), coral products, algae and algal products, and sessile invertebrates. The smallest possible fragments of corals are collected. ESA coral taxa would be collected as sparingly as possible and would never exceed more than 10 samples per taxon per cruise. Voucher samples would be small (2 cm x 2 cm) and would only be collected from well-established colonies using gloved hands or hammer and chisel with tools bleached between uses.

NMFS has conducted section 7 consultations related to the PIFSC RAMP Survey in the ASARA and WCPRA and issued a BiOp on the effects of these surveys on ESA-listed corals (NMFS 2015). The BiOp concluded that directed take and voucher specimens of *Acropora jacquelineae*, *Acropora retusa*, *Acropora rudis*, *Acropora speciosa*, *Euphyllia paradivisa*, *Isopora crateriformis*, and *Pavona diffluens* as part of the RAMP Survey in the ASARA and WCPRA is not likely to jeopardize the continued existence of any of these species. The overall impact from directed take of coral specimens may result in minor adverse effects on coral only due to a small amount being collected. However, there would be no adverse effects on coral populations. As described in Section 2.3 PIFSC has initiated consultation with PIRO regarding all effects of their fishery research program on all ESA-listed species (including corals) and their critical habitat that could be affected.

4.2.7.3 Mortality from Fisheries Research Activities

Mortality from fisheries research activities in the PIFSC research areas under the Status Quo Alternative would be limited to the above surveys which perform directed take of corals, and the Northwestern Hawaiian Islands Lobster Survey.

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring these relative effects is difficult because there are very few species for which total populations have been estimated with any degree of certainty. To assess the magnitude of mortality effects in this PEA, the amount of invertebrates caught in PIFSC research is compared to the amount caught in commercial fisheries, which is well known. Because commercial harvest limits are set at a fraction of estimated population, the magnitude of research catches relative to overall population levels would be much less than what is indicated in the comparisons with commercial landings.

Total directed take of corals from the Deep Coral and Sponge Research Survey is less than 5.5 lbs. per year under the Status Quo Alternative. Commercial harvest data of corals is only available for Hawaiʻi during 2012-2013, where average annual catch was 1,874 lbs. Research landings would therefore be less than 0.3 percent of commercial landings for all coral species taken during this research survey. Captured lobsters during the Northwestern Hawaiian Islands Lobster Survey are generally released alive, but some may be retained for additional research and nutritional analysis. This survey was most recently conducted from 2007 to 2009 and resulted in approximately 100 retained lobsters per year (spiny and slipper lobsters). Commercial harvest of lobsters during this same time period averaged 9,553 lbs. per year. With an average weight of approximately 1.5 lbs. per individual (Uchida and Hida 1976), total research landings of lobsters account for 1.6 percent of commercial landings. A small variety of other invertebrates are collected ad hoc (e.g., urchins, sea cucumbers, sea stars), but total less than 100 individuals of each species per year.

Chambered nautilus were listed as threatened in 2018 (83 FR 48976). While chambered nautilus may be caught as bycatch in some Indo-Pacific deep-sea fisheries (i.e., in the Philippines, India, Papua New Guinea (82 FR 48948), the likelihood of PIFSC research incidentally catching chambered nautilus is considered extremely low based on the low volume of research, short duration and disperse nature of surveys. Giant clams were petitioned to be listed under the ESA in 2016; status reviews of 7 of the 10 species petitioned for listing is ongoing (82 FR 28946). Bycatch of this species in PIFSC research is not anticipated and therefore potential effects would likely be negligible.

Overall, the amounts of invertebrates removed as a result of PIFSC research activities under the Status Quo Alternative would be small relative to commercial catches and even smaller relative to the estimated populations of these invertebrates.

4.2.7.4 Changes in Species Composition

Massive removals of marine invertebrate species from an ecosystem could potentially alter community structure and predator-prey relationships at possibly unsustainable levels (Donaldson et al. 2010). Commercially important invertebrate species are managed under FMPs with the management intent to harvest at rates that promote optimal yield, with an increasing emphasis on taking ecosystem considerations into account when setting harvest levels. In commercial fisheries, bycatch is either returned to the sea or landed if it has adequate commercial value and is allowed by the appropriate FMP. Bycatch can be minimized through gear and operational modifications, including localized geographic or seasonal fishing closures.

Changes in the species composition of benthic invertebrates are likely affected most by bottom trawling gear than all other gear types. It is important to note that surveys conducted by PIFSC are limited to surface and midwater trawls, which do not directly interact with the benthos. No fishing gears would be intentionally dragged along the sea-floor under any of the research alternatives. Deployments of the previously discussed stationary bottom-contact gear (e.g., lobster traps, ARMS) are not expected to alter species composition due to the small footprint created by these gear types.

4.2.7.5 Contamination or Degradation of Habitat

Fisheries research activities involving gear that contacts the sea floor can physically disturb benthic habitat used by invertebrate species. Such effects can include furrowing and smoothing of the sea floor (Morgan and Chuenpagdee 2003). Physical effects to the sea floor from bottom-contact fishing gear increases with increasing frequency, duration, and footprint size.

However, many research surveys conducted by PIFSC are stratified random designs, meaning the exact location of bottom-contact gear is randomly determined each year within an area of interest. Repeated gear deployments in the same location are rare or infrequent. The footprint of bottom-contact gear is also very small (see above discussion of physical damage to infauna and epifauna). Therefore, effects to invertebrate habitat from research surveys are expected to be minor in magnitude and short-term in duration, especially compared to the magnitude of habitat disturbance caused by commercial fishing operations.

The potential for research vessels to cause degradation of benthic and pelagic habitat through contamination would only be through accidental spills and discharges, which would likely be limited in magnitude, rare, and localized for the reasons described in Section 4.2.3.

4.2.7.6 Conclusion

PIFSC fisheries research conducted under the Status Quo Alternative could have direct and indirect effects on many invertebrate species through physical damage to infauna and epifauna, directed take of coral specimens, mortality, changes in species composition, and contamination or degradation of habitat.

For all invertebrate species targeted by commercial fisheries and managed under FMPs, mortality due to research surveys and projects is less than two percent of commercial and non-commercial harvest and is considered to be minor in magnitude for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities and the risk of altering benthic community structure would be minimal. Disturbance of animals and benthic habitats from research activities would be temporary and minor in magnitude for all species. As described in Section 4.2.1, the potential for accidental contamination of marine habitats from accidental spills from research vessels is considered unlikely and would be minor in magnitude and temporary or short-term in duration. The overall direct and indirect effects of the Status Quo Alternative on invertebrates would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

In addition to these adverse effects, the Status Quo Alternative would contribute to long-term beneficial effects on invertebrate species throughout the Pacific Islands Region through the contribution of PIFSC fisheries and ecosystem research. Specifically, the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing and planning conservation strategies, and detecting ecosystem shifts.

4.2.8 Effects on the Social and Economic Environment

Section 3.3 describes the interaction of PIFSC with the social and economic environment of the Pacific Island region. This section describes the effects of PIFSC-affiliated fisheries and ecosystem research conducted under the Status Quo Alternative on socioeconomic resources of the PIFSC research areas. Major factors that could be influenced by the PIFSC research program include:

- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries research
- Fulfillment of legal obligations specified by laws and treaties

4.2.8.1 Effects of the Status Quo Alternative on Cultural Resources

Under the Status Quo Alternative, PIFSC would continue existing research operations, at current levels and using current research methods. The Section 106 process is designed to help guide federal agencies in making decisions about the identification and treatment of cultural resources including shipwrecks, burial sites, and fishponds. Known locations of shipwrecks, burial mounds, and fishponds are typically found onshore, or away from research activity areas and are avoided based on best available information. As outlined in Section 2.1, PIFSC research activities would occur primarily away from shorelines with limited research activities occurring in the nearshore environment. As with current surveys, PIFSC research activities would avoid cultural or maritime heritage resources based on areas of known sites, including historic properties, shipwrecks, burial sites, and fishponds. Activities occurring in the nearshore environment and in proximity to known cultural resources could potentially include randomized PIFSC surveys conducted as part of the RAMP and marine debris research and removal efforts. As identified in Table 2.2-1, these research activities utilize survey techniques and activities unlikely to affect known cultural resources. Furthermore, the free divers and SCUBA divers used in these surveys to install instruments and carry out visual surveys are highly trained and proficient divers capable of avoiding known sites in the water, as well as sites that may appear to be historic sites. Due to the small number of cultural resources and limited research activities that occur in the nearshore environment, the Status Quo Alternative would have negligible effects on archaeological or cultural resources listed or eligible for listing on the NRHP.

While not formally protected under Section 106, living marine resources can be of cultural importance to many indigenous persons residing in the Pacific Island Region and include the human relationship with marine life and use of marine resources for dietary or other purposes. Examples of culturally important marine resources within the PIFSC research areas include sea turtles and sharks. Further descriptions of potential impacts to these resources under the Status Quo alternative can be found in Section 4.2.4 for sea turtles and Section 4.2.3 for highly migratory species such as sharks. Mitigation measures and policies for avoiding impacts to marine resources can be found in Section 2.2.1. While historically there has been no turtle catch associated with PIFSC survey efforts, culturally important resources have the potential to be impacted by PIFSC research activities. These resources include contemporary cultural use areas used by designated fishing communities (see Section 3.3.1). The Status Quo Alternative has the potential to affect marine resources important to fishing communities; however, direct impacts would be minimal in magnitude, restricted to local geographic areas and temporary due to the intermittent duration of research activities. As an indirect beneficial effect, fisheries research would be used to inform forecasting future productivity and setting harvest limits, thus facilitating the long-term use of marine resources important to fishing communities.

The Status Quo Alternative assumes that potential direct adverse effects of PIFSC would continue to occur infrequently and would not be located near identified historic properties and to a limited extent in areas with contemporary cultural use. Therefore, research activities would continue to affect a large geographical area, but any potential impacts would be local, low intensity, and not expected to impact historic and contemporary cultural resources important to Pacific Island peoples. Overall, the Status Quo Alternative would have negligible to no direct or indirect effect on historical properties or contemporary cultural resources with at most minor beneficial direct and indirect effects on cultural resources and contemporary cultural practices within the affected environment.

4.2.8.2 Collection of Scientific Data used in Sustainable Fisheries Management

The PIFSC fisheries research program has the most potential to affect the social and economic environment through its contribution to the fisheries management process. The MSA, as amended by the Sustainable Fisheries Act, establishes a collaborative fisheries management process with key roles for NMFS. Under the MSA, FMPs must contain conservation and management measures which prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery. The MSA defines optimum yield as:

A. The amount of fish which will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

B. Is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and

C. In the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

Among other considerations, FMPs must also contain provisions to conserve EFH, minimize bycatch and the mortality of bycatch, and provide for the sustained participation of fishing communities while minimizing adverse economic impacts on them, to the extent practicable and consistent with conservation aims and requirements. In carrying out Congress's mandate under the MSA, NOAA Fisheries is responsible for ensuring that management decisions involving fishery resources are based on the highest quality, best available scientific information on the biological, social, and economic status of the fisheries.

Under the Status Quo Alternative, the long-term, standardized resource surveys conducted by PIFSC and its cooperative research partners, as summarized in Table 2.2-1, provide a rigorous scientific basis for the development of fisheries stock assessments and federal fishery management actions in the Pacific Island Region. The extended time-series of data helps identify trends that inform fisheries management planning. This information is essential to establishing annual species-specific sustainable harvest limits on an optimal yield basis.

Many of the Status Quo research surveys also provide important comparative information on open, managed, and closed fishing areas, such as the differences between recovery rates, biodiversity, and species density that is vital to assessing the success of fisheries management measures. PIFSC fisheries research also provides information on ecosystem characteristics that is essential to management of commercial fisheries. Climate change and increase in ocean acidification have the potential to impact the population and distribution of marine species. Long-term, predictable marine research provides information on changes to and trends regarding the marine ecosystem that must be considered by fisheries managers. In addition to the long-term PIFSC research surveys, short-term research projects conducted by cooperative research partners, as described in Table 2.2-2, address strategic issues important to the commercial fishing industry, such as the development and monitoring of current and emerging fisheries, habitat characterization and conservation, development of ecosystem management methods, and ways to reduce bycatch of non-target species. The scientific information provided by PIFSC is therefore used not just for current management decisions, but also to conserve resources and anticipate future trends, ensure future fishing utilization opportunities, and assess the effectiveness of the agency's management efforts.

Scientific data provided through the long-term and short-term fisheries research conducted and associated with PIFSC has played an important role in the development of fisheries and conservation policies through informing the fisheries management process.

4.2.8.3 Economic Support for Fishing Communities of Hawai‘i and Pacific Island Territories

One of the ways PIFSC research activities support the social and economic environments is through its role in providing the science used by regulators to manage the commercial and non-commercial fisheries in the Pacific Island region. Within the PIFSC research regions, the HARA makes up the largest economic base. In 2012, commercial anglers in Hawaiʿi earned $92 million from their commercial harvest, landing over 27 million lbs. of finfish and shellfish. In 2012, commercial fishermen in the Pacific Island Region, including the areas of the HARA, MARA, ASARA, and WCPRA, landed 31 million lbs. of fish, earning $112 million in landings revenue. Overall in 2011, Hawai‘i's commercial fishing and seafood industry generated $694 million in sales impacts, $213 million in income impacts, and approximately 8,600 full- and part-time jobs (NMFS 2012). In that same period, 87,000 recreational anglers took 1.4 million trips. Overall, recreational fishing in Hawai‘i generated 2,861 thousand jobs, $284,912 thousand in expenses, $118,815 thousand in income, and $186,196 thousand in value added (Table 3.3-4).

Social and economic data collection and analysis in the Pacific Islands allows for determination of the relative social and economic impacts of a set of proposed management alternatives. This type of information is also important for compliance with EO 12898 on environmental justice, which directs agencies to assess actions that may disproportionately affect low income and minority populations. Where conservation outcomes are similar, NMFS attempts to choose alternatives with the most positive or, at a minimum, least negative social and economic impact on fishermen, the fishing industry, related shoreside industries, and fishing communities.

Another way PIFSC contributes to the social and economic environments is through direct expenditures on fisheries research. While breakdowns for each of the individual research areas budgets and employment statistics outside of the HARA are not currently available, PIFSC's annual budget fluctuates, but has averaged around $29.2 million for fiscal year 2010-2012 (Pooley 2013). However, data is available for the territories of American Samoa, CNMI, and Guam with total revenues for these regions being estimated at around $9.9 million altogether (WPFIN 2013c). This spending has direct and indirect beneficial economic effects on the communities and ports in the Pacific Island Region through expenditures in support of NOAA vessels, chartered vessels, and research facilities as well as providing employment and contracted services that contribute to local economies. Similarly, in addition to benefits of social and economic research to the fisheries management enterprise, PIFSC supplies contracts and grants to individual social science researchers and to academic and other institutions throughout the Pacific Islands that conduct social science research on how humans impact and are impacted by ecosystems, climate change, interactions with protected species, and other issues.

The magnitude of the economic impacts of PIFSC fisheries research activities must be placed in the context of regional and local economies according to the impact criteria in Table 4.1-1. While the contribution of research-related employment and purchased services is undoubtedly important and beneficial for many individuals and families, the total sums spent for research are very small compared to the value of commercial and recreational fisheries in the area as well as the overall economy of those communities. The contribution of PIFSC research is relatively larger for some communities where the research is centered (i.e., Honolulu, Hawai'i) or where the fishing industry is a large component of the local economy and may be considerate moderate in magnitude for those communities, but the overall direct impact would be minor in magnitude for most communities. The economies of the MARA, ASARA, and WCPRA are typically smaller in scale, with a larger component of the overall economy coming from research activities for each of the research areas. These direct impacts would occur under the Status Quo Alternative, would affect numerous communities throughout the region, and would be long-term and beneficial. Overall, the beneficial economic impacts of PIFSC fisheries research activities would be considered minor to moderate according to the impact criteria in Table 4.1-1.

There are certainly indirect impacts of fisheries research to the economic status of fishing communities but these impacts are filtered through a long and complicated fisheries management environment. It is not possible to assign a monetary value to these indirect impacts although, as stated before, these impacts are generally considered beneficial to fishing communities through their contribution to sustainable fisheries management. In any case, fisheries management decisions by the FMCs and NMFS are subject to their own NEPA compliance processes where these types of economic impacts are analyzed in depth so they will not be assessed in this PEA.

4.2.8.4 Collaborations between the Fishing Industry and Fisheries Research

Under the Status Quo Alternative, the relationships that are being built between scientists and the fishing industry through collaborative research efforts would continue to serve as a vehicle for sharing knowledge and building mutual understanding and respect. As more members of the fishing industry become engaged in the research programs that ultimately feed into the development of fisheries management measures, there will be an increased level of public education and awareness about the basis for fishery regulatory changes. The participation of highly experienced and resourceful members of the fishing industry also leads to valuable advances in conservation engineering, which in turn results in more efficient fishing and fewer adverse effects on the marine environment. The PIFSC fisheries research program contributes to these objectives by providing rigorous scientific data for the development of fisheries stock assessments and federal fishery management actions in the Pacific Island Region. The survey data from PIFSC research surveys thereby provides the scientific basis for fisheries management in the region. As a result, many communities are directly affected by the fisheries research program and fisheries management.

4.2.8.5 Fulfillment of Legal Obligations Specified by Laws and Treaties

Chapter 6 provides a list of laws and treaties applicable to the PIFSC fisheries research program. These obligations include the 1996 amendment to the MSA, which requires assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007). The PIFSC fisheries research programs in the HARA, MARA, ASARA, and WCPRA help fulfill these obligations under the MSA for the Pacific Island Region.

4.2.8.6 Conclusion

PIFSC-affiliated fisheries and ecosystem research conducted under the Status Quo Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate levels. It also contributes directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and non-commercial fishing interests, and helps fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Status Quo Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the Pacific Island Region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Status Quo Alternative on the social and economic environment would be minor to moderate and beneficial.

4.3 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 2—PREFERRED ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 2 – Preferred Alternative on the physical, biological, and social environment. Under this Alternative, PIFSC would conduct a new suite of research activities, expand on several of the Status Quo research activities, eliminate other Status Quo research alternatives, and implement new mitigation measures in addition to the Status Quo program to comply with the MMPA and ESA compliance process. The new suite of research activities is a combination of past research and additional, new research. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all resource components evaluated under the Preferred Alternative is presented below in Table 4.3-1.

Table 4.3-1 Preferred Alternative Summary of Effects

Resource	Physical Environment	Special Resource Areas and EFH	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	**4.3.1**	**4.3.2**	**4.3.3**	**4.3.4**	**4.3.5**	**4.3.6**	**4.3.7**	**4.3.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *advers e*	Minor *adverse*	Minor *advers e*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.3.1 Effects on the Physical Environment

The effects of the Preferred Alternative on the physical environment would be similar to those of the Status Quo Alternative (Section 4.2.1). For example, new bottom-contact instruments with updated technologies (e.g., MOUSS) have very similar effects (usually with a smaller footprint) as the previous generation instruments (e.g., BotCam). The additional mitigation measures for protected species proposed under the Preferred Alternative would not change the effects of the research activities on physical properties of the environment. The changes to the suite of research activities conducted under the Preferred Alternative would result in minimal changes to the physical effects to the benthic environment relative to the Status Quo Alternative. Therefore, the overall effects of The Preferred Alternative on the physical environment would be minor in magnitude. Small areas (much less than one percent of each research area) would be impacted, and the areas of impact would be dispersed over a large geographic area. Low intensity impacts resulting from the disturbance of organisms that produce structure could persist for several months, however impacts resulting in measurable changes to the physical environment would be temporary and the intensity of impact would decrease with the passage of time. In general, any measurable alterations to benthic habitat would recover within several months through the action of water currents and natural sedimentation. Overall impacts would be considered minor adverse according to the impact criteria in Table 4.1-1, with a minor long-term beneficial impact from continued removal of derelict fishing gear during the Marine Debris Research and Removal Surveys.

4.3.2 Effects on Special Resource Areas and EFH

The effects of the Preferred Alternative on special resource areas would be similar to those of the Status Quo Alternative (Section 4.2.2). The additional mitigation measures for protected species proposed under the Preferred Alternative would not change the effects of the research activities on the physical components of the environment or most biological components; they would only tend to decrease effects on protected species. The changes to the suite of research activities conducted under the Preferred Alternative would result in minimal changes to the physical and biological effects to special resource areas relative to the Status Quo Alternative. Therefore, the overall effects of The Preferred Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1. As was the case for the Status Quo Alternative, the scientific data generated from PIFSC research activities under the Preferred Alternative would also have beneficial effects on special resource areas, including MNMs, NMSs, and other MPAs through their contribution to science-based conservation management practices. In a letter dated August 30, 2016, ONMS provided specific recommendations to PIFSC regarding research alternatives and mitigation measures to be undertaken to minimize potential effects on NMSs as part of the Section 304(d) consultation under NMSA (see Section 1.3). The Preferred Alternative and mitigation measures has been developed considering the ONMS recommendations to avoid and minimize effects on NMSs. Table 1 of the 2016 ONMS consultation letter also provides a list of the NMS areas where PIFSC research may occur (see Table 1 of the ONMS letter). As described in Section 3.1.2.1, EFH includes hard bottom structures underlying the waters and associated biological communities. These biological communities include corals, seagrass, algae, and mangroves. Effects to these biological communities under the Preferred Alternative are evaluated in Section 4.3.7.

4.3.3 Effects on Fish

PIFSC fisheries research conducted under the Preferred Alternative would have the same types of effects on fish species as described for the Status Quo Alternative (Section 4.2.3) through mortality, disturbance, and changes in habitat. There are small changes in the research projects conducted under the Preferred Alternative (Table 2.3-1) that could affect the catch rate or species of fish caught relative to the Status Quo Alternative, including:

- Elimination of Northwestern Hawaiian Islands Lobster Survey
- Elimination of Northwestern Hawaiian Islands Bottomfish Survey
- Elimination of Pelagic Longline Hook Trials
- Elimination of Longline Gear Research Surveys
- Elimination of Marlin Longline Surveys
- Increase in geographic scope and in number of annual operations of Insular Fish Abundance Estimation Comparison Survey
- Addition of Pelagic Troll and Handline Sampling Survey
- Addition of hook-and-line gear to Kona Integrated Ecosystem Assessment Cruises
- Addition of Sampling of Juvenile-stage Bottomfish via Settlement Traps Survey
- Addition of Pelagic Longline, Troll, and Handline Gear Trials Survey

Several other projects also either add or subtract video camera equipment, UAS gear, plankton sampling, scuba divers, or other minor gears that would not affect catch of fish. None of the differences between the Preferred Alternative and the Status Quo Alternative would substantially change the potential impacts of research on benthic habitat or the risk of accidental contamination. These potential effects were considered minor adverse under the Status Quo Alternative because of their relatively low magnitude, dispersal over time and space, and, in the case of contamination, the small risk of occurrence (Section 4.2.3). These types of effects would also be considered minor adverse under the Preferred Alternative for the same reasons. The following discussion will therefore focus on potential effects through mortality of fish.

4.3.3.1 ESA-listed Species

No ESA-listed fish species have been caught under the Status Quo Alternative. The overall net effort of troll and longline operations would be reduced under the Preferred Alternative from 130 operations to 70 operations per year, further reducing the likelihood of catch. Given the lack of historical takes coupled with decreased fishing effort, the potential for future takes under the Preferred Alternative is considered small and unlikely to affect the population of any ESA-listed fish species. The effects of the Preferred Alternative are therefore considered minor adverse based on the criteria in Table 4.1-1.

As reported in Benaka et al. (2019), based on 2014 data, fishery bycatch estimates were 10.94 M lbs. for the Hawai‘i Deep-Set Fishery, 604,251 lb for the Hawai‘i Shallow-Set Fishery and 752,135 lbs. for the American Samoa Deep-Set Fishery. Bycatch of oceanic whitetip sharks in commercial fisheries were rare based on the ratios of bycatch of this species in relation to the frequency of the catch (Benaka et al. 2019). Similar bycatch ratios were reported for 2015 (Benaka et al. 2019). Based on this information and considering the relatively low volume of research when compared to commercial fisheries, bycatch of oceanic whitetip sharks in PIFSC research is considered low. The effects of the Status Quo Alternative on these species are therefore considered minor adverse based on the criteria in Table 4-1.1.

Under the preferred Alternative, PIFSC is proposing to tag or tissue sample oceanic whitetip sharks that are caught as bycatch in the MHI small-boat tuna fishery to identify best practices when releasing sharks incidentally caught in these fisheries. The project would support research activities on the threatened oceanic whitetip shark (*Carcharhinus longimanus*) to improve understanding of habitat use, movement behavior and fishery interaction rates. Approximately 50 (approximately 30 from the MHI small boat tuna fishery and approximately 20 from commercial fisheries in the central and western Pacific) sharks would be affixed with satellite tags or undergo tissue sampling per year for the next 5 years. All individuals involved with tagging efforts (fishers, fishery observers, and scientists) involved in the program would attend a training workshop and may be provided with materials such as tagging poles, electronic and identification tags, data cards and training documents. No additional oceanic whitetip sharks would be targeted beyond those incidentally caught in the fishery as bycatch. The tagging effort is currently undergoing formal ESA consultation, and a Biological Evaluation was prepared in 2020 (NMFS 2020). The same tagging methods would be used in all fisheries where oceanic whitetip sharks may be incidentally caught, and while research activities are not expected to result in M&SI, individuals will be exposed to stress resulting from handling, tagging, and tissue sampling post-capture (NMFS 2020). These activities would be likely to have an adverse effect on these ESA-listed sharks. However, because research activities will not result in serious injury or mortality, any adverse effects would not result in a reduction in numbers or reproduction that would contribute to the jeopardy of the species (NMFS 2020). As described in Section 2.3 on Sept 8, 2021, PIFSC has initiated ESA section 7 consultation for all fishery research activities.

As described for the Status Quo/No Action, demand for manta ray gills and other manta ray products parts in Asian markets is the most significant threat for this species (Oliver et al. 2015 as cited in Miller and Klimovich (2017). U.S. bycatch of manta rays from fisheries operating primarily in the central and western Pacific Ocean, includes the U.S. tuna purse seine fisheries, Hawaiʻi-based DSLL fisheries for tuna, and American Samoa pelagic longline fisheries. Estimates of M. birostris (i.e., Giant manta rays) bycatch in the U.S. tuna purse seine fishery (1.69 mt in 2015) (Secretariat of the Pacific Community, unpublished data, 2016), Hawaiʻi-based DSLL (0.20 mt in 2013) (Miller and Klimovich 2017), and American Samoa pelagic longline fisheries (0.32 mt in 2013), are low and therefore impacts on the giant manta ray are likely to be minimal (Miller and Klimovich 2017). Considering the distribution and volume of PIFSC research is much lower than commercial fisheries, giant manta rays are not likely to be caught incidentally as bycatch during PIFSC surveys.

However, under the Preferred Alternative, PIFSC is proposing to tag, track and biologically sample giant manta rays that are caught as bycatch during commercial fishing operations in the western and central Pacific Ocean. The research would assess post-release mortality rates and identify handling and dispatch methods that would improve survival rates for the species. Annually, approximately 30 rays would be affixed with satellite tags and/or undergo tissue sampling for the next 5 years. PIFSC would direct the research and would conduct training fishery observers to tag, photograph, collect tissue samples and/or collect interaction data from giant manta rays captured incidentally during fishing. PIFSC prepared a Draft Biological Evaluation for this research project in 2021 (NMFS 2021). While research activities are not expected to result in mortality or serious injury, individuals would be exposed to some stress resulting from handling, tagging, and tissue sampling post-capture (NMFS 2021). These activities would be likely to have an adverse effect on ESA-listed giant manta rays. However, because research activities would not result in serious injury or mortality, any adverse effects would not be likely to have a measurable impact on the population as a whole, nor appreciably threaten the survival of manta within their range (NMFS 2021). Therefore, PIFSC research would have a minor adverse effect on giant manta rays.

4.3.3.2 Target and Other Fish Species

<u>Mortality from Fisheries Research Activities in the HARA</u>

Under the Preferred Alternative, the Northwestern Hawaiian Islands Bottomfish Surveys (hook-and-line gear with 256 operations per year) is not carried forward. New surveys or modified surveys in the HARA that may catch fish include the Sampling of Juvenile-stage Bottomfish via Settlement traps Survey (up to 60 lines of traps per year), the addition of a midwater trawl to the Cetacean Ecology Assessment Survey (90 trawls per year), and addition of hook-and-line gear to the Kona Integrated Ecosystem Assessment Cruise (50 hours of total soak time per year).

The new Pelagic Troll and Handline Sampling Survey may increase catch. Since this survey has not been deployed previously, it is difficult to know how much and what types of fish may be caught. However, based on the type of gear being used and the planned amount of effort, PIFSC has estimated potential catch of pelagic species (Boggs pers. comm. 2015). Catch estimates of these species have been added to Status Quo average annual catches of these species to estimate potential future catches under the Preferred Alternative, with totals shown in Table 4.3-2.

For the Insular Fish Abundance Estimation Comparison Survey, there is a substantial increase in the number of operations in the HARA. The Status Quo Alternative includes 540 drops per year whereas 7,680 drops per year are planned under the Preferred Alternative, an increase of more than 14 times the original number of deployments. It is likely that this increase in effort will translate to a corresponding increase in catch and may result in additional species being caught besides the Deep-7 species this survey has traditionally caught. Survey design parameters indicating spacing between drop locations, depth, water temperature, and other variables would influence species and number of fish caught. For the purpose of this PEA, it is assumed that a 14-fold increase in gear deployments will translate to a 14-fold increase in catches of historic fish species. This increase is captured in Table 4.3-2.

Table 4.3-2 provides an analysis of the impact of research catch under the Preferred Alternative. The combined estimated catch from surveys in the HARA is compared to recent ACLs and commercial catch, as was done for the Status Quo Alternative analysis (Table 4.2-1). These data indicate that for all species the average amount of fish mortality under the Preferred Alternative would be less than one percent of ACLs or of commercial catches. For these species, the magnitude of research mortality is small relative to the fisheries and even smaller relative to the estimated populations of these fish. For all target species in the HARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Preferred Alternative.

For all research areas, research data is necessary for monitoring the status of stocks of conservation concern and to determine if management objectives for rebuilding those stocks are being met. Fisheries managers typically consider the estimated amount of research catch from all projects along with other sources of mortality (e.g., bycatch in other fisheries, predation) before setting commercial fishing limits to prevent overfishing of stocks or to help overfished stocks rebuild. The amount of fish that are likely to be caught in various research projects is often estimated and incorporated into the fishery management process during annual reviews of research proposals, which would continue to occur in the future under the Preferred Alternative. These annual reviews would also determine whether the proposed projects were consistent with the NEPA analysis presented in the PEA or whether additional NEPA analysis was required (see Section 2.3.5).

Table 4.3-2 indicates that, while mortality to fish species under the Preferred Alternative is a direct effect of PIFSC HARA surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations for these species. In all cases, research catch in the HARA represents much less than one percent of the ACL or commercial catch. For all target species in the HARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Preferred Alternative.

Species are listed in descending order of estimated research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed

Table 4.3-2 Estimated Fish Caught under the Preferred Alternative Compared to ACLs or Commercial Catch in the HARA

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)[B]	2013 Commercial catch (lbs.)[C]	Estimated PIFSC catch compared to ACL or commercial catch (percentage)
Blue shark (*Prionace glauca*)	Not overfished	Pelagic MUS	597	N/A	138,423	0.43%
Amberjack (*Seriola* spp.)	Not overfished	Hawai'i Bottomfish MUS	327	193,423[D]	N/A	0.17%
Brown speckled eel (*Gymnothorax steindachneri*)	Unknown	Hawai'i CHCRT	238	142,282[D]	N/A	0.17%
Red snapper (*Etelis carbunculus*)	Not overfished	Hawai'i Deep 7 Bottomfish MUS	596	346,000[D]	N/A	0.17%
Longtail snapper (*Etelis coruscans*)	Not overfished	Hawai'i Deep 7 Bottomfish MUS	291	346,000[D]	N/A	0.08%
Sea bass (*Epinephelus quernus*)	Unknown	Hawai'i Deep 7 Bottomfish MUS	332	346,000[D]	N/A	0.10%
Pink snapper (*Pristipomoides filamentosus*)	Not overfished	Hawai'i Deep 7 Bottomfish MUS	117	346,000[D]	N/A	0.03%
Undulated moray (*Gymnothorax undulates*)	Unknown	Hawai'i CHCRT	189	142,282[D]	N/A	0.13%
Broadbill swordfish (*Xiphias gladius*)	Not overfished	Pelagic MUS	120	N/A	2,332,850	0.01%
Silky shark (*Carcharhinus falciformis*)	Unknown	Pelagic MUS	102	N/A	138,423	0.07%
Albacore tuna (*Thunnus alalunga*)	Not overfished	Pelagic MUS	483	N/A	828,487	0.06%

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)[B]	2013 Commercial catch (lbs.)[C]	Estimated PIFSC catch compared to ACL or commercial catch (percentage)
Bigeye tuna (*Thunnus obesus*)	Subject to overfishing, not overfished	Pelagic MUS	298	N/A	15,864,768	<0.01%
Skipjack tuna (Katsuwonus pelamis)	Not overfished	Pelagic MUS	100	N/A	1,114,756	<0.01%
Yellowfin tuna (*Thunnus albacares*)	Not overfished	Pelagic MUS	1470	N/A	3,686,695	0.04%
Dolphinfish (Coryphaena hippurus)	Unknown	Pelagic MUS	486	N/A	1,585,129	0.03%
Moonfish (*Lampris* spp.)	Unknown	Pelagic MUS	270	N/A	2,102,745	0.01%
Wahoo (*Acanthocybium solandri*)	Unknown	Pelagic MUS	270	N/A	878,640	0.03%
Striped marlin (*Tetrapturus audax*)	Subject to overfishing, overfished	Pelagic MUS	126	N/A	982,750	0.01%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. Available online: https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. 2014 ACL information from WPRFMC.

C. Commercial catch information compiled by Hawai‘i DAR and the Western Pacific Fishery Information Network. Available online: http://www.pifsc.noaa.gov/wpacfin/hi/dar/Pages/hi_data_3.php

D. This species is included in a MUS; catch is managed as a complex, in total, not by individual species. The ACL stated is for all species in the specified MUS.

Mortality from Fisheries Research Activities in the MARA

New surveys or modified surveys in the MARA that may catch fish include the Pelagic Troll and Handline Sampling Survey, the addition of a midwater trawl to the Cetacean Ecology Assessment Survey and expanded geographic scope of Insular Fish Abundance Estimation Comparison Surveys to include the MARA. The total effort under the Preferred Alternative would be up to 330 trawls, 880 hook-and-line operations, and 28 new pelagic troll and handline operations per year. This is almost 1.5 times the average level of effort for midwater trawling and four times the effort for hook-and-line gear under the Status Quo Alternative (240 trawls and 240 hook-and-line operations per year). Given the uncertainties about the scope and nature of research projects, there is no way to translate this programmatic increase in research fishing effort into quantitative estimates of catch without making some assumptions. For the purposes of this PEA analysis, the resulting mortality from fish catch is assumed to be 400 percent of the Status Quo Alternative for most species. This level of catch is likely to be substantially higher than what might actually occur and therefore provides a conservative estimate of the impacts of research.

The new Pelagic Troll and Handline Sampling Survey may increase research catch of some pelagic species caught in either very small amounts or not at all in past surveys. For these species (e.g., tunas, wahoo, mahimahi, sharks, and striped marlin), it is difficult to know how much and what types of fish may be caught. However, based on the area and type of gear being used and the planned amount of effort, PIFSC has estimated catch of these pelagic species (Boggs pers. comm. 2015) and added them to Status Quo average annual catches of these species to estimate potential future catches under the Preferred Alternative, with totals shown in Table 4.3-3.

Table 4.3-3 provides the same analysis of research catch relative to ACLs as the Status Quo Alternative (Table 4.2-3) but multiplies the catch from hook-and-line research by four. The combined estimated catch from surveys in the MARA is then compared to the recent ACLs as was done for the Status Quo Alternative analysis. For pelagic species which may not have ACLs, research estimates are compared to commercial catches. These data indicate that for most species the average amount of fish mortality is less than one percent of ACLs or commercial landings. For these species, the magnitude of research mortality is small relative to the fisheries and even smaller relative to the estimated populations of these fish. Four species have catch totals over one percent of ACLs or commercial landings: whitetip reef shark (1.03 percent), orangespine unicornfish (1.31 percent), yellowfin tuna (3.73 percent), and bicolor parrotfish (4.33 percent). While these catches represent a higher percentage of ACLs or commercial landings compared to other species, they still represent a small fraction of the total population. For all target species in the MARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Preferred Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed

Table 4.3-3 Estimated Fish Caught under the Preferred Alternative Compared to ACLs or Commercial Catch in the MARA

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)[B,C]	2013 Commercial catch (lbs.)[D]	Estimated PIFSC catch compared to ACL or commercial catch (percentage)
Longtail snapper (*Etelis coruscans*)	Not overfished	MARA Bottomfish MUS	2,324	294,800[E]	N/A	0.79%
Bicolor parrotfish (*Scarus rubroviolaceus*)	Unknown	MARA CHCRT	1,404	32,433[E]	N/A	4.33%
Orangespine unicornfish (*Naso lituratus*)	Unknown	MARA CHCRT	1020	77,586[E]	N/A	1.31%
Black jack (*Caranx lugubris*)	Not overfished	MARA Bottomfish MUS	720	294,800[E]	N/A	0.24%

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)[B,C]	2013 Commercial catch (lbs.)[D]	Estimated PIFSC catch compared to ACL or commercial catch (percentage)
Red snapper (*Etelis carbunculus*)	Not overfished	MARA Bottomfish MUS	552	294,800[E]	N/A	0.05%
Yellowtail snapper (*Pristipomoides auricilla*)	Not overfished	MARA Bottomfish MUS	460	294,800[E]	N/A	0.19%
Silver jaw jobfish (*Aphareus rutilans*)	Not overfished	MARA Bottomfish MUS	432	294,800[E]	N/A	0.15%
Bluefin trevally (*Caranx megalampys*)	Unknown	MARA CHCRT	412	66,889[E]	N/A	0.62%
Bluespine unicornfish (*Naso unicornus*)	Unknown	MARA CHCRT	323	77,586	N/A	0.42%
Yelloweye snapper (*Pristipomoides flavipinnis*)	Not overfished	MARA Bottomfish MUS	178	294,800[E]	N/A	0.06%
Humpnose big-eye bream (*Monotaxis grandoculis*)	Unknown	MARA PHCRT	148	93,034	N/A	0.16%
Whitetip reef shark (*Trianodon obesus*)	Unknown	MARA CHCRT	129	12,542	N/A	1.03%
Snapper (*Pristipomoides zonatus*)	Not overfished	MARA Bottomfish MUS	656	294,800[E]	N/A	0.22%
Pink snapper (*Pristipomoides filamentosus*)	Not overfished	MARA Bottomfish MUS	1022	294,800[E]	N/A	0.35%
Longnose Emperor (*Lethrinus olivaceus*)	Unknown	MARA PHCRT	123	93,034	N/A	0.13%
Blue shark (*Prionace glauca*)	Not overfished	Pelagic MUS	180	N/A	N/A	N/A
Silky shark (*Carcharhinus falciformis*)	Unknown	Pelagic MUS	450	N/A	N/A	N/A
Albacore tuna (*T. alalunga*)	Not overfished	Pelagic MUS	483	N/A	N/A	N/A
Bigeye tuna (*Thunnus obesus*)	Unknown	Pelagic MUS	298	N/A	N/A	N/A

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)[B,C]	2013 Commercial catch (lbs.)[D]	Estimated PIFSC catch compared to ACL or commercial catch (percentage)
Skipjack tuna (Katsuwonus pelamis)	Not overfished	Pelagic MUS	100	N/A	193,382	0.05%
Yellowfin tuna (*Thunnus albacares*)	Subject to overfishing, not overfished	Pelagic MUS	1470	N/A	39,372	3.73%
Dolphinfish (Coryphaena hippurus)	Not overfished	Pelagic MUS	243	N/A	134,234	0.18%
Wahoo (*Acanthocybium solandri*)	Not overfished	Pelagic MUS	135	N/A	33,060	0.41%
Striped marlin (*Tetrapturus audax*)	Unknown	Pelagic MUS	63	N/A	20,597	0.31%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. Available online: https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. 2014 ACL information from WPRFMC.

C. ACLs are listed separately for the CNMI and Guam. The ACL stated is combined for both regions to represent all of the MARA.

D. Commercial catch information is combination of data compiled by Guam DAWR, CNMI, and the Western Pacific Fishery Information Network. Available online: http://www.pifsc.noaa.gov/wpacfin/guam/dawr/Pages/gdawr_data_menu.php , and http://www.pifsc.noaa.gov/wpacfin/cnmi/Pages/cnmi_data_menu.php .

E. This species is included in a MUS; catch is managed as a complex, in total, not by individual species. The ACL stated is for all species in the specified MUS.

Mortality from Fisheries Research Activities in the ASARA

Similar to the activities in the MARA, new surveys or modified surveys in the ASARA that may catch fish include the Pelagic Troll and Handline Sampling Survey. A midwater trawl has been added to the Cetacean Ecology Assessment Survey and expanded geographic scope of Insular Fish Abundance Estimation Comparison Surveys to include the MARA, ASARA, and WCPRA. The total effort under the Preferred Alternative would be up to 130 trawls, 900 hook-and-line operations, and 28 new pelagic troll and handline operations per year. This is about three times the average level of effort for midwater trawling and almost four times the effort for hook-and-line gear under the Status Quo Alternative (240 trawls and 240 hook-and-line operations per year). Given the uncertainties about the scope and nature of research projects, there is no way to translate this programmatic increase in research fishing effort into quantitative estimates of catch without making some assumptions. For the purposes of this PEA analysis, the resulting mortality from fish catch is assumed to be 400 percent of the Status Quo Alternative for most species. This level of catch is likely to be substantially higher than what might actually occur and therefore provides a conservative estimate of the impacts of research.

The new Pelagic Troll and Handline Sampling Survey may increase research catch of some pelagic species caught in either very small amounts or not at all in past surveys. For these species (e.g., albacore, skipjack, striped marlin), it is difficult to know how much fish may be caught. However, based on the area and type of gear being used and the planned amount of effort, PIFSC has estimated catch of these pelagic species (Boggs pers. comm. 2015) and added them to Status Quo average annual catches of these species to estimate potential future catches under the Preferred Alternative, with totals shown in Table 4.3-4.

Table 4.3-4 provides the same analysis of research catch relative to ACLs as the Status Quo Alternative (Table 4.2-4) but multiplies the catch from hook-and-line research by four. The combined estimated catch from surveys in the ASARA is then compared to the recent ACLs or commercial catch landings as was done for the Status Quo Alternative analysis. These data indicate that for most species the average amount of fish mortality is less than one percent of ACLs or commercial catch landings. For these species, the magnitude of research mortality is small relative to the fisheries and even smaller relative to the estimated populations of these fish. Two species have catch totals over one percent of ACLs or commercial catches: great barracuda (1.78 percent) and blue shark (4.74 percent). While these catches represent a higher percentage of the ACLs or commercial landings compared to other species, they still represent a small fraction of the total population. For all target species in the ASARA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Preferred Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed

Table 4.3-4 Estimated Fish Caught under the Preferred Alternative Compared to ACLs or Commercial Catch in the ASARA

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)	2013 Commercial catch (lbs.)[B]	Estimated PIFSC catch compared to ACL or Commercial Catch (percentage)
Yellowfin tuna (*Thunnus albacares*)	Not Overfished	Pelagic MUS	1,920	N/A	901,323	0.21%
Wahoo (*Acanthocybium solandri*)	Unknown	Pelagic MUS	730	N/A	198,325	0.37%
Blue marlin (*Makaira mazara*)	Not Overfished	Pelagic MUS	480	N/A	67,557	0.71%
Silver jaw jobfish (*Aphareus rutilans*)	Not Overfished	ASARA Bottomfish MUS	380	101,000	N/A	0.38%
Longtail snapper (*Etelis coruscans*)	Not Overfished	ASARA Bottomfish MUS	350	101,000	N/A	0.35%
Great barracuda (*Sphyraena barracuda*)	Not Overfished	ASARA CHCRT	336	18,910	N/A	1.78%

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2014 ACL (lbs.)	2013 Commercial catch (lbs.)[B]	Estimated PIFSC catch compared to ACL or Commercial Catch (percentage)
Dolphinfish (Coryphaena hippurus)	Unknown	Pelagic MUS	192	N/A	41,948	0.46%
Bigeye tuna (*Thunnus obesus*)	Not Overfished	Pelagic MUS	180	N/A	187,954	0.10%
Blue shark (*Prionace glauca*)	Not Overfished	Pelagic MUS	164	N/A	3,477	4.74%
Albacore tuna (*T. alalunga*)	Not overfished	Pelagic MUS	483	N/A	4,678,485	0.01%
Skipjack tuna (Katsuwonus pelamis)	Not overfished	Pelagic MUS	100	N/A	162,307	0.06%
Striped marlin (*Tetrapturus audax*)	Subject to overfishing, overfished	Pelagic MUS	63	N/A	8,049	0.78%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. Available online: https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. Commercial catch information compiled by American Samoa DMWR and the Western Pacific Fishery Information Network. Available online: http://www.pifsc.noaa.gov/wpacfin/as/Pages/as_data_menu.php

Mortality from Fisheries Research Activities in the WCPRA

The reduced longline effort from 130 operations to 70 operations per year described in Section 4.3.3.1 would likely result in reduced mortality of target and other fish species throughout the WCPRA. Modifications to existing surveys include the addition of a midwater trawl to the Cetacean Ecology Assessment Survey and expanded geographic scope of Insular Fish Abundance Estimation Comparison Surveys to include the WCPRA. When considered with the reduced longline effort, the above-mentioned survey modifications would have a negligible effect on the overall fishing effort in the WCPRA.

The new Pelagic Troll and Handline Sampling survey may increase catch. Since this survey has not been deployed previously, it is difficult to know how much and what types of fish may be caught. However, based on the area and type of gear being used and the planned amount of effort, PIFSC has estimated potential catch of pelagic species (Boggs pers. comm. 2015). Catch estimates of these species have been added to Status Quo average annual catches to estimate potential future catches under the Preferred Alternative, with totals shown in Table 4.3-5.

Table 4.3-5 provides an analysis of the impact of research catch under the Preferred Alternative. The combined estimated catch from surveys in the WCPRA is compared to recent commercial catch, as was done for the Status Quo Alternative analysis (Table 4.2-4). In most cases, research catch in the WCPRA represents much less than one percent of the commercial catch. For thresher sharks, the average annual research catch is greater than 1 percent, and greater than 7 percent in the case of silky sharks. While this catch represents a higher percentage of commercial landings compared to other species, they still represent a very small portion of total populations.

Table 4.3-5 indicates that, while mortality to fish species under the Status Quo Alternative is a direct effect of the PIFSC WCPRA surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of commercial landings, which are just fractions of the total populations for these species. For all target species in the WCPRA, mortality from PIFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Preferred Alternative.

Species are listed in descending order of total research catch by weight. Only survey species with total catch greater than 100 lbs. or those that are overfished are listed.

Table 4.3-5 Estimated Fish Caught under the Preferred Alternative Compared to Commercial Catch in the WCPRA

Species	Stock Status[A]	Stock Complex	Estimated PIFSC catch per year under Preferred Alternative (lbs.)	2012 Commercial catch (lbs.)[B]	Estimated PIFSC catch compared to Commercial Catch (percentage)
Yellowfin tuna (*Thunnus albacares*)	Not Overfished	Pelagic MUS	3120	2,610,273	0.12%
Silky shark (*Carcharhinus falciformis*)	Unknown	Pelagic MUS	327	4,409	7.42%
Thresher sharks *(Alopias* spp.)	Unknown	Pelagic MUS	525	28,660	1.83%
Bigeye tuna (*Thunnus obesus*)	Not Overfished	Pelagic MUS	838	11,375,853	0.01%
Broadbill swordfish (*Xiphias gladius*)	Unknown	Pelagic MUS	348	2,008,411	0.02%
Albacore tuna (*T. alalunga*)	Not overfished	Pelagic MUS	483	8,265,130	0.01%
Skipjack tuna (Katsuwonus pelamis)	Not overfished	Pelagic MUS	100	1,064,833	0.01%
Blue shark (*Prionace glauca*)	Not overfished	Pelagic MUS	180	39,683	0.45%
Dolphinfish (Coryphaena hippurus)	Unknown	Pelagic MUS	243	773,823	0.03%
Moonfish (*Lampris* spp.)	Unknown	Pelagic MUS	135	981,057	0.01%
Wahoo (*Acanthocybium solandri*)	Unknown	Pelagic MUS	135	526,905	0.03%
Striped marlin (*Tetrapturus audax*)	Subject to overfishing, overfished	Pelagic MUS	63	593,043	0.01%

A. Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, Fourth Quarter 2014 Status of U.S. Fisheries. Available online: https://www.fisheries.noaa.gov/about/office-sustainable-fisheries

B. Commercial catch information from the Pelagic Fisheries of the Western Pacific Region 2012 Annual Report. Available online: http://www.wpcouncil.org/wp-content/uploads/2013/03/2012-Pelagics-Annual-Report_9-21-2014.pdf

4.3.4 Effects on Marine Mammals

The direct and indirect effects of the Preferred Alternative on marine mammals are very similar to those described for the Status Quo (Section 4.2.4). The Preferred Alternative is comprised of a combination of research activities continued from the past and additional, new research surveys and projects. The Preferred Alternative would not include several of the projects described in Table 2.2-1 under the Status Quo. Those surveys have been noted in Table 2.2-1 and include the following:

- The Northwestern Hawaiian Islands Lobster Survey
- The Northwestern Hawaiian Islands Bottomfish Survey
- Pelagic Longline Hook Trials
- Longline Gear Research Surveys
- Marlin Longline Surveys

The above longline projects will not continue to be supported by PIFSC under the Preferred Alternative, however, similar research continues to be conducted and funded by the Pacific Islands Regional Office through contracts with commercial fisheries. Any incidental takes resulting from such research would be authorized under sections of the MMPA dealing with commercial fisheries and incidental takes of protected species resulting from such research would be considered to be the result of the commercial fishery. The impacts of non-PIFSC research are included in the analysis of cumulative effects (Chapter 5.5) but are not considered further in this analysis of the Preferred Alternative.

Several new research surveys and projects have been added to the Preferred Alternative that were not included in the Status Quo Alternative and other existing research projects have been modified; these new projects and changes in existing projects are summarized in Table 2.3-1. Under the Preferred Alternative, the Cetacean Ecological Assessment surveys described under the Status Quo would include increased levels of effort and would be expanded to include all four of the research areas within the Pacific Islands Region.

Under this alternative, PIFSC would also apply for authorizations under the MMPA and the ESA for incidental take of protected species during these research activities. The Preferred Alternative includes several mitigation measures for protected species designed to reduce adverse impacts to marine mammals (visual monitoring, move-on rule, and gear modifications).

The following analysis draws heavily on the analysis provided under the Status Quo Alternative (Section 4.2.4) but focuses on the differences that may result from the new research elements and mitigation measures added under the Preferred Alternative.

The Preferred Alternative is the PIFSC research program and suite of mitigation measures that are being proposed in the MMPA LOA application (Appendix C of the 2015 Draft PEA). The analysis of effects in the LOA application was based primarily on the history of past environmental effects under the status quo conditions. However, especially with regard to mitigation measures for marine mammal interactions, the status quo reflects a dynamic situation in that PIFSC is continually monitoring their effects and exploring ways to effectively reduce and document those adverse interactions while fulfilling their mission to collect scientific information for fisheries and natural resource management. The Status Quo Alternative therefore reflects the mitigation equipment and procedures as they were implemented at the end of 2014 while the Preferred Alternative includes ongoing efforts to improve mitigation measures.

The potential effects of the Preferred Alternative on marine mammals involve adverse interactions with research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment, including:

- Disturbance and behavioral responses due to acoustic equipment
- M&SI due to vessel strikes
- M&SI due to interactions with research gear
- Changes in food availability due to research survey removal of prey and discards
- Contamination from discharges

These mechanisms of potential effects are discussed in the Status Quo Alternative (Section 4.2.4), most of which will not be repeated here. The mechanism for acoustic disturbance would be the same for the Preferred Alternative as it is for the Status Quo Alternative because there are no new acoustic sound sources that would be introduced, and no new mitigation measures are being proposed that would address potential effects due to acoustic disturbance. Although every species of marine mammal in the four research areas may be exposed to sounds from active acoustic equipment used in PIFSC research, many of the acoustic sources are likely not audible to many species and the others would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through any given area. The overall effects from acoustic disturbance are considered minor adverse for all species, in all four research areas.

The potential effects from changes in food availability and contamination are also considered to be minor adverse for all species of marine mammals in all four research areas in which PIFSC operates and will not be discussed further. The potential for PIFSC research vessels to accidentally strike marine mammals is also considered to be remote and would not differ from the risks presented under the Status Quo Alternative. The following discussion will therefore focus on the potential effects from entanglement or incidental capture in fishing gear used in PIFSC research under the Preferred Alternative.

4.3.4.1 ESA-listed Species

The ESA listed marine mammals that occur in PIFSC research areas include blue, fin, sei, sperm, false killer whale (only the MHI insular stock of false killer whales is ESA-listed), North Pacific right whales, and Hawaiian monk seals. All of these species are under the jurisdiction of NMFS in regard to compliance with the MMPA and ESA. There have been no entanglements of ESA-listed marine mammals in PIFSC fisheries research from NOAA vessels or NOAA chartered vessels. However, the LOA application (Appendix C of the 2015 Draft PEA) includes a request for authorization of potential M&SI takes due to entanglement or collision for one ESA-listed cetacean species (sperm whales) based on documented takes in analogous commercial and non-commercial fisheries. The take request includes one take over the five-year authorization period for sperm whales in longline gear due to entanglement in mooring lines during instrument deployment (Table 4.2-7). This take, if it actually occurred, would represent less than ten percent of PBR the species and would be considered minor in magnitude according to the impact criteria described in Table 4.1-1.

PIFSC considered the risk of interaction with marine mammals for all the research gears and instruments it uses but did not request incidental takes in research gears other than midwater trawls, longline, and instrument deployments. There is evidence that Hawaiian monk seals (and bottlenose dolphins) occasionally pursue fish caught on various hook-and-line gears (depredation of fishing lines) deployed in commercial and non-commercial fisheries across Hawaiʻi (Nitta and Henderson 1993). This depredation behavior, which is documented as catch loss from the hook-and-line gear, may be beneficial to the marine mammal in providing prey but it also opens the possibility for the marine mammal to be hooked or entangled in the gear. PIFSC gave careful consideration to the potential for including incidental take requests for marine mammals in bottom handline (bottomfishing) gear although it has not had any marine mammal interactions in the past while conducting research with bottomfishing gear in the MHI.

Fisheries in state waters are not observed by independent, trained monitors and therefore few data exist on interactions with marine mammals. A recently published preliminary summary of self-reported catch loss data from the State of Hawaiʻi Commercial Marine License reporting system indicates that the number of catch loss incidents by monk seals and dolphins in the MHI may be increasing but is still relatively rare (Boggs et al. 2015). The authors of the summary emphasize that the data received only cursory treatment and should not be viewed as comprehensive.

The population of monk seals in the MHI is relatively small (minimum abundance estimate in 2011 of 138 seals), but it is growing at approximately 6.5% percent per year (Caretta et al. 2015). No M&SI of monk seals have been attributed to the MHI bottomfish handline fishery (Caretta et al. 2015). However, the latest marine mammal stock assessment report (Caretta et al. 2015) notes: "In 2012, 16 Hawaiian monk seals were observed hooked, four of which died as a result of ingesting hooks. The remaining 12 were non-serious hookings, although 5 of these would have been deemed serious had they not been mitigated by capture and hook removal. Several incidents involved hooks used to catch ulua (jacks, *Caranx spp*.)." The hook-and-line rigging used to target ulua are typical of shoreline fisheries that are distinct from the bottomfishing gear and methods used by PIFSC during its fisheries and ecosystem research. Although there are some similarities between the shoreline fishery and the bottomfishing gear used by PIFSC (e.g., circle hooks), the general size and the way the hooks are rigged (e.g., baits, leaders, weights, tackle) are typically different and probably present different risks of incidental hooking to monk seals. Ulua hooks are generally much larger circle hooks than PIFSC uses because the targeted ulua are usually greater than 50 lbs. in weight. Shoreline fisheries (deployed from shore with rod and reel) also typically use "slide bait" or "slide rigs" that allow the use of live bait (small fish or octopus) hooked in the middle of the bait. If a monk seal pursued this live bait and targeted the center of the bait or swallowed it whole, it could get hooked in the mouth. PIFSC research with bottomfishing gear uses pieces of fish for bait that attract bottomfish but not monk seals. Monk seals could be attracted to a caught bottomfish but, given the length of the target bottomfish (averaging approximately 14 inches long; Boggs, personal communication), it is unlikely that a monk seal would be physically capable of swallowing the whole fish and therefore bites and tears at the caught fish (i.e., shreds the body of the fish while feeding). The risk of monk seals getting hooked on bottomfishing gear used in PIFSC research is therefore less than the risk of getting hooked on shoreline hook-and-line gears which are identified in the marine mammal stock assessment report (Caretta et al. 2015).

Given the mitigation measures the PIFSC intends to implement for bottomfishing research under the Preferred Alternative (see Section 2.3.1.3), PIFSC has concluded that the risk of marine mammal interactions with its research bottomfishing gear is not high enough to warrant an incidental take request for marine mammals in that gear. PIFSC intends to document potential depredation of its bottomfish research gear (catch loss) in the future, and increase monitoring efforts when catch loss becomes apparent, in an effort to better understand the potential risks of hooking to monk seals and other marine mammals.

In addition to Level B harassment takes of Hawaiian monk seals from acoustic disturbance, PIFSC seeks authorization of Level B harassment takes of this species due to the physical presence of researchers near haulouts used by Hawaiian monk seals. In some cases, PIFSC research involves nearshore diving and shallow water fisheries sampling using rod and reel or other such gear. In addition, nearshore and shore-based research to assess and remove marine debris (primarily derelict fishing gear) is conducted at many locations where Hawaiian monk seals may be present. Often, when removing marine debris from shallow-water coral reefs, fish hiding in the debris may be flushed out and thus attract monk seals in the vicinity. PIFSC scientists are very aware of this situation and take precautions to avoid and minimize the chance of inadvertently disturbing monk seals, including reconnaissance of all beaches before approaching in skiffs or on foot (see mitigation procedures detailed in Section 2.2.1). However, there are numerous locations where Hawaiian monk seals may be resting adjacent to vegetation, or just emerging from the water onto the beach, and would not be immediately visible and where the options for alternate passage may be limited. Combined with the fact that this population is expanding in some PIFSC regions and that pinnipeds may haul out in new locations on a regular basis, it is essentially impossible for researchers to completely avoid disturbing monk seals as they travel around to conduct research.

Based on the locations of known haulouts (Baker and Johanos 2004, PIFSC 2014a and 2014b), PIFSC estimates the minimum population estimate for the Hawaiian monk seal population at about 1,182 animals. Given that only about one-third of the population is onshore at any particular time (Parrish et al. 2000) and that researchers generally do not approach any particular beach more than once per year, PIFSC conservatively estimates that no more than one-third of the Hawaiian monk seal population might be approached per year (394 animals). Thus, the total request for Level B harassment takes is 1,970 Hawaiian monk seals (394 x 5) for the duration of the five-year authorization period.

Given the mitigation measures in place and the lack of historical takes, PIFSC does not expect that all of the requested takes of ESA-listed species would actually occur during future PIFSC fisheries and ecosystem research under the Preferred Alternative. While the LOA application (Appendix C of the 2015 Draft PEA) takes a conservative approach when estimating take; in the unlikely event that the requested takes actually occur, the effects would likely have minor adverse impacts on each ESA-listed stock with the exception of whales according to the impact criteria described in Table 4.1-1. If a take of a sperm whale occurs, it could result in a mortality which is considered an adverse effect. However, adverse effects on the species' population are not anticipated due to research.

4.3.4.2 Other Cetaceans

As noted above, there has been no history of marine mammal takes in PIFSC fisheries and ecosystem research gears. Measures to mitigate the risk of entanglements are described in Section 2.2.1. The PIFSC LOA application (Appendix C of the 2015 Draft PEA) includes estimates of the potential number of marine mammals that may interact with research gear based on documented takes of species taken in analogous commercial fisheries, e.g., those operating in similar areas and using similar gear types (Table 4.2-7). Note that the LOA application does not request authorization to take all species of marine mammals that occur in the PIFSC research areas; only those species listed in Table 4.2-7 are considered to have a reasonable risk of adverse interactions with gear used for PIFSC fisheries and ecosystem research. PIFSC considers these estimates to be greater than what is likely to occur in the future, especially given the fact that none of these species have been taken in research gears in the past, the relatively small level of fishing effort during PIFSC fisheries and ecosystem research, and the mitigation measures in place to reduce potential interactions.

The take request includes 12 species of cetaceans in longline gear (one each of the stocks listed in Table 4.2-7 over the five-year authorization period), requested takes of bottlenose dolphin, pantropical spotted dolphin, spinner dolphin, and rough-toothed dolphin in midwater trawl gear (one each of the stocks listed in Table 4.2-7 over the five-year authorization period), and requested takes of bottlenose dolphin, pantropical spotted dolphin, rough-toothed dolphin, and spinner dolphin (one take for each species over the five-year authorization period) by entanglement during instrument deployments (Table 4.2-7).

For almost all of these stocks, the combined requested level of take in all gears, if it occurred, would be less than ten percent of PBR and would be considered minor in magnitude for each stock. The exception is for spinner dolphins. The combined take of two spinner dolphins (one in midwater trawl and one in instrument deployments) would be 12.1 percent of the O‘ahu /“4-Islands Region” stock’s PBR if both takes occurred on this one stock and this level of take would be considered to be moderate in magnitude. However, since the request is for all stocks due to the spatial extent of the research, the uncertainty of stock boundaries, and possibility of encountering individuals from undescribed stocks, the impact would be more likely to be spread across more than one stock of spinner dolphin and the resulting impact would likely be of smaller magnitude.

In addition, under the Preferred Alternative, PIFSC would make gear modifications to their instrument deployments that are designed to reduce the risk of entanglement in mooring lines (see Section 2.3.1), thereby mitigating some of the risk of entangling humpback whales and dolphins.

There are several species for which the stock structure throughout the PIFSC research area has not been determined (e.g., bottlenose dolphin) or for which abundance and PBR values have not been determined. The impact of potential takes from these stocks relative to PBR is therefore not available.

PIFSC considered the risk of interaction with marine mammals for all the research gears it uses but did not request incidental takes in research gears other than trawls, longline, and instrument deployments. There is evidence that bottlenose dolphins occasionally pursue fish caught on various hook-and-line gears (depredation of fishing lines) deployed in commercial and non-commercial fisheries across Hawaiʿi (Boggs et al. 2015). However, PIFSC has concluded that the risk of marine mammal interactions with its research bottomfishing gear is not high enough to warrant an incidental take request for marine mammals in that gear in the LOA application (see section 4.3.4.1 above). PIFSC intends to document potential depredation of its bottomfish research gear (catch loss) in the future, and increase monitoring efforts when catch loss becomes apparent, in an effort to better understand the potential risks of hooking to bottlenose dolphins and other marine mammals.

4.3.4.3 Conclusion

Under the Preferred Alternative, the potential direct and indirect effects on marine mammals through ship strikes, acoustic disturbance, potential changes in prey availability, and contamination or degradation of habitat would be similar to those described for the Status Quo Alternative (Section 4.2.4) and would be considered minor adverse for all species.

PIFSC has never caught or had marine mammals entangled in fisheries research gear. However, incidental takes of marine mammals have occurred in commercial and non-commercial fisheries in the same areas as PIFSC research occurs and using gears similar to those used in research. PIFSC has used information on these analogous fisheries to make estimates of marine mammals that may be incidentally taken during future fisheries and ecosystem research. The M&SI takes include one ESA-listed species (sperm whales) and 15 non-listed cetacean species, primarily by research using longline gear but also including midwater trawls and instrument deployments (potential entanglement in mooring lines). For almost all stocks for which PBR has been determined, the requested takes, if they occurred, would represent less than ten percent of PBR and would be considered minor in magnitude. The exception is for spinner dolphins. If all of the requested takes for spinner dolphin occurred on the O‘ahu / “4-Islands Region” stock, the takes would be 12.1 percent of PBR for this stock and would be considered moderate in magnitude.

Given the mitigation measures that would be implemented under the Preferred Alternative, including modification of instrument deployment gears to reduce the risk of entanglement in mooring lines relative to the status quo conditions, the relatively small amount of fishing effort involved in PIFSC research, and the lack of takes in the past, PIFSC does not anticipate that the level of requested takes will actually occur in the future. The overall impact of the potential takes of these species, if they occurred, would be considered minor to moderate adverse according to the criteria described in Table 4.1-1.

In addition to Level B harassment takes for many species through acoustic disturbance, PIFSC is requesting Level B harassment takes for Hawaiian monk seals due to the physical presence of researchers in nearshore waters and beaches. Given the protocols for monitoring and avoiding interactions with monk seals, these potential takes would likely result in only temporary disturbance of small numbers of monk seals and adverse impacts would be minor.

The overall effects of the Preferred Alternative on marine mammals would be minor to moderate in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.5 Effects on Birds

The effects of the Preferred Alternative on birds would be very similar to those described for the Status Quo Alternative (Section 4.2.5). An additional mitigation measure under the Modified Research Alternative, PIFSC may deploy tori lines (streamer lines) on longline gear to reduce the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has proven effective in reducing seabird bycatch in some Pacific fisheries (Melvin et al. 2001). This measure would reduce the already-low risk to seabirds from PIFSC’s longline surveys but considering the lack of historical interactions with birds during historic PIFSC research activities using similar gear configurations and protocols, the difference in impacts to birds resulting from implementation of this mitigation measure would likely be minimal. If seabird interactions with longline gear are documented in the future, PIFSC will revisit whether the use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and changes to research protocols that might affect time-series data. Tori lines plus additional mitigation for protected species proposed under the Preferred Alternative may theoretically decrease the potential for seabirds to become entangled in floating line used to deploy stationary research equipment to the seafloor, but in general but the additional mitigation associated with the Preferred Alternative is unlikely to change the actual effects of PIFSC research activities on seabirds, which are minor.

The changes to the suite of research activities conducted under the Preferred Alternative would also result in minimal changes to the effects on seabirds relative to the Status Quo Alternative. The overall effects of the Preferred Alternative on seabirds would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1. On December 14, 2016, PIFSC initiated informal consultation with the USFWS regarding potential effects of proposed research on ESA-listed birds (see Table 3.2-4). The USFWS concurred with PIFSC in a response letter dated February 21, 2017 that proposed research is not likely to adversely affect the ESA-listed bird species discussed herein (Consultation No. 01EPIF00-2017-1-0073).

4.3.6 Effects on Sea Turtles

The effects of the Preferred Alternative on sea turtles would be similar in nature and magnitude to those of the Status Quo Alternative (see Section 4.2.6). Direct and indirect effects of PIFSC research activities on sea turtles may include: disturbances or changes in sea turtle behavior due to physical movements and sounds, injury or mortality due to ship strikes, gear interaction, changes in food availability, and contamination or degradation of sea turtle habitat. These mechanisms are described in Section 4.2.6.

Mitigation measures for protected species required under the Preferred Alternative, such as the use of sinking line to allow any excess scope in the line to sink to a depth where it would be below where most whales and dolphins commonly occur, could potentially decrease the likelihood of adverse impacts to sea turtles. Although no adverse interactions have occurred in the past between sea turtles and PIFSC fisheries and ecosystem research activities, the additional mitigation measure proposed under the Preferred Alternative may decrease the likelihood of sea turtle entanglement in line used to deploy stationary instruments to the seafloor. In addition, the implementation of procedures for handling of incidentally captured protected species could decrease the potential for adverse impacts to sea turtles. However, considering that there have been no reported instances of PIFSC survey activities resulting in sea turtle entanglement or mortality, the mitigation measures described under the Preferred Alternative would not result in substantial changes to the overall level of impact on sea turtles.

Under the Preferred Alternative, the addition of several new surveys in the HARA, MARA, ASARA, and WCPRA would involve deployment of pelagic longline gear, plankton nets, CTD sensors, sediment traps, and water sampling equipment, as well as collection of additional acoustic data and deployment of unmanned surface and underwater vehicles. These survey activities would pose a small additional risk of adverse effects to turtles. However, there have been no reported adverse interactions between sea turtles and PIFSC fisheries and ecosystem research activities, due in part to adherence to the requirements based on regulations of the WPRFMC (2014). Based on the lack of adverse interactions with sea turtles during previous PIFSC research activities, it is not anticipated that any sea turtles would be adversely affected during the research proposed under the Preferred Alternative.

The additional survey activities described under the Preferred Alternative would result in the potential for minor impacts to sea turtles in addition to those described under the Status Quo Alternative. However, the discontinuation of several surveys involving longline gear under the Preferred Alternative would decrease the potential for adverse interactions between PIFSC survey activities and longline research gear. Therefore, the overall effects of the Preferred Alternative on sea turtles would be substantially the same as those resulting from the Status Quo Alternative; minor adverse effects are expected to occur using the gear types and mitigation measures described under the Preferred Alternative; these effects would be isolated and rare and would not impact sea turtles at the population level in any of the PIFSC research areas. On December 14, 2016, PIFSC initiated informal consultation with the USFWS regarding potential effects of proposed research on ESA-listed sea turtles (see Table 3.2-6). The USFWS concurred with PIFSC in a response letter dated February 21, 2017 that proposed research is not likely to adversely affect the ESA-listed turtle species discussed herein (Consultation No. 01EPIF00-2017-1-0073).

4.3.7 Effects on Invertebrates

PIFSC fisheries research conducted under the Preferred Alternative would have the same types of effects on invertebrate species as described for the Status Quo Alternative (Section 4.2.7) through physical damage, directed take of coral, mortality, changes in species composition, and contamination. There are small changes in the research projects conducted under the Preferred Alternative (Table 2.3-1) that could affect the physical damage and mortality of invertebrates relative to the Status Quo Alternative, including:

- Elimination of Northwestern Hawaiian Islands Lobster Survey
- Addition of a midwater trawl to the Cetacean Ecology Assessment Survey
- Increased geographic scope of Insular Fish Abundance Estimation Comparison Surveys

None of the differences between the Preferred Alternative and the Status Quo Alternative would substantially change the potential impacts of research with respect to directed take of corals, changes in species composition, or risk of accidental contamination. Similarly, proposed research under Alternative 2 would result in similar effects on chambered nautilus (ESA-listed) and giant clams (proposed for ESA listing) as described for Status Quo (considered negligible). Stereo-video surveys would transition from the previous generation of BRUVs and BotCams in the Status Quo Alternative to the new generation of MOUSS in the Preferred Alternative. The MOUSS is a smaller and lighter instrument than the BotCam, with better instrumentation than the BRUVs, and uses similar but smaller weights than the BotCam when deployed. These potential effects were considered minor adverse under the Status Quo Alternative because of their relatively low magnitude, dispersal over time and space, and, in the case of contamination, the small risk of occurrence (Section 4.2.3). These types of effects would also be considered minor adverse under the Preferred Alternative for the same reasons. The following discussion will therefore focus on potential effects through physical damage and mortality of invertebrates.

Under the Preferred Alternative, the Northwestern Hawaiian Islands Lobster Survey is not carried forward. The elimination of this survey would substantially reduce the total mortality of lobsters from PIFSC research activities. Modified surveys include a midwater trawl added to the Cetacean Ecology Assessment Survey and increased geographic scope of the Insular Fish Abundance Estimation Comparison Surveys (deploys a BotCam, BRUVS, and MOUSS) to include the MARA, ASARA, and WCPRA. As discussed above in Section 4.2.7, these stationary bottom-contact gears have very small footprints and therefore the potential to crush, bury, remove, or expose invertebrates is also very small.

In addition, ESD may conduct SfM surveys consisting of marking off plots on the seafloor (1-3 m depth) with cable ties or stainless steel pins, collecting photographs of the plots and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images. New research would result only in minor, temporary effects (if any) because gear is temporarily deployed on the seafloor to mark off plots, removed once photos are taken.

The overall effects of the Preferred Alternative on invertebrates would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

In addition to these minor adverse effects, the Preferred Alternative would contribute to long-term beneficial effects on invertebrate species throughout the Pacific Islands Region through the contribution of PIFSC fisheries and ecosystem research, especially through the removal of derelict fishing gear. Specifically, the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing and planning conservation strategies, and detecting ecosystem shifts.

4.3.8 Effects on the Social and Economic Environment

Under the Preferred Alternative, PIFSC would change current operations to include additional observation and monitoring research activities (Section 2.2-1). Similar to the Status Quo Alternative, research activities under the Preferred Alternative would be conducted away from known historic cultural resource sites, such as shipwrecks, burial sites, and fishponds, and avoid locations were contemporary cultural resources are known to occur. Relative to the Status Quo Alternative, the addition of observation and monitoring research activities would minimally increase direct impacts to marine resources important to Pacific Island peoples.

The PIFSC-affiliated research program under the Preferred Alternative includes the addition or expansion of several long-term surveys noted in Table 2.3-1 and the modification of several long-term surveys conducted under the Status Quo Alternative noted in Table 2.2-1. In addition, short-term cooperative research projects would use the same types of fishing gears but have greater levels of effort than the Status Quo Alternative and the particular goals and objectives of those projects could be different under the Preferred Alternative (see Section 2.3.4). These differences in the PIFSC fisheries research program under the Preferred Alternative are not expected to measurably increase or decrease socioeconomic effects compared to the Status Quo Alternative (see Section 4.2.8).

PIFSC-affiliated fisheries and ecosystem research conducted under the Preferred Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate levels. It would also contribute directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and help fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Preferred Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the Pacific Island region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Preferred Alternative on the social and economic environment would be minor to moderate and beneficial.

4.4 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 3 – MODIFIED RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of the Modified Research Alternative on the physical, biological, and social environment. Under this Alternative, PIFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program. The new suite of research activities is a combination of past research and additional, new research, as described for the Preferred Alternative. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all Resource Components evaluated under the Modified Research Alternative is presented below in Table 4.4-1.

Table 4.4-1 Modified Research Alternative Summary of Effects

Resource	Physical Environment	Special Resource Areas and EFH	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	4.4.1	4.4.2	4.4.3	4.4.4	4.4.5	4.4.6	4.4.7	4.4.8
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.4.1 Effects on the Physical Environment

The effects of the Modified Research Alternative on the physical environment would be similar to those of the Status Quo Alternative (see Section 4.2.1). Additional mitigation measures for protected species required under the Modified Research Alternative would not change the effects of the research activities on physical properties of the environment with the potential exception of the spatial/temporal restrictions on PIFSC research activities intended to reduce adverse impacts to protected species (i.e., spatial/temporal restrictions). This type of mitigation measure could potentially reduce the overall level of research effort or alter where and when the research occurs. However, the overall effects on the physical environment are assumed to be essentially the same as those described under the Status Quo Alternative. Therefore, the overall effects of the Modified Research Alternative on the physical environment would be minor in magnitude. Small areas (much less than one percent of each research area) would be impacted, and the areas of impact would be dispersed over a large geographic area. Low intensity impacts resulting from the disturbance of organisms that produce structure could persist for months, however impacts resulting in measurable changes to the physical environment would be temporary. In general, any measurable alterations to benthic habitat would recover within several months through the action of water currents and natural sedimentation. Overall impacts would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.2 Effects on Special Resource Areas and EFH

The effects of the Modified Research Alternative on special resource areas and EFH would be similar to those of the Status Quo Alternative (see Section 4.2.2). As described in Section 3.1.2.1, EFH includes hard bottom structures underlying the waters and associated biological communities.

These biological communities include corals, seagrass, algae, and mangroves. Effects to these biological communities under the Modified Research Alternative are evaluated in their respective sections below.

Most of the additional mitigation measures for protected species proposed under the Modified Research Alternative would not change the effects of the research activities on the physical components of the environment or most biological components; they would only tend to decrease effects on protected species. The exception is the potential for spatial/temporal restrictions on PIFSC research activities intended to reduce adverse impacts on protected species. These restrictions could be placed on particular gear types of concern or in particular areas of concern such as federal and state MPAs. Some MPAs have permit systems for activities that would otherwise be prohibited, such as scientific research with bottom trawl gear, and PIFSC routinely applies for such permits if a particular research activity may adversely affect the MPA. These permits may restrict the level of effort, gear types used, locations, and other conditions of the activity as well as having monitoring and reporting requirements. The Status Quo therefore already includes the potential prohibition or restriction of PIFSC research activities in MPAs. Any spatial/temporal restrictions on PIFSC fisheries research in MPAs (or other designated areas) under the Modified Research Alternative would decrease or minimize the potential for direct adverse impacts to special resource areas relative to the Status Quo Alternative, which were considered minor.

MPAs are, by definition, managed more carefully than other special resource areas and depend more heavily on scientific data about their status to sustain the habitats and resources they are designed to protect. Furthermore, many of the MPAs in the Pacific Islands Region were designated with the specific purpose of being used as places of research. As was the case for the Status Quo Alternative, the scientific data generated from PIFSC research activities under the Modified Research Alternative could have beneficial effects on special resource areas through their contribution to science-based conservation management practices. This is why many MPAs include exemptions or permit processes for scientific research. Indirect effects resulting from spatial/temporal restrictions on research in MPAs could include adverse impacts resulting from a lack of the data needed to support science-based management of MPAs. The magnitude and duration of the indirect adverse effects would depend on how extensive the restrictions on research became and how long such restrictions lasted.

Specific spatial/temporal restrictions on PIFSC research have not been proposed under the Modified Research Alternative; the overall level of research effort and therefore effects on the marine environment are assumed to be essentially the same as those described under the Status Quo Alternative. Therefore, the overall effects of the Modified Research Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.3 Effects on Fish

Under the Modified Research Alternative, PIFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Most of the additional mitigation measures would be unlikely to affect the amount of fish caught for research purposes. The exceptions are the suspension of trawl operations at night or periods of low visibility and the potential for spatial/temporal restrictions on PIFSC research in areas considered important to protected species.

One potential measure would require PIFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with protected species that would be difficult to detect by visual monitoring. This would have negative budgetary and logistical implications for completing the research. Currently research vessels have a limited midwater trawl depth capability and need to conduct trawls at night when the targeted micronekton migrate to shallower depths. Such a rule would prevent PIFSC from meeting its scientific objectives for fisheries management under the MSA.

Spatial/temporal restrictions could reduce research fishing and hence impacts on fish in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations if such movements are consistent with research goals and do not compromise time-series data sets. If so, overall research efforts could remain the same. The Modified Research Alternative does not specify particular spatial/temporal restrictions but it is assumed for the PEA analysis that overall research effort and therefore impacts to fish would be very similar under the Modified Research Alternative as they are for the Preferred Alternative, although they may occur in somewhat different locations and times.

It is assumed for this PEA analysis that overall impacts to fish under the Modified Research Alternative would be substantially the same as those described under the Preferred Alternative. These effects would be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1. As was the case with the Status Quo and Preferred Alternatives, the Modified Research Alternative would also contribute to long-term beneficial effects on managed fish species throughout the Northeast region through the contribution of PIFSC fisheries research to sustainable fisheries management.

4.4.4 Effects on Marine Mammals

The Modified Research Alternative includes the same scope of research in all four of the PIFSC research areas (HARA, MARA, ASARA, and WCPRA) as the Preferred Alternative, including the same mitigation measures currently implemented or to be implemented, and intended to reduce potentially adverse interactions with marine mammals and other protected species. The Modified Research Alternative differs from the Preferred Alternative in that it also includes a suite of mitigation measures that PIFSC is not proposing to implement as part of the proposed action in the PIFSC LOA application (Appendix C of the 2015 Draft PEA). PIFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the optimal mix of efficacy and practicability to reduce the risk of adverse interactions with protected species during the research activities. However, the NMFS' OPR must consider a broad range of mitigation measures under the MMPA authorization and ESA consultation processes, and these additional measures will be considered in this alternative. These additional mitigation measures focus on reducing the likelihood of injury, serious injury, and mortality from interaction with fisheries research gear and are described in Section 2.4 of this PEA. They involve:

- The use of additional personnel and equipment or new technologies to improve detection of marine mammals, especially at night or other low-visibility conditions.
- Operational restrictions on survey activities at night or other low-visibility conditions.

- The use of additional acoustic or visual deterrents to keep marine mammals away from research gear.
- The incorporation of high-resolution, high-speed video cameras into trawl nets with open cod ends.
- Temporal or geographic restrictions to avoid known concentrations of marine mammals or federal and state MPAs.
- Use of decoy vessels to distract marine mammals away from research sets.

None of the additional mitigation measures directly concern the reduction of noise from acoustic devices (Level B harassment take), reducing the numbers of fish and invertebrates caught in research samples, or reducing the risk of accidental contamination from spills. The analyses of effects through these mechanisms (disturbance or changes in habitat quality) are the same as described for the Status Quo and Preferred Alternatives and will not be discussed further. The following analysis will therefore focus on the potential for the additional mitigation measures to reduce the risk of injury, serious injury, and mortality through entanglement in fishing gear or ship strikes.

Scientists at PIFSC continually review their procedures to see if they can do their work more efficiently and with fewer adverse effects on the marine environment, including effects on marine mammals. Many of the additional mitigation measures included in this alternative have been discussed and considered in the past by PIFSC scientists; however, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It is not possible to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. Any revisions to the estimated takes of each species, to directly compare with the Status Quo or Preferred Alternatives, would be based on speculation. This analysis will therefore provide a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, data integrity, and other aspects of the survey work.

4.4.4.1 Trawl Surveys

Several PIFSC surveys use midwater and surface trawl gear. The following mitigation measures would apply to all trawl gear, even though no marine mammals have been taken in PIFSC trawl gears.

Monitoring Methods

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been tested or used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

Visual surveillance by dedicated Protected Species Observers (PSO)

This measure would require PIFSC to use trained protected species observers whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel. Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.

Under the Status Quo Alternative, the officer on watch (or other designated member of the scientific party), and crew standing watch on the bridge visually scan for marine mammals (and other protected species) during all daytime operations. Bridge binoculars are used as necessary to survey the area upon arrival at the station, during reconnaissance of the trawl line to look for potential hazards (e.g., presence of commercial fishing gear, etc.), and while the gear is deployed. If any marine mammals are sighted by the bridge or deck crew prior to or after setting the gear, the bridge crew and/or Chief Scientist are alerted as soon as possible. Currently, not all crew members have received formal training in marine mammal identification or marine mammal mitigation procedures, although they are briefed on what they are looking for and may have considerable experience with the task. The difficulty in having crew members assigned only to PSO duties is that most vessels have limited carrying capacity for personnel and any berths given to PSOs would mean a reduction in personnel available to help with other research or vessel duties. This could compromise crew safety or the amount of research that could be conducted. For research projects using contracted commercial fishing vessels, there is often no additional space on the vessels for personnel other than essential crew.

Use of underwater video systems to monitor trawl gear

Underwater video technology may allow PIFSC to determine the frequency of marine mammal interactions with the trawl gear and evaluate the effectiveness of Marine Mammal Excluder Devices (MMEDs) or other efforts to mitigate entanglement interactions. Underwater video systems have been used for these purposes in several fisheries, both in the U.S. and abroad (Northridge 2003, Lyle and Willcox 2008, Dotson et al. 2010). Northridge (2003) describes a twin camera system used to monitor the grid and escape hole of an MMED and quantify the frequency and outcome of marine mammal interactions with trawl gear. Video images were carried by cable from the cameras to the wheelhouse for continuous display and recording (Northridge 2003). Similarly, Lyle and Willcox (2008) used a low-light black and white digital camera with a 90-degree wide-angle lens coupled to a commercially available hard drive unit to monitor interactions involving marine mammals and other megafauna.

Underwater video equipment may provide useful information about the efficacy of additional mitigation measures but the video equipment itself is unlikely to influence bycatch rates of protected species. In order to directly reduce takes of marine mammals, a video system to detect marine mammals underwater would have to be linked to a means of avoiding entanglement in gear. However, ships with deployed trawl nets cannot "swerve" to avoid a marine mammal for two reasons: 1) all marine mammals can swim faster than the tow speed so trying to move gear away from an animal that is likely attracted to fish in the net will be ineffective, and 2) changing the vessel direction suddenly risks tangling the gear, making it difficult and dangerous to retrieve, delaying retrieval and making the risk of marine mammal entanglement worse. Furthermore, PIFSC currently targets plankton, micronekton, and other small organisms in their midwater trawls, therefore few if any prey fish are found in the codend and a camera system would not be capable of providing the desired scientific data.

Use of passive acoustic monitoring

PAM involves the detection of animals by listening for the sounds that they produce (Barlow and Gisiner 2006). Use of passive acoustic monitoring may aid in the detection of marine mammals present in survey areas and could potentially be used to inform decisions about when to implement appropriate modifications of fishing operations to prevent interactions with marine mammals. Marine mammal calls can be reliably detected using hydrophones mounted on ships, autonomous underwater gliders, buoys, moorings, or bottom-founded installations. However, not all marine mammals vocalize and the vocalization rates of marine mammals may vary in a complex fashion depending upon environmental factors, including long periods of silence (Barlow and Gisiner 2006). While detection of a marine mammal call indicates the presence of a marine mammal, the absence of marine mammal calls does not necessarily indicate the absence of marine mammals. In addition, if the intent is to locate marine mammals so that they can be avoided, hydrophones in multiple locations combined with real-time processing are required to allow triangulation of the acoustic signal. This may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Taking the time to set up a triangulated hydrophone system in an area prior to each trawl would greatly lengthen the time and cost of collecting a certain amount of sample data. In summary, passive acoustic monitoring may be useful for detecting underwater marine mammals that could potentially interact with research activities but it would have substantial costs in terms of the research data collected and it would not guarantee the avoidance of all adverse interactions; passive acoustic monitoring inevitably overlooks those marine mammals that are not vocalizing and marine mammals may move into an area after trawl gear is deployed and still be at risk.

Use of aircraft or unmanned aerial or underwater gliders to expand detection of marine mammals

Currently, surveys using manned aircraft are routinely conducted to obtain unbiased estimates of marine mammal populations and their distributions. Aerial surveys provide reliable information about marine mammal populations because they are able to cover large areas over relatively short periods of time. In addition, airborne survey platforms generally do not influence the distribution or behavior of the marine mammals being counted, whereas many species of marine mammals are either attracted to or avoid seagoing vessels (Barlow and Gisiner 2006). The usefulness of manned aerial surveys for detection of marine mammals that could interact with fisheries research activities is limited by the range that the aircraft may travel from shore, flight time constraints, weather conditions, poor visibility in rough seas, logistical difficulties in matching a fast-moving airplane with a slow-moving research vessel, and considerable expense that would likely decrease the amount of ship-based research that could be conducted. Aerial surveys may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Even with this capacity, the risk of marine mammal interactions would remain because any marine mammals that are not near the surface would not be detectable by airborne observers and, as with other extended detection methods, marine mammals may move into an area after trawl gear is deployed but before it is retrieved.

Unmanned aerial vehicles have the potential to overcome many of the limitations associated with manned aerial surveys for detection of marine mammals. Unmanned aerial systems range from inexpensive lightweight radio-controlled aircraft to complex autonomous aircraft developed for military applications. Unmanned aerial systems could be launched and retrieved from the research vessel, stream video data to observers onboard or at a shore station and provide near-real-time data of marine mammals in proximity to fisheries research activities. Several systems are commercially available that have the ability to remain airborne for up to 24 hours and can be operated many miles from the control station. Several tests have successfully used unmanned aerial vehicles for marine mammal detection (NOAA 2006). However, these systems can only be operated in mild to moderate wind conditions, with increasing wind speeds strongly reducing their range and making recovery difficult.

Advantages associated with the use of unmanned aerial systems include the ability to operate in areas far from shore, long flight times, increased safety of observers who can monitor the data from the ship or a shore-based location, and decreased expense relative to surveillance conducted from manned aircraft. Unmanned aerial technologies are rapidly evolving; over the next five to 10 years, increased video resolution and advanced sensors are likely to increase the utility of these systems for monitoring marine mammals. However, approval from additional regulatory agencies, including the Federal Aviation Administration, would be required for operation of unmanned aerial vehicles for marine mammal monitoring or research purposes. Federal Aviation Administration approval has been very difficult to obtain, even in areas with very little air traffic, which currently limits the potential for using these systems over large areas.

Autonomous underwater gliders are highly successful platforms for the collection of oceanographic data and environmental characterization. Gliders offer an attractive platform for marine mammal detection due to their relatively low cost, low power consumption, and the ability to cover large areas of ocean during long-term deployments (Olmstead et al. 2010). Gliders have been used to locate and identify marine mammals using passive acoustic technology, and the U.S. Navy is conducting additional research and development using autonomous underwater gliders to support efforts to mitigate impacts from marine mammal interactions (Hildebrand et al. 2009). The use of underwater gliders to provide mitigation options for research activities is limited by the same issues as described above for other passive acoustic detection systems.

Use of infrared technologies

IR sensors may be useful for detection of marine mammals under certain circumstances. IR sensors used for marine mammal detection generally measure the spatial distribution of mid-wavelength IR radiation (three to five micrometers). IR emissivity of an object in this waveband is closely correlated to the object's surface temperature, such that IR sensor arrays can detect slight variations in temperature across relatively large areas. This technology, also known as 'thermal imaging', could be useful to augment visual detection of marine mammals, particularly in conditions with low ambient light when visual detection of marine mammals would be difficult. IR image data also lends itself to automated image processing. With additional research and development, it is possible that an automated marine mammal detector could be designed to recognize the IR 'signatures' of certain marine mammals. However, several major drawbacks currently preclude such use of IR detection for automated marine mammal detection.

First, because emitted IR radiation is absorbed in the first few millimeters of water surrounding an object, IR technology is only able to detect animals at the surface, and only those parts that are above the surface of the water. Since water is virtually opaque to IR radiation, IR detection of marine mammals is also complicated by the thin film of water that covers the dorsal surfaces of marine mammals at the sea surface. The temperature measured by an IR sensor is the temperature of the water on the surface of the animal, which may only be a couple degrees above the surface water temperature (Cuyler et al. 1992, Kasting et al. 1989). Under ideal conditions (flat calm seas and close proximity to the IR detector), this slight temperature difference can be detected. However, waves cause the measured temperature of the sea surface to be much more variable and the thermal signature of the animal can easily be masked (Graber et al. 2011).

Second, the likelihood of detecting a temperature signature from a marine mammal falls off quickly with distance from the detector. In tests under ideal conditions, the ability of an IR system to detect killer whales, which present a large portion of their body and a tall dorsal fin above the surface of the water, was very poor beyond 330 feet (Graber et al. 2011). The ability of an IR system to detect much smaller targets like dolphins and porpoises would presumably be much less than it is for killer whales. Finally, considerable effort and time is required to process the video data so that the thermal signatures of animals can be distinguished from the surrounding water. This greatly reduces the effectiveness of the technique for real-time monitoring tied to potential mitigation. In summary, the logistical difficulties of using IR detectors in a real-life context on a research vessel would be overwhelming and currently preclude this potential tool as a practical element of mitigation.

Use of night vision devices

Like IR imaging devices, night vision devices may be used for detecting marine mammals at or above the water surface in low-light conditions. Unlike IR sensors, night vision devices operate by amplifying the signal produced when visible light interacts with a detector. Although night vision devices could potentially improve an observer's ability to detect a marine mammal under low light conditions, previous studies have shown that the effective range of detection for marine mammals using night vision devices is only about 330 feet (Calambokidis and Chandler 2000, Barlow and Gisiner 2006). These devices work best when there is a little light on the water (from the moon or nearby land sources) but they must be directed away from deck lights because they are too bright. This means they could not be used to monitor trawl gear as it is being deployed or retrieved because of the deck lights used for crew safety. They also have a very narrow field of view, making broad area searches inefficient and unreliable, and if sea conditions are rough the many reflections off waves make it very difficult to distinguish objects in the water. Some observers found the devices disorienting and uncomfortable and all observers said it was very difficult to estimate distances while using the night vision devices (Calambokidis and Chandler 2000). Failure to detect marine mammals using such devices would not decrease the uncertainty about whether marine mammals are actually in the immediate area or not and would thus offer no help in deciding whether to deploy trawl gear or not.

Operational Restrictions

One potential mitigation measure considered here would require PIFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with marine mammals that would be difficult to detect by visual monitoring. Since many PIFSC research trawls occur during dusk, hours of darkness, or in early morning conditions, this measure has the potential to substantially reduce sampling effort with trawl gear. Restrictions on trawling at night could seriously hinder the ability of PIFSC to complete their sampling protocol. If survey vessels had to stand down when they encountered fog or rough seas, survey periods would have to be extended or fewer stations would have to be sampled to accommodate such delays. This would mean substantially higher costs and/or decreased quality of data. Although visual monitoring is a reasonable and practicable precaution to undertake for trawl surveys, it does not ensure that marine mammals will be detected or that entanglement can be prevented even if they are detected.

Acoustic and Visual Deterrents

This measure would require PIFSC to use acoustic deterrents on all trawl gear, including pingers and recordings of predator (e.g., killer whale) vocalizations to deter interactions with trawl gear. This measure would also require PIFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear.

Acoustic pingers have been shown to be effective in deterring some marine mammals, particularly harbor porpoises, from interacting with gillnet gear (Nowacek et al. 2007, Carretta and Barlow 2011). There are, however, few studies testing their efficacy when used with trawl gear. Studies of acoustic deterrents in a trawl fishery in Australia concluded that pingers are not likely to be effective in deterring bottlenose dolphins, as they are already aware of the gear due to the noisy nature of the fishery (Stephenson and Wells 2008, Allen et al. 2014). Acoustic deterrents were also ineffective in reducing bycatch of common dolphins in the U.K. bass pair trawl fishery (Mackay and Northridge 2006). Although acoustic deterrents may be effective in preventing bycatch in gillnets, their efficacy in preventing bycatch in trawl nets is currently uncertain. A primary reason for this is that the noise associated with trawl gear (chains, ropes, trawl doors) is sufficiently loud that any acoustic device used would have to be louder than that generated by the ship and fishing gear which could, in turn, cause auditory damage or exclusion of cetaceans from important habitat (Zollett 2005). Underwater broadcasting of pre-recorded predator sounds (e.g., killer whale calls) to scare animals away from the fishing operation has been suggested as a potential mitigation measure but Jefferson and Curry (1996) concluded that this technique was largely ineffective for reducing marine mammal interactions with commercial fisheries based on their review of multiple studies. It is also unclear whether killer whale calls would be effective at deterring marine mammals from an area in places where killer whales are rarely encountered, i.e., where PIFSC research occurs.

Several methods have been suggested to help protected species visually detect fishing gear and avoid entanglement. Increasing acoustic reflectivity of nets through the addition of materials such as barium sulphate or acoustic reflectors has been tested, with varying degrees of success, in several set-net fisheries (Mooney et al. 2004, Rowe 2007). The applicability and efficacy in trawl fisheries is currently unknown. Similarly, nets could be illuminated with phosphorescent or luminescent materials and, ultimately, reduce the potential for entanglement. Wang et al. (2013) tested the efficacy of illuminating nets used in a Mexican bottom set-net fishery with ultraviolet (UV) light-emitting diodes to reduce sea turtle bycatch. UV net illumination significantly reduced green sea turtle bycatch without impacting target fish catch rates. Applicability in trawl fisheries and efficacy in deterring marine mammals with similar technology are, however, currently unknown. It is possible that different colored anchor or tether lines on instruments and gear could improve the ability of whales to detect those lines and avoid entanglement, although such suggestions have not been tested.

Gear Modifications

PIFSC would need to install marine mammal excluder devices on trawl nets under the Modified Research Alternative. Marine mammal excluder devices have been developed for several types of trawl nets. These devices are similar to turtle excluder devices and are designed to allow fish to pass through the bars of the excluder while marine mammals are guided to an escape hatch built into the net. The challenge with developing an excluder device is to minimize the impact on the fishing performance of the net while effectively reducing captures of marine mammals in the net. The shape, size, design, and positioning of an excluder device in the net can substantially impact the fishing performance of the net (Dotson et al. 2010). Unlike research efforts oriented toward stock assessments of commercially harvested target species, PIFSC uses midwater trawls to sample planktonic organisms rather than commercially harvested fish, so changes in "catchability" of target organisms would likely not be an issue for PIFSC research trawls.

An important factor to consider when developing excluder devices or any other gear modifications is to determine how the device or gear modification impacts the scientific objectives of the research. Given the value of long time-series data sets for tracking ecosystem changes and the potentially huge economic implications for fisheries management of highly valuable commercial fisheries, any potential changes to research gear or protocols that may introduce uncertainty and bias into survey results must be thoroughly examined and planned years in advance of their implementation.

PIFSC has not attempted to develop marine mammal excluder devices for any of the midwater trawls it uses for research. There have been no historical captures of marine mammals in PIFSC trawls; given the scientific uncertainties it could introduce into time-series data, and the economic cost of conducting calibration experiments to validate such gear modifications, PIFSC is not proposing to conduct such gear modification research on trawl nets in the near future.

Temporal or Geographic Restrictions

Spatial/temporal restrictions can be a direct way of reducing adverse impacts to protected species if there are known overlaps in time and space of the survey's footprint with concentrations of protected species. This measure would require PIFSC to identify areas and times that are most likely to result in adverse interactions with marine mammals (e.g., areas of peak humpback whale abundance during winter) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with marine mammals. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.

While the rationale for such restrictions is clear, the methods for identifying appropriate places and times for effective restrictions are not. PIFSC has been conducting marine mammal surveys in the Pacific for many years to monitor the changing patterns of marine mammal abundance and distribution. These patterns of abundance are dynamic and often correlated to particular oceanographic conditions, which vary among seasons and years, so marine mammal survey information from the previous year or even the previous month may not reflect actual conditions when it is time to deploy trawl gear. It might be possible to conduct aerial surveys or passive acoustic surveys in an area prior to conducting trawls, but such surveys require time to process data before actual density information is available.

Assuming recent marine mammal survey data are available for delimiting time or area restrictions, questions remain about what standards of density should be used for limiting research. This is important to the potential effectiveness of such restrictions because it is not clear if marine mammal density is a key factor in the risk of catching animals in a research trawl. Marine mammals can all swim much faster than an active trawl tow (two to four knots) so they can easily avoid such gear if they perceive it and choose to move. This is true no matter how many animals are in a given area. The risk of entanglement is likely influenced much more by the attraction of marine mammals to fish caught in the trawl or disturbed by it as the trawl passes by, which in turn may be influenced by the overall availability of prey and the nutritional status of the marine mammals. Even if there are only a few marine mammals in an area, the risk of entanglement could be high if they are very hungry and strongly attracted to fish in a trawl. Conversely, the risk of entanglement could be quite small even if there are many marine mammals in an area if they have been foraging successfully and are inclined to avoid the disturbance of a trawl operation.

In any case, under the Status Quo and Preferred Alternatives, the "move-on" rule would be applied if any marine mammals are sighted from the vessel within 30 minutes before deploying trawl gear and appear to be at risk of interactions with the gear. If an area has a high density of marine mammals, they would likely be sighted during this 30-minute monitoring period prior to setting the gear and the station would be moved away or abandoned to avoid the marine mammals.

A special case of spatial/temporal restrictions would be for PIFSC to avoid trawl survey work within federal and state MPAs (see Section 3.1.2). While PIFSC has conducted survey work within some MPAs under the authority of special use permits, these permits primarily provide authority to scientifically sample fish in areas that are otherwise closed to fishing and do not concern the incidental take of marine mammals. PIFSC will continue to apply for special use permits to sample in MPAs as necessary to meet the scientific needs of their surveys and, if the managing agencies of any MPAs prohibit such sampling, PIFSC will avoid those areas. However, as described above, the same concerns about the effectiveness of spatial/temporal restrictions as a mitigation measure would apply to MPAs. They may or may not have high concentrations of marine mammals relative to the surrounding areas but, given the uncertainty about what factors contribute to high risk of entanglement in trawl gear and the imposition of the "move-on" rule, the potential for actually reducing incidental take by avoiding certain areas is not clear. Such avoidance also comes at the cost of not sampling in areas that are important to different fish species or that were established to promote recovery of depleted stocks. Scientific sampling is often the only reliable way to track the status of these stocks and the effectiveness of the MPA in fulfilling its established goals.

4.4.4.2 Longline Gear

Monitoring Methods

The potential to use additional monitoring methods during hook-and-line surveys mostly involves the same considerations discussed with trawl surveys above. However, the potential to use dedicated PSOs is restricted primarily by vessel and crew size considerations. Longline surveys are conducted on smaller vessels than trawl surveys and the size of the crew is typically smaller. Under the Status Quo, at least one member of the crew is charged with watching for protected species before the gear is set. Dedicated PSOs would not be distracted by other vessel or research gear duties and would thus offer an advantage in monitoring for protected species. However, given the current size of vessels and crews used for these surveys, the inclusion of a crew member dedicated to only one task would compromise the ability of the remaining crew to conduct the survey safely.

Operational Procedures

This measure would require use of a decoy research vessel playing pre-recorded longline fishing sounds to distract marine mammals away from research longline sets. There have been no attempts to test the effectiveness of this method but it is likely that cetaceans would quickly learn to tell the difference between decoys and actual fishing operations (Gillman et al. 2006). Although the potential effectiveness is not clear, the additional cost of chartering another vessel to serve as a decoy would certainly compromise the research budget and restrict the amount of data that could be collected. In addition, a second vessel and broadcast fishing sounds would add to the amount of noise introduced to the marine environment, potentially increasing the number of animals taken by disturbance (Level B takes) everywhere the survey was conducted.

Acoustic Deterrents

This measure would require PIFSC to use deterrents such as acoustic pingers or recordings of predator (e.g., killer whales) vocalizations to deter interactions with longline gear. Although no marine mammals have been taken in longline gear during PIFSC fisheries research, takes of marine mammals on longline surveys in other regions involved animals hooked while depredating fish caught on the gear. Tests of the use of acoustic deterrents to mitigate depredation showed varying results. Signals emitted by pingers may decrease interactions of toothed whales with longlines by interrupting echolocation signals. Depredation by dolphins in the Mediterranean Sea appeared to decrease in response to some pingers, although distance from fishing vessels was not affected (Buscaino et al. 2011). Tests of similar devices in the tuna longline fishery off Hawai‘i indicate that the pingers probably reduced depredation rates (Nishida and McPherson 2011). Fixed frequency (10 kHz) acoustic pingers affixed to longlines in the South Pacific and Indian Oceans had a deterrent effect compared to random frequency (5-160 kHz) small pingers (Huang 2011). Adding pingers to the longline could also serve to attract animals rather than deter them (the “dinner bell” effect) (Jefferson and Curry 1996). As with trawl gear, attempts to scare animals off by playing killer whale recordings are likely to prove ineffective. In a draft review paper, Hamer et al. (2010) note that, although the use of predator playback has not been well studied, it may only work over short distances and individuals would likely habituate to the sounds. There is also the potential that introduction of these acoustic devices could deter or attract the target species, thereby compromising the continuation of the time-series data set.

Visual Deterrents

This measure would require PIFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope, or marked lines) to make the longline gear more detectable thereby reducing the likelihood of hooking or entangling a marine mammal. This measure would theoretically reduce rates of interaction or entanglement for animals that have trouble detecting the fishing gear in order to avoid it (Gillman et al. 2006). Similarly, phosphorescent or luminescent material can be incorporated into fishing gear to emit light underwater at wavelengths that are visible to protected species. However, it is not clear that such measures to enhance the acoustic or visual appearance of trawl nets would have the same effect on all species. For some species that are attracted to the fish caught on the longline, efforts to increase the “visibility” of a longline set may increase the potential for interactions rather than decrease those risks. In addition, devices added to longline gear to increase their visibility may deter or attract the target species, potentially compromising the continuation of the time-series data set.

4.4.4.3 Conclusion

Under the Modified Research Alternative, PIFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Of the potential techniques and procedures considered under this alternative to improve monitoring of trawl gear, three techniques appear to offer some promise in helping to detect marine mammals in conjunction with the current visual monitoring protocol. These include the use of underwater video technology, passive acoustic monitoring, and unmanned aerial or underwater surveillance vehicles. However, all three techniques have substantial limitations in terms of conditions under which they may be useful (e.g., weather and sea state), the logistics of incorporating them into sampling procedures (e.g., timing of deployment, crew responsibilities, and data processing), and how they might be incorporated into actual marine mammal take-avoidance decisions like the "move-on" rule. These three techniques may warrant further examination to explore these limitations and to see how they may be applied under actual survey conditions if the technology advances and is improved. The other technological approaches considered, infra-red imaging and use of night vision devices, have severe limitations to their usefulness in a real-world situation and therefore offer no advantages for actual mitigation.

Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions would certainly reduce the risk of taking marine mammals. However, part of their effectiveness may be due to reduced overall sampling effort rather than because marine mammals are more likely to be caught under those conditions. Such restrictions could have a serious impact on the ability of PIFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. The spatial/temporal restrictions that were considered to avoid high densities of marine mammals are similar in that they would reduce risk of take by reducing overall sampling effort but also strongly impact the ability of PIFSC to pursue certain scientific goals (e.g., studies on the seasonal life histories of certain species).

The use of additional acoustic and visual deterrents may warrant further investigation if new devices enter the market and are demonstrated to be effective. However, the effectiveness of the devices considered in this alternative appears to be species specific; mitigation advantages for some species may lead to higher risk for other species. The effectiveness of these techniques may also decrease with time as animals habituate to various devices and techniques.

The analysis of additional measures considered to decrease the risk of marine mammal takes in hook-and-line gear is similar to trawl gear. Hook-and-line surveys are conducted on much smaller vessels with limited crew. Dedicated PSOs could offer an advantage for monitoring, but the lack of crew space is limiting; all crew members have multiple tasks that are necessary for safe navigation and to conduct the survey. Decoy vessels, acoustic deterrents, and visual deterrents are all unlikely to provide consistent mitigation value and may increase the risk for certain species. New variations on these techniques may be developed in the future that address some of these concerns. Thus far, there have been no takes of marine mammals by hook-and-line gear during PIFSC fisheries research.

In conclusion, some elements of the Modified Research Alternative (e.g., dedicated PSOs) could offer mitigation advantages compared to the Status Quo Alternative and the Preferred Alternative, although with no history of past takes in research gear, the advantage for using PSOs during PIFSC research appears to be minimal. The impacts of the Modified Research Alternative on marine mammals would therefore be similar to the impacts of the Preferred Alternative, which were considered minor adverse under the criteria described in Table 4.1-1. Some concepts and technologies considered in the Modified Research Alternative are promising and NMFS will evaluate the potential for implementation if they become more practicable.

4.4.5 Effects on Birds

The effects of the Modified Research Alternative on birds would be very similar to those described for the Status Quo Alternative (Section 4.2.5) and the Preferred Alternative (Section 4.3.5). The exceptions involve two potential additional mitigation measures intended to reduce impacts on protected species. The Modified Research Alternative includes potential spatial/temporal restrictions on where and when PIFSC-affiliated research could occur. Such restrictions may reduce impacts on sea birds in certain areas such as marine protected areas if such closures were determined to be effective mitigation measures. However, specific determinations about potential research restrictions have not been made and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Status Quo Alternative. Overall effects on seabirds would therefore be similar even if research was conducted in somewhat different places and times.

Similar to the Preferred Alternative, as an additional mitigation measure under the Modified Research Alternative, PIFSC may deploy tori lines (streamer lines) on longline gear to reduce the risk of catching seabirds. Deploying streamer lines on each side of the baited longline to discourage seabirds from diving on baited hooks has proven effective in reducing seabird bycatch in some Pacific fisheries (Melvin et al. 2001). This measure would reduce the already-low risk to seabirds from PIFSC's longline surveys but considering the lack of historical interactions with birds during historic PIFSC research activities using similar gear configurations and protocols, the difference in impacts to birds resulting from implementation of this mitigation measure would likely be minimal. If seabird interactions with longline gear are documented in the future, PIFSC will revisit whether the use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and changes to research protocols that might affect time-series data.

The overall effects of PIFSC research activities on birds under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.6 Effects on Sea Turtles

Additional mitigation measures described under the Modified Research Alternative are unlikely to decrease the potential for adverse impacts to sea turtles relative to the Status Quo Alternative. Under the Modified Research Alternative, underwater video technology may allow PIFSC to determine the frequency of sea turtle interactions with research equipment and evaluate the effectiveness of devices intended to reduce entanglement or bycatch of protected species. This technology may provide useful information about the efficacy of some mitigation measures; however, the use of video equipment is unlikely to influence the impact of PIFSC research activities on sea turtles.

Passive acoustic monitoring involves the detection of animals by listening for the sounds that they produce (Barlow and Gisiner 2006). This technology is not expected to be effective for detection or avoidance of sea turtles because sea turtles vocalize only during copulation and nesting and are the least vocal of living reptiles (Cook and Forrest 2005). Likewise, IR detection is unlikely to improve the ability to detect and avoid sea turtles in the water because water is effectively opaque to IR radiation. Although turtles come to the surface to breathe, only a very small area of a turtle is exposed above the sea surface. In addition, because turtles are ectothermic (cold-blooded) reptiles, temperature differences between the turtle and the surrounding water would be minimal and difficult to detect using IR-sensing devices. Similarly, sea turtles in the water would be extremely difficult to detect using night-vision technology.

Operational restrictions proposed under the Modified Research Alternative would require PIFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize adverse interactions with protected species including sea turtles, which would be difficult to detect by visual monitoring under low-visibility conditions. As discussed in Section 4.3.4, visual monitoring is a reasonable precaution to undertake in relation to research equipment using trawl gear or other towed equipment, but would not ensure detection of sea turtles, nor would it necessarily decrease the potential for adverse interactions between sea turtles and PIFSC research activities. Thus, the suspension of trawl activities during low-visibility conditions is not expected to influence overall effects of PIFSC research activities on sea turtles in the HARA, MARA, ASARA, and WCPRA. Under the Modified Research Alternative, PIFSC would implement video sampling with an open codend as an additional mitigation measure. However, this mitigation measure is not expected to influence the likelihood or outcome of interactions with sea turtles.

The effectiveness of visual deterrents for mitigation of sea turtle interactions with fishing gear is uncertain. Some data suggest that the use of luminescent lightsticks and LEDs may decrease rates of green sea turtle bycatch in longline gear (Wang et al. 2009). However, results from other studies demonstrate that sea turtles are attracted to underwater illumination (Wang et al. 2007).

The uses of aircraft or unmanned aerial or underwater gliders to detect sea turtles in the vicinity of PIFSC research operations are untested. While this mitigation could potentially be effective for detecting and subsequently avoiding sea turtles, the overall influence of the mitigation measure on the impacts to sea turtles is expected to be trivial.

Spatial-temporal restrictions are one of the most direct means of reducing adverse impacts to protected species. Where and when the gear is deployed and retrieved are critical variables for reducing the potential for adverse interactions with sea turtles. The implementation of time-area closures to restrict fishing activities at times and places turtles are most likely to be present in the highest numbers have been shown to be effective for reducing impacts to sea turtles in the Pacific Islands Region (Kobayashi and Polovina 2005). Time-area restrictions proposed as mitigation measures under the Modified Research Alternative could potentially alter the spatiotemporal distribution and overall level of impacts to sea turtles resulting from PIFSC research activities; if the species of interest has a predictable distribution in time and space, this would facilitate the design of an effective time-area closure. However, the identification of specific sea turtle migratory pathways or high-residence areas and times would be essential for the establishment of effective spatial-temporal restrictions to reduce adverse interactions with sea turtles. Because PIFSC fisheries and ecosystem research has not resulted in any historical adverse interactions with sea turtles, additional restrictions on the spatiotemporal distribution of research activities proposed under the Modified Research Alternative would be unlikely to influence the overall level of impacts on sea turtles in the HARA, MARA, ASARA, and WCPRA.

Thus, additional mitigation measures described under the Modified Research Alternative are unlikely to substantially decrease the potential for adverse impacts to sea turtles relative to the Status Quo Alternative. Mitigation measures for protected species proposed under the Modified Research Alternative could result in decreased potential for adverse interactions with sea turtles relative to the Status Quo Alternative provided that the restrictions accurately address the spatiotemporal distribution of sea turtles in PIFSC research areas. However, considering that PIFSC research activities historically have not resulted in any adverse interactions with sea turtles, the implementation of such mitigation measures would not be expected to result in any substantial reduction in impacts to sea turtles. Thus, the overall level of effects on sea turtles resulting from the actions proposed under the Modified Research Alternative would be substantially similar to those of the Status Quo Alternative. Minor adverse effects could occur using gear types and mitigation measures described under the Modified Research Alternative; these effects would be isolated, infrequent, and would not result in any measurable changes to sea turtles at the population level in any of the PIFSC research areas.

4.4.7 Effects on Invertebrates

The effects of the Modified Research Alternative on invertebrates would be very similar to those described for the Status Quo Alternative (Section 4.2.7). The Modified Research Alternative includes potential spatial/temporal restrictions on where and when PIFSC research could occur. Spatial/temporal restrictions may reduce impacts on invertebrates in certain areas such as marine protected areas if such closures were determined to be effective mitigation measures. Such restrictions could also reduce overall research fishing effort in important habitats and limit the ability of PIFSC to sample invertebrate species as prescribed in their research plans. However, specific determinations about potential research restrictions have not been made and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Preferred Alternative. Overall effects on invertebrates would therefore be similar even if research was conducted in somewhat different places and times.

Overall impacts to invertebrates under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.8 Effects on the Social and Economic Environment

Under the Modified Research Alternative, PIFSC would continue fisheries research as described in Section 2.3. Research activities under the Modified Research Alternative would include one or more additional mitigation measures as described in Section 4.2.4.

The effects of the Modified Research Alternative on the social and economic environment depend on the extent that additional mitigation measures would be implemented. Some of the mitigation measures require additional equipment than is currently used and the addition of trained protected species observers to the crew, which could increase spending on wages, rentals, and equipment (see Section 2.4.1). However, on surveys conducted on relatively small vessels with limited crew space, the inclusion of crew dedicated to protected species monitoring would decrease the number of crew available to conduct research, thereby decreasing the amount of research that could be conducted in a given time period and potentially creating safety concerns. Other measures such as no night fishing and spatial/temporal restrictions could curtail research operations in areas important for stock assessment and fishery management purposes. Spatial/temporal restrictions may reduce some operational costs if surveys are reduced in scope, with a resulting loss of scientific information, but may also increase survey expenses if surveys need to be extended in time to compensate for restricted data collection opportunities.

The scientific value of data collected with changes in research protocols due to additional mitigation measures has not been evaluated because the number of unresolved variables would make any such analysis speculative. It is therefore uncertain if an altered PIFSC fisheries research program under the Modified Research Alternative would contribute a similar value to fisheries management as the Status Quo Alternative. However, it is probable that some of the additional mitigation measures included in the Modified Research Alternative, if implemented, would decrease the ability of PIFSC to provide comparable levels or quality of scientific information to the fisheries management process. While these conditions may reduce the scientific value of PIFSC research relative to the Status Quo Alternative, the overall contribution of PIFSC research to the socioeconomic environment would likely be similar to those described for the Status Quo Alternative (Section 4.2.8).

The direct and indirect effects of the Modified Research Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the Pacific Island Region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Modified Research Alternative on the social and economic environment would be minor to moderate and beneficial.

4.5 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 4—NO RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 4—the No Research Alternative—on the physical, biological, and social environment. Under the No Research Alternative, PIFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this PEA. This discontinuation of fieldwork would not extend to research that is not within the scope of this PEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. Under Alternative 4, NMFS would rely on other data sources, such as fishery-dependent data (i.e., harvest data), and state or privately supported data collection programs to fulfill its responsibility to manage, conserve, and protect living marine resources in the U.S.

The potential direct and indirect effects of implementing Alternative 4 were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all Resource Components evaluated under this Alternative are presented below in Table 4.5-1.

Table 4.5-1 No Research Alternative Summary of Effects

Resource	Physical Environment	Special Resource Areas and EFH	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	4.5.1	4.5.2	4.5.3	4.5.4	4.5.5	4.5.6	4.5.7	4.5.8
Effects Conclusion	Minor adverse	Minor adverse	Moderate adverse	Minor adverse	Minor adverse	Minor adverse	Moderate adverse	Minor to Moderate adverse

4.5.1 Effects on the Physical Environment

Under the No Research Alternative, PIFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters. This would eliminate the potential for direct adverse impacts to the physical environment from PIFSC-affiliated fisheries research, although such impacts may continue through research activities conducted and funded by other entities. Under this alternative, PIFSC would also discontinue efforts to remove derelict fishing gear from sensitive reefs and nearshore habitats, which has beneficial effects on benthic substrates and living marine resources. Those beneficial impacts would be lost under the No Research Alternative.

The research conducted by PIFSC includes assessments of fisheries and marine ecosystems that are used to inform a wide range of plans, policies, and resource management decisions. Many of the plans, polices and decisions that are partially based upon PIFSC data are concerned with conservation of ecological properties of the environment, and maintenance of the habitat that sustains living marine resources. FMPs developed for the Pacific Islands and Western Pacific Regions are partially based on scientific advice derived from PIFSC data. These FMPs strategically limit impacts to physical habitat such as disturbance of benthic habitat and removal of organisms that produce seafloor structure. Without a relatively continuous input of PIFSC data, including long-term time-series data, management authorities would lose some of the information necessary to establish management measures in a meaningful fashion. Discontinuance of research under the No Research Alternative would also substantially reduce the capacity of NMFS to monitor and investigate changes to the physical environment due to coastal developments, marine industrial activities, and climate change among other factors.

The loss of information on physical resources under the No Research Alternative would affect a number of different federal and state resource management agencies to various degrees. The PIFSC research program is not the only source of information available to these resource managers but the No Research Alternative could lead to changes in some management scenarios based on greater uncertainty. Given the potential for resource management agencies to compensate for this loss of information to some extent, and the preference to avoid rapid, major changes in management strategies, the potential magnitude of effects on the physical environment would likely be minor and be limited in geographic extent in the near future. Under the No Research Alternative, the overall impact of these indirect effects on physical resources would be considered adverse and minor according to the criteria in Table 4.1-1.

4.5.2 Effects on Special Resource Areas and EFH

The No Research Alternative would result in the elimination of the minor adverse direct impacts to special resource areas described in Section 4.2.2 for the Status Quo Alternative. However, the beneficial effects of PIFSC research on the conservation management of special resource areas would also be lost under the No Research Alternative.

The loss of scientific information about these areas would make it difficult for fisheries managers to assess the habitats, resources, and ecosystem functions that closed areas such as MNM, NMS, and other MPAs, are designed to protect through the implementation of sound science-based management practices. Furthermore, a loss of input from PIFSC research would handicap the maintenance and effective management of existing EFH, component HAPC, and closed areas, and would encumber the designation of additional special resource areas in the future. The loss of information about special resource areas under the No Research Alternative would have various implications for different federal and state resource management agencies. The PIFSC research program is not the only source of information available to these resource managers but it could lead to changes in some management scenarios based on greater uncertainty (e.g., greater restrictions on commercial fisheries in MPAs). If PIFSC discontinued collecting information on special resource areas and EFH, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment could become less effective. The indirect effects of these potential management implications would likely vary among the many special resource areas considered. Given the potential for resource management agencies to compensate for this loss of information to some extent and the tendency to avoid rapid, major changes in management strategies, the potential magnitude of effects on special resource areas would likely be minor and be limited to a few local areas within the Pacific in the near future. Under the No Research Alternative, the overall impact of these indirect effects on special resource areas would be considered adverse and minor according to the impact criteria described in Table 4.1-1.

As described in Section 3.1.2.1, EFH includes hard bottom structures underlying the waters and associated biological communities. These biological communities include corals, seagrass, algae, and mangroves. Effects to these biological communities under the No Research Alternative are evaluated in Section 4.5.7.

4.5.3 Effects on Fish

Under the No Research Alternative, there would be no direct effects of PIFSC research on fish because PIFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research. The lack of at-sea research activities would eliminate the risk of mortality from fisheries research activities, disturbance and changes in behavior due to the presence of vessels and research gear, and potential contamination from vessel discharges. However, the loss of scientific information about fish populations and their habitats, especially commercially valuable species (e.g., tuna and billfishes), would make it increasingly difficult for fisheries managers to effectively monitor stock status, set commercial harvest limits, or develop fishery regulations to recover depleted stocks or protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable. For non-commercial species, the absence of new fieldwork conducted and funded by PIFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular fish species is unknown.

The conservation and management of fishery resources is a core mission for NMFS and is listed among the ten National Standards set forth in the MSA. In carrying out Congress's mandate under the MSA, NMFS is responsible for ensuring that management decisions involving fishery resources are based on the highest quality, best available scientific information on the biological, social, and economic status of the fisheries. In the Pacific Islands Region, this is achieved through the work of PIFSC, which provides supporting scientific information that NMFS uses as the basis for their fisheries management actions. In addition to assessing the status of stocks and examining potential effects of commercial fishing activities, NMFS uses PIFSC research data in the development and implementation of FMPs. The ability to acquire scientific information is essential to the agency's responsibility to manage our nation's fishery resources.

Without PIFSC fisheries research, NMFS would need to rely on other data sources, such as fishery-dependent harvest data and state or privately supported fishery-independent data collection surveys or programs. It is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by PIFSC.

Although other data sources are available to support resource management decisions, the No Research Alternative would be expected to result in increased uncertainty and changes in some management scenarios. If PIFSC discontinued collecting information on fish stocks, management authorities would lose important information needed to establish sustainable harvest limits and other management measures in a meaningful fashion, and current conservation measures in place to rebuild overfished stocks and protect ecological properties of the environment would become less effective. The indirect effects of these potential management implications would likely vary among fisheries management areas and the different fish stocks assessed by PIFSC. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular fish stock. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on fish stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact on commercially important fish stocks would be considered moderate adverse for the areas surveyed by PIFSC according to the criteria in Table 4.1-1

4.5.4 Effects on Marine Mammals

Under the No Research Alternative, PIFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the HARA, MARA, ASARA, or WCPRA. Directed research on marine mammals (i.e., Cetacean Ecology Assessment surveys) may continue under MMPA section 101 directed research permits but the associated use of active acoustic equipment and fishing gear (small, towed nets) to sample prey fields and other oceanographic conditions would not be conducted under the No Research Alternative. This would eliminate the potential for direct effects on marine mammals through disturbance, entanglement in gear, changes to prey availability, and contamination of the marine environment in all four research areas and for all species of marine mammals.

Under this alternative PIFSC would also discontinue efforts to remove derelict fishing gear from sensitive reefs and nearshore habitats, which has beneficial effects on marine mammals that may be entangled in such gear. Those beneficial impacts would be lost under the No Research Alternative.

Many of the PIFSC projects that would be eliminated under this alternative include observations made from the deck of the vessels (transects while vessels are underway) which provide scientific data on the abundance and distribution of marine mammals in these four areas. Oceanographic and fisheries data collected by PIFSC is also important for monitoring the ecological status of the environment important to marine mammals. While there would be no direct effects on marine mammals due to adverse interactions with ships and scientific gear, the loss of some opportunistic observational information and a great deal of ecological information important to marine mammals would indirectly affect resource management decisions concerning the conservation of marine mammals.

Given the fact that PIFSC is not the only source of information available to federal and state resource managers, and the potential for resource managers to compensate for this loss of information, the No Research Alternative is expected to have an adverse and minor indirect effect on marine mammals for all of the PIFSC research areas. There are too many unknown variables to estimate what the indirect effects this lack of information would mean to any particular stock of marine mammal. However, the overall impact on marine mammals would likely be adverse and minor for all four PIFSC research areas.

4.5.5 Effects on Birds

The No Research Alternative would result in the elimination of the minor adverse direct impacts to seabirds through disturbance, entanglement in gear, changes to prey fields, and contamination of the marine environment for all species of birds (Section 4.2.5). However, as discussed in the marine mammal section above, some of the PIFSC projects that would be eliminated under this alternative have beneficial impacts on seabirds, including removal of derelict fishing gear and seabird observations made from PIFSC research vessels which provide scientific data on the abundance and distribution of seabirds in the Pacific. This information contributes to ecosystem modeling and resource management issues important to seabirds. Oceanographic and fisheries data collected by PIFSC is also important for monitoring the ecological status of the environment important to seabirds. While there would be no direct effects on seabirds, the loss of observational and ecological information important to seabirds would adversely affect resource management decisions concerning the conservation of seabirds. Although NMFS does not have regulatory jurisdiction over birds, the scientific contribution from PIFSC observational research on seabirds is used, at least partially, to support fishery management decisions, USFWS conservation efforts, and international treaties. If PIFSC discontinued collecting ecological and observational information on seabirds, long-term data sets contributing to the quality of information about seabird trends would be disrupted and adverse effects could result from the decreased ability of state and federal agencies to make informed decisions regarding the conservation of seabirds and the ecosystems that sustain them. Considering PIFSC fisheries and ecosystem research activities are not the only source of seabird-related information available to federal and state resource managers, and the potential for resource managers to compensate for loss of information to some extent on other vessels of opportunity, the No Research Alternative is expected to have an adverse and minor indirect effect on seabirds in the PIFSC research areas.

4.5.6 Effects on Sea Turtles

Under the No Research Alternative, PIFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the four research areas. This would eliminate the potential for direct impacts to sea turtles through disturbance, entanglement in gear, changes in food availability, or contamination associated with PIFSC research activities. PIFSC would also discontinue efforts to remove derelict fishing gear from sensitive reefs and nearshore habitats, which has beneficial effects on sea turtles that may be entangled in such gear. Those beneficial impacts would be lost under the No Research Alternative.

Several of the PIFSC projects that would be eliminated under this alternative include observations made from the deck of the vessels which provide scientific data on the distribution of sea turtles in the HARA, MARA, ASARA and WCPRA. Oceanographic and fisheries data collected by PIFSC is also important for monitoring the ecological status of environments important to sea turtles. These data support the management and conservation of sea turtle populations and the habitats and ecosystems that sustain them. Many of the plans, polices and decisions that are based upon PIFSC data are used to support the conservation and ongoing management of sea turtle populations, both inside and outside the U.S. EEZ. FMPs that are developed based, at least partially, on scientific advice derived from PIFSC data include management measures such as time area closures and gear type restrictions for commercial fisheries specifically intended to reduce adverse interactions with sea turtles. These management measures strategically limit impacts to sea turtles and are partially dependent on periodic input of PIFSC data. Without these data, management authorities would lack some of the information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect sea turtles would become obsolete. The loss of scientific information important to understanding sea turtle ecology under Alternative 4 would affect federal and state resource management agencies to various degrees. Without the input of PIFSC data relevant to sea turtle ecology, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective. Since PIFSC is not the sole provider of scientific information on sea turtles or their habitats, resource management agencies would be forced to compensate for this loss of information through changes in management scenarios. There are too many unknown variables to estimate what the indirect effects of this loss of information and associated management implications would mean to any particular sea turtle species. Under the No Research Alternative, the loss of information currently provided by PIFSC research activities is expected to have adverse and minor indirect effects on sea turtles in the HARA, MARA, ASARA and WCPRA.

4.5.7 Effects on Invertebrates

Under the No Research Alternative, there would be no direct effects of PIFSC research on invertebrates through physical damage, directed take of coral, mortality, changes in species composition, and contamination. The beneficial effects of derelict fishing gear removal from coral reefs would be lost under this alternative.

The loss of scientific information about invertebrates would impede the ability of fisheries managers to effectively assess and monitor stocks, set harvest limits, or develop necessary regulations to protect vulnerable stocks. For non-commercial species (e.g., various corals), the absence of new fieldwork conducted and funded by PIFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular invertebrate species is unknown.

As described in Section 4.5.3 for fish, the conservation and management of marine invertebrate resources is a core mission for NMFS under the MSA and needs to be based on the best available scientific information. In addition to assessing the status of commercially important invertebrate stocks and examining potential effects of commercial fishing activities, NMFS uses PIFSC research data to develop and implement FMPs. The ability to acquire scientific information is essential to the agency's responsibility to manage our nation's fishery resources.

Without PIFSC fisheries research, NMFS would need to rely on other data sources such as fishery-dependent harvest data and state or privately supported fishery-independent data collection surveys or programs. It is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by PIFSC.

Although other data are available to support resource management decisions, the interruption or cessation of long-term data series on commercially valuable invertebrate stocks could lead to increased uncertainty and changes in some management scenarios. Management authorities would lose important information needed to establish sustainable harvest limits and help conserve and restore benthic habitats. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on invertebrate stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact on commercially important invertebrate stocks would be considered moderate adverse according to the impact criteria in Table 4.1-1.

4.5.8 Effects on the Social and Economic Environment

Section 3.3 describes the interaction of PIFSC with the social and economic environment of the Pacific Island region. This section describes the effects of the No Research Alternative on socioeconomic resources of the Pacific Island Region. Major factors that would be affected by the cessation of fieldwork associated with the PIFSC fisheries research program include:

- Cultural resources in the PIFSC research areas
- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries research
- Fulfillment of legal obligations specified by laws and treaties

4.5.8.1 Effects on Cultural Resources

Under Alternative 4, the No Research Alternative, PIFSC fisheries at-sea fieldwork would be suspended in all four research areas. With no field operations and no personnel actively engaged in research activities, Alternative 4 would not have a direct impact on archaeological and contemporary cultural resources because there would be no actions that could affect these resources.

Alternative 4 would have an indirect adverse impact on marine resources of cultural importance through the loss of fisheries management data used to set harvest limits and ensure the long-term use of marine resources important to fishing communities and their contemporary cultural uses. Without fisheries research being conducted, fishing community fisheries management needs would be less informed, and contemporary cultural resources potentially impacted through unsustainable fishing practices. The extended time-series of data helps identify trends that inform fisheries management planning and can help determine which communities are designated as fishing communities.

Under the No Research Alternative, indirect impacts would be medium in intensity with measurable impacts to the fisheries resources utilized by fishing communities. Possible impacts from the loss of fisheries management data to contemporary cultural resources would be long-term in duration, with impact extend beyond authorization period, regional in extent due to the large geographic range of the research areas, and important in context due to value of these resource to fishing communities. Overall, the direct and indirect effects of PIFSC operations under the No Research Alternative would be moderate because of reduced contributions to local fishing communities, collaboration with other researchers, and contributions to fisheries management.

4.5.8.2 Collection of Scientific Data used in Sustainable Fisheries Management

Under the No Action Alternative, PIFSC would not conduct or fund fisheries research involving the deployment of vessels or fishing gear in marine waters of the Pacific Island region. Without the scientific data for updated stock and habitat assessments provided by PIFSC-affiliated research, scientists and fisheries managers would have to rely on other data sources, such as commercial and recreational fisheries harvest data and fisheries-independent research conducted and funded by state agencies, academic institutions, or other independent research organizations. Organizations that have participated in cooperative research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding (see Section 2.5). This would have a direct adverse effect on the statistical confidence of stock assessments and other scientific information important to fisheries management. Without federal fisheries-independent research, areas closed to fishing for various conservation reasons, such as stock or habitat recovery, would be without the primary scientific data used to monitor the effectiveness of those conservation measures and the recovery of depleted species.

The use of fishery-dependent data alone may severely limit the ability of managers to evaluate and make predictions about the status of some stocks because harvest data do not sample early age classes and therefore provide little data on potential recruitment to harvestable stocks. Uncertainty about stock assessments would increase over time as knowledge of population structures diminish. This, in turn, could require use of ever more precautionary approaches, which could reduce commercial and recreational fishing opportunities, and therefore associated income, through such means as reduced fishing quotas or target catch levels and/or extended closures of fishing areas. The redistribution of research effort to non-NMFS entities would also require new lines of communication with the Fishery Management Councils, new data review processes, and new procedures for integrating separate research results into the regional perspective. Cessation of fisheries research conducted and funded by PIFSC would gradually undermine the statistical basis for use of more sophisticated management models, leading to reliance on less sophisticated and more conservative fishery management.

Another potential result of greater uncertainty in the scientific basis for fisheries management is that fisheries managers may overestimate overfishing levels and set harvest limits too high for some species, resulting in overfishing and depletion of fish stocks. The initial effect of this would be to increase the revenues from commercial fishing and its related industries. However, over time, the depletion of fish stocks would result in lower catches and therefore reduced incomes. Further, quotas that are lower than objectively necessary mean not only losses to the fishing industry, fisheries dependent shoreside industries and fishing families and communities. Even with a precautionary approach, in the absence of objective data, quotas may still be set too high, meaning the long-term yield from the fishery will be driven down due to unsustainable harvest levels. This would result in both a conservation loss and a long-term economic loss to the Pacific Island Region.

The absence of federal fishery-independent research surveys and the long-term data sets they provide would eliminate the primary set of trend information used to monitor broad changes in the marine ecosystem. Climate change and ocean acidification have the potential to impact the population and distribution of many marine species. Long-term, scientifically robust research that provides information on changes to and trends in the marine ecosystem, and on human impacts from and adaptations to those changes and trends, would be greatly diminished if PIFSC ceased conducting and funding fisheries and ecosystem fieldwork.

The end result could be an undermining of confidence in the fisheries management program. This could lead to less cooperation and exchange of important information and data. Without this cooperation the Fishery Management Councils would find it more difficult to sustain the support of the individual states, potentially undermining the fisheries management process. The No Research Alternative clearly does not enable collection and development of adequate, timely, high quality scientific information comparable to that provided by PIFSC under any of the three research alternatives. In NMFS view, the inability to acquire scientific information essential to developing fisheries management actions that must prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and fully restore the nation's fishery resources.

4.5.8.3 Economic Support of Fishing Communities

As stated previously, PIFSC currently spends approximately $29.2 million annually in support of fisheries research that support local economies in the form of employment, services, chartered vessels, fees, taxes, equipment, and fuel. Cooperative research grants and research set-aside programs account for substantial additional charter services. Under the No Research Alternative, this financial contribution to local economies and the resulting support of the social environment would cease. A number of people currently employed to conduct fisheries research either as federal employees or contractors would likely lose their jobs and the number of support services required for PIFSC would decrease substantially. It is unlikely that state agencies or other funding sources would be able to completely compensate for this loss of federal funding to support fisheries research by state agencies, academic institutions, and industry groups.

While the loss of research-related employment and purchased services would be important and adverse for many individuals and families, the total sums spent for research are very small compared to the value of commercial and recreational fisheries in the area as well as the overall economy of those communities. The lost economic contribution of PIFSC research would be relatively larger for some communities where the research is centered (i.e., Honolulu, Hawai‘i) and may be considered moderate in magnitude for those communities but the overall direct impact of that loss would be minor in magnitude for most communities. The economies of the MARA, ASARA, and WCPRA are typically smaller in scale, with a larger component of the overall economy coming from research activities for each of the research areas. These direct adverse economic impacts would be certain to occur under the No Research Alternative, would affect numerous communities throughout the region, and could be felt for several years. Overall, the direct economic impacts of the No Research Alternative would be considered minor to moderate and adverse according to the impact criteria in Table 4.1-1.

4.5.8.4 Collaborations between the Fishing Industry and Fisheries Management

Over time, the No Research Alternative would cause an adverse indirect effect on the social and economic environment by degrading the relationships that has been established between scientists and fishing groups through working together on cooperative research programs. This deterioration in trust and cooperation would likely get worse if commercial fisheries were managed more conservatively because of higher uncertainty resulting from less reliable information to feed into fisheries management. It is not clear what impacts this would have on particular economic or regulatory issues but an atmosphere of distrust often complicates and slows down public decision-making processes such as those used to develop fisheries regulations and harvest allocations. This type of effect could last for many years and would therefore be considered a long-term, adverse effect.

4.5.8.5 Fulfillment of Legal Obligations Specified by Laws and Treaties

The cessation of field work associated with the PIFSC research programs considered in this PEA would compromise the ability of NMFS to fulfill its obligations under various U.S. laws and international treaties (Chapter 6). NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the MSA, MMPA, and ESA. Fulfilling the obligations of these statutes requires NMFS to provide specific research data and scientific expertise to support legal reviews and management decision-making processes. The cessation of field research would substantially erode the value of scientific advice provided to these various processes and increase uncertainty about the effects of conservation and management measures on fishing communities as well as NMFS ability to provide socioeconomic analyses required for fisheries regulatory actions. It would also compromise the U.S. partnership and collaboration with other agencies, entities, and countries that collect, analyze, and share complementary data for management of highly migratory species and other international resources.

4.5.8.6 Conclusion

The direct and indirect effects of The No Research Alternative on the social and economic environment would be subject to a great deal of uncertainty depending on the response of many entities to the cessation of PIFSC fisheries research and the ensuing uncertainty in the fisheries management process. The impacts on the economies of local communities would be adverse, minor to moderate in magnitude depending on the community, long-term in duration, and would be felt throughout the Pacific Island region. The loss of research related to highly migratory species would compromise the ability of the U.S. to comply with its international treaty obligations. The loss of cooperative research programs would also cause deterioration in the relationships between NMFS scientists and fisheries managers with the fishing industry and public, with decreasing public trust in fisheries management regulations. The overall direct and indirect effects of the No Research Alternative on the social and economic environment would be minor to moderate in magnitude, felt across a broad geographic area, and long-term and would therefore be considered moderate adverse according to the impact criteria established in Table 4.1-1.

4.6 COMPARISON OF THE ALTERNATIVES

The following discussion compares and contrasts the direct and indirect impacts of the four alternatives on each resource area. The first three alternatives are much more similar to each other than to Alternative 4 because the first three alternatives involve robust and extensive PIFSC fisheries and ecosystem research programs. Alternative 4 is quite different from the other alternatives in that it does not include fieldwork conducted or funded by PIFSC.

Alternative 1, the Status Quo Alternative, includes the research program as it has been performed over the past five years, although some of the surveys/projects conducted in that period have not been conducted recently or were short-term projects that were not intended to be continued in the future. The mitigation measures for protected species under Alternative 1 are those that have been consistently used over the past five years.

Alternative 2, the Preferred Alternative, includes the suite of research surveys/projects that are currently being conducted and are anticipated to be conducted in the foreseeable future. It also includes the current suite of mitigation measures for protected species as well as proposed improvements to protected species impact mitigation procedures. These new efforts are intended to improve the overall effectiveness of mitigation measures to reduce adverse interactions with protected species.

Alternative 3, the Modified Research Alternative, includes the same set of research activities as Alternative 2, and also includes a range of additional mitigation measures for protected species that are not included in Alternative 2. These additional mitigation measures include operational restrictions as well as the potential incorporation of gear modifications into research protocols. Many of these additional mitigation measures would impact the collection of fisheries and ecosystem research data or require extensive and costly testing before they could be implemented and are therefore, not part of the Preferred Alternative.

Under Alternative 4, the No Research Alternative, PIFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered within the scope of this PEA. Under the No Research Alternative, it is unlikely that any state or other institutional research programs would be able to achieve the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by PIFSC. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S.

The effects of the alternatives on each resource type were assessed using an impact assessment criteria table to distinguish between major, moderate, and minor effects. The analysis shows that all three of the research alternatives could directly and indirectly impact the physical and biological environments in similar ways, and that the effects would be minor and adverse. In addition, the three research alternatives would have indirect beneficial effects on many biological resources and special resource areas through their contribution of scientific information to various resource management and conservation processes. The three research alternatives would also have minor to moderate beneficial effects on the social and economic environment of fishing communities by providing the scientific information needed for sustainable fisheries management and by providing funding, employment, and services. The No Research Alternative, in contrast, would eliminate the direct minor adverse effects of the research alternatives on the marine environment, but would have moderate indirect adverse effects on the social and economic environment through long-term and widespread adverse impacts on sustainable fisheries management. Table 4.6-1 provides a summary of impact determinations for each resource component by alternative.

Table 4.6-1 Summary of Environmental Effect Conclusions for Each Alternative

Resource Component	Alternative 1 (Status Quo)	Alternative 2 (Preferred)	Alternative 3 (Modified Research)	Alternative 4 (No Research)
Physical Environment	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Special Resource Areas and EFH	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Fish	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Marine Mammals	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Birds	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Sea Turtles	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Invertebrates	Minor *adverse*	Minor *adverse*	Minor *adverse*	Moderate *adverse*
Social and Economic Environment	Minor to Moderate *beneficial*	Minor to Moderate *beneficial*	Minor to Moderate *beneficial*	Minor to Moderate *adverse*

4.6.1 Summary of Effects on the Physical Environment

Under the three research alternatives, direct impacts to benthic habitats would occur through the use of several types of bottom-contact equipment. Bottom-contact fishing gear used in PIFSC fishery research activities under the three research alternatives would include lobster traps and BRUVs that rest directly on the seafloor, as well as ARMS, ADCPs, BMUs, CAUs, STRs, HARPs, PUCs, RAS, SEAFETs and SAMIs and EARs that are either fixed or anchored to the benthic substrate (Table 2.2-1; also see Appendix A for description of gear types). Due to the small areas affected by stationary bottom-contact fishing gear, the geographic extent of impacts would be limited to much less than 1 percent of the project area and would therefore be considered minor in magnitude and localized. PIFSC does not use bottom trawl or dredge equipment for any of its research programs.

Most disturbances to benthic habitats would be expected to recover with several months due to the action of ocean currents and natural depositions. Water quality could be affected through disturbance of bottom sediments, causing temporary and localized increases in turbidity. The potential for accidental fuel spills or other contamination from research vessels is considered small and any incidents would be rare due to the training and spill response equipment required for work on all research vessels, and adherence to Coast Guard regulations regarding safety and pollution prevention, and the experience of NOAA Corps and charter captains and crew. The overall effects on benthic habitat and water quality are considered minor in magnitude, s dispersed over a large geographic area, and temporary in duration. Low intensity impacts resulting from the disturbance of organisms that produce structure could persist for months, however impacts resulting in measurable changes to the physical environment would be temporary. In general, any measurable alterations to benthic habitat would recover within several months through the action of water currents and natural sedimentation. Overall impacts would therefore be considered minor adverse under all three of the research alternatives, as they would all have similar impacts on the physical environment.

Under the No Research Alternative, there would be no direct impacts on the physical environment from PIFSC-affiliated fisheries and ecological research. However, the loss of scientific information generated by PIFSC research would contribute to greater uncertainty about the effects of climate change, ocean acidification, commercial fisheries impacts, and other external factors on benthic ecosystems. Indirect effects could occur through less scientifically informed decisions by resource management agencies. The loss of information from PIFSC would likely affect a large geographic area but would be minor in magnitude given other potential sources of scientific research data. Impacts to the physical environment would therefore be considered minor adverse under the No Research Alternative.

4.6.2 Summary of Effects on Special Resource Areas and EFH

Under the three research alternatives, PIFSC would conduct some fisheries and ecosystem research activities in EFH, monument areas, sanctuaries, and refuges; however, the research activities would be limited, minimally invasive, and extractive sampling would not occur to any considerable extent. The potential effects on special resource areas and EFH resulting from PIFSC research under the Status Quo Alternative are similar or the same as those discussed for physical, biological, and socioeconomic resources elsewhere in this PEA. These effects primarily involve potential adverse interactions with EFH coral habitat, protected species, and the risk of accidental spills or contamination from vessel operation. Near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment could result in temporary impacts to pelagic habitat within special resource areas and EFH. Presence of pelagic sampling equipment may result in short-term disturbance or displacement of pelagic species, but the duration of impacts to pelagic habitats within special resource areas and EFH would generally not extend beyond the duration of the research activity. While survey activities may occur within special resource areas and EFH, these activities would have *de minimus* impacts on benthic habitats within sanctuaries, EFH, or other special resource areas because PIFSC does not use bottom-contact trawl equipment or other mobile bottom-contact research equipment for any of fisheries and ecosystem research programs proposed under the three research alternatives. Stationary bottom-contact equipment that could potentially influence benthic habitat within special resource areas and EFH are described in Section 4.2.1.

Possible PIFSC surveys conducted within the special resource areas and EFH would include the randomized RAMP surveys in nearshore areas using non-invasive survey techniques. RAMP survey locations are selected randomly and can potentially occur within MPAs and other special resource areas. Under all of the three research alternatives such activities would be minimally extractive and would occur infrequently. Any research activities occurring within special resource areas and EFH would meet established conservation measures and restrictions for the location.

Impacts to special resource areas and EFH under Alternative 2 would be very similar to the impacts under Alternative 1. Alternative 3 includes the potential for spatial/temporal restrictions on PIFSC fisheries research as a means to reduce impacts on protected species. This provision may reduce impacts on certain areas if such closures were determined to be effective mitigation measures. However, specific determinations about potential research restrictions have not been made and it is assumed that impacts to special resource areas and EFH under Alternative 3 would be very similar to those under Alternatives 1 and 2.

Under the No Research Alternative, there would be no direct impacts on special resource areas and EFH from PIFSC-affiliated fisheries and ecosystem research. However, the indirect effects on resource management agencies and conservation plans for protected areas due to the loss of scientific information would be similar to that described for the physical environment and would be considered minor adverse.

4.6.3 Summary of Effects on Fish

Under all of the three research alternatives, potential effects of research vessels, survey gear, and other associated equipment on fish species found in the research areas would include mortality from fisheries and ecosystem research activities, contamination from discharges, and potential disturbance and changes in behavior due to sound sources. Three fish species in the project area listed are as threatened or endangered under the ESA: the scalloped hammerhead shark, the oceanic white tip shark, and the giant manta ray. Historically, only four scalloped hammerhead sharks have been captured as a result of PIFSC fisheries and ecosystem research, all of which belonged to the non-ESA-listed Central Pacific DPS. Furthermore, all four of these captures were released alive with no resulting mortality. No takes of the other two species have occurred and are not expected. Given the lack of historical takes of ESA-listed fish species, the potential for future takes is considered small and unlikely to affect any ESA-listed populations of fish. For most species targeted by commercial fisheries and managed under FMP, mortality due to research surveys and projects is much less than one percent of ACLs or commercial harvest and is considered to be minor in magnitude for all species. For species which exceed one percent of ACLs or commercial harvest, catch is still small relative to the population of each species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. Disturbance of fish from research activities would be temporary and minor in magnitude for all species. However, because the Preferred Alternative would tag ESA-listed oceanic whitetip sharks, scalloped hammerheads, and giant manta rays, research would adversely affect a small number of individuals from each of these species though the effects would not likely cause long-term changes in fitness or survival. Population-level effects to these species associated with tagging would not occur. As described in Section 4.2.3.6, the potential for accidental contamination of fish habitat is considered minor in magnitude and temporary or short-term in duration. The overall effects of any of the three research alternatives on target fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

In contrast to these adverse effects, PIFSC research also provides long-term beneficial effects on managed fish species throughout the Pacific Islands Region through its contribution to sustainable fisheries management. Data from PIFSC fisheries and ecosystem research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by PIFSC research programs effects are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries research, provide the basis for monitoring changes to the marine environment important to fish populations.

Under the No Research Alternative, there would be no direct effects of PIFSC research on fish because PIFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research. The lack of at-sea research activities would eliminate the risk of mortality from fisheries research activities, disturbance and changes in behavior due to the presence of vessels and research gear, and potential contamination from vessel discharges. However, the loss of scientific information about fish populations and their habitats, especially commercially valuable species (e.g., tuna and billfishes), would make it increasingly difficult for fisheries managers to effectively monitor stock status, set commercial harvest limits, or develop fishery regulations to recover depleted stocks or protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable. For non-commercial species, the absence of new fieldwork conducted and funded by PIFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular fish species is unknown. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on fish stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact of the No Research Alternative on commercially important fish stocks would be considered moderate adverse for the areas surveyed by PIFSC according to the criteria in Table 4.1-1

4.6.4 Summary of Effects on Marine Mammals

The potential direct and indirect effects of PIFSC research activities on marine mammals have been considered for each of the four PIFSC research areas (HARA, MARA, ASARA, and WCPRA) and for all gear types used in research under each of the three research alternatives. While many of the marine mammal species in the PIFSC research areas may be exposed to sounds from active acoustic equipment used in PIFSC research, not all are. Additionally, many of the acoustic sources are not likely to be audible to many marine mammal species. For the marine mammals affected, those effects would likely be temporary and minor changes in behavior for nearby animals as the ships pass through any given area. The potential for TTS in hearing is low for high frequency cetaceans (beaked whales and dwarf and pygmy sperm whales) and very low to zero for other species. The potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and the short-term duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all species under all of the three research alternatives.

PIFSC has never caught, hooked, or had marine mammals entangled in fisheries research gear. However, incidental takes of marine mammals have occurred in commercial and non-commercial fisheries in the same areas as PIFSC research occurs and using gears similar to those used in research. PIFSC has used information on these analogous fisheries to make estimates of marine mammals that may be incidentally taken during future fisheries and ecosystem research, which are assumed to be the same for all three of the research alternatives. These requested MS&I takes include one ESA-listed species (sperm whales) and 15 non-listed cetacean species, primarily by research using longline gear but also including research with midwater trawl gear and instrument deployments (potential entanglement in mooring lines or other lines). For almost all species and stocks with determined PBR values, the requested takes, if they occurred, would represent less than ten percent of PBR and would be considered minor in magnitude. The exception is for spinner dolphins. If all of the requested takes for spinner dolphin occurred on the O‘ahu / “4-Islands Region” stock, the takes would be 12.1% of PBR for this stock (Table 4.2-7) and would be considered moderate in magnitude. Given the mitigation measures implemented under the Status Quo and Preferred Alternatives, the relatively small amount of fishing effort involved in PIFSC research, and the lack of takes in the past, PIFSC does not anticipate that the level of requested takes will actually occur in the future. Mitigation measures would be expanded considerably under the Modified Research Alternative but the potential benefit to marine mammals would be minimal considering the absence of takes under status quo conditions. The overall impact of the potential takes of these species, if they occurred, would be considered minor to moderate adverse according to the criteria described in Table 4.1-1.

In 2017, there were 12 reports of human-caused injuries to cetaceans including four vessel collisions with entanglement of seven humpbacks with marine debris or fishing gear and one pantropical dolphin entangled in marine debris (Bradford and Lyman 2019). However, PIFSC is not requesting any take due to ship strikes as it is assumed that these events were rare occurrences that are very unlikely occur in the next five years and that little can be done to mitigate the chances of a future occurrence other than the standard monitoring and avoidance procedures already in place. Impacts would be minor adverse.

PIFSC considered the risk of interaction with marine mammals for all the research gears it uses but did not request incidental takes in research gears other than midwater trawls, longline, and instrument deployments. PIFSC also uses bottomfishing hook-and-line gear, troll gear, bongo nets, baited traps, SCUBA gear, and other gears and scientific instruments in the course of conducting fisheries and ecosystem research (Table 2.2-1) that are not considered to present reasonable risks of incidental takes of marine mammals and for which no take requests have been made.

In addition to Level B harassment takes for many species through acoustic disturbance, PIFSC is requesting Level B harassment takes for Hawaiian monk seals due to the physical presence of researchers in nearshore waters and beaches. Given the existing protocols for monitoring and avoiding interactions with monk seals, these potential takes would likely result in only temporary disturbance of small numbers of monk seals and adverse impacts would be minor.

Given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse for all research areas under each of the three research alternatives. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse for all three research alternatives.

The overall impacts to marine mammals would be similar among the three research alternatives, and would be minor to moderate in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

Under the No Research Alternative, PIFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters of the HARA, MARA, ASARA, or WCPRA, with the exception of directed marine mammal research conducted under MMPA section 101 research permits. These surveys could continue but would not be authorized to deploy active acoustic gear or nets that may interact with marine mammals. This would eliminate the potential for direct effects on marine mammals through disturbance, entanglement in gear, changes to prey availability, and contamination of the marine environment in all four research areas and for all species of marine mammals. However, many of the PIFSC non-marine mammal research projects that would be eliminated under this alternative sometimes include opportunistic observations of marine mammals made from the deck of the vessels (transects while vessels are underway) which provide information on the abundance and distribution of marine mammals in these four research areas. Oceanographic and fisheries data collected by PIFSC is also important for monitoring the ecological status of the environment important to marine mammals. While there would be no direct effects on marine mammals due to adverse interactions with ships and scientific gear, the loss of observational and ecological information important to marine mammals would indirectly affect resource management decisions concerning the conservation of marine mammals. There are too many unknown variables to estimate the magnitude of effects this lack of information would mean to any particular stock of marine mammal but they would likely be minor in the near future. Through these indirect effects on future management decisions, the overall impact to marine mammals would be adverse and minor for all four PIFSC research areas under the No Research Alternative.

4.6.5 Summary of Effects on Birds

There have been no known adverse interactions with seabirds during PIFSC research activities; there are no records of birds being hooked or caught in research gear or ship strikes. All three of the research alternatives include the use of fishing gear (e.g., trawls, longlines) that have had substantial incidental catch of seabirds in commercial fisheries. However, research gear is generally smaller than commercial gear and research protocols are quite different than commercial fishing practices. In particular, fisheries research uses much shorter duration sets than commercial fisheries and no bait/offal is thrown overboard while research gear is in the water, thereby greatly reducing the attraction of seabirds to research vessels. Based on this historical lack of interactions between seabirds and equipment used for PIFSC fisheries and ecosystem research, incidental take of seabirds in research gear is unlikely.

Outdoor lighting on research vessels could result in seabird disorientation, fallout, and injury or mortality. To minimize potential project impacts to seabirds during their breeding season, the use of lights and lighting intensity on vessels where PIFSC research activities are conducted would be minimized. Based on the history of minimal interaction/observation of seabirds landing on, or circling both NOAA research and chartered vessels, and implementation of the aforementioned mitigation measures (e.g., minimizing use of lights at night, retrofitting vessel lighting to be fully shielded, and turning off lights temporarily (when feasible) at night when seabirds are observed), the effects of artificial lighting from any of the action alternatives are expected to be negligible.

This PEA also considers the potential for fisheries research to affect the habitat quality of seabirds through removal of prey and contamination of seabird habitat and, as described above for marine mammals, concludes that these effects would be minor adverse for all species. The overall effects on seabirds are therefore considered minor adverse under all three research alternatives. One potential mitigation measure under the Preferred Alternative (2) and Alternative 3 (Modified Research) would be for PIFSC to deploy streamer lines on longline gear to reduce the risk of catching seabirds. If seabird interactions with longline gear are documented in the future, PIFSC will evaluate whether use of streamer lines is warranted given the tradeoffs between the potential conservation benefit and changes to research protocols that might affect time-series data.

Some PIFSC surveys take bird biologists on board when there is bunk space available to conduct transect surveys for bird distribution and abundance in the PIFSC research area. This information is used by NMFS, the U.S. Fish and Wildlife Service, and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on birds.

Under the No Research Alternative, the risk of direct adverse effects on seabirds from PIFSC research would be eliminated, but there could be potential long-term minor adverse indirect impacts to seabirds because resource management authorities would lose ecological information about the marine environment important to seabird conservation.

4.6.6 Summary of Effects on Sea Turtles

The DPEA analyzes the same direct and indirect effects of PIFSC fisheries research on sea turtles as described for marine mammals. The potential for ship and small boat strikes, removal of prey, and contamination of marine habitat would be similar to the risks described for marine mammals; these effects are considered minor adverse for all species under all three research alternatives. Sea turtles hearing range is apparently well below the frequencies of acoustic instruments used in fisheries research so turtles are unlikely to detect these sounds or be affected by them. PIFSC has no history of interactions with sea turtles in research gear and the potential for injury or mortality under all of the research alternatives is very small. The overall effects of the research alternatives would therefore be considered minor adverse on all species of sea turtles.

As with marine mammals and seabirds, the No Research Alternative would eliminate the risk of direct adverse effects on sea turtles from PIFSC research. However, there could be minor adverse indirect impacts due to the loss of PIFSC-affiliated research on bycatch reduction and ecological information important to sea turtle conservation.

4.6.7 Summary of Effects on Invertebrates

PIFSC fisheries and ecosystem research conducted under all of the three research alternatives could have direct and indirect effects on many invertebrate species through physical damage to infauna and epifauna, directed take of coral specimens, mortality, changes in species composition, and contamination or degradation of habitat.

For all invertebrate species targeted by commercial fisheries and managed under FMPs, mortality due to PIFSC fisheries and ecosystem research surveys and projects is less than two percent of commercial and recreational harvest and is considered to be minor in magnitude for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities and the risk of altering benthic community structure would be minimal. Disturbance of invertebrates and benthic habitats from research activities would be temporary and minor in magnitude for all species. The overall direct and indirect effects of the Status Quo Alternative on invertebrates would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

Chambered nautilus were listed as threatened in 2018 (83 FR 48976). The likelihood of PIFSC research incidentally catching chambered nautilus is considered extremely low based on the low volume of research, short duration and disperse nature of surveys. Giant clams were petitioned to be listed under the ESA in 2016; status reviews of seven of the ten species petitioned for listed is ongoing (82 FR 28946). Bycatch of this species in PIFSC research is not anticipated and therefore potential effects of any of the action alternatives would likely be negligible.

Under the Preferred Alternative, the Northwestern Hawaiian Islands Lobster Survey is not carried forward. The elimination of this survey would substantially reduce the total mortality of lobsters from PIFSC research activities. Modified surveys include a midwater trawl added to the Cetacean Ecology Assessment Survey and increased geographic scope of the Insular Fish Abundance Estimation Comparison Surveys (deploys a BotCam, BRUVS, and MOUSS) to include the MARA, ASARA, and WCPRA. As discussed above in Section 4.2.7, these stationary bottom-contact gears have very small footprints and therefore the potential to crush, bury, remove, or expose invertebrates is also very small. In addition, ESD may conduct SfM surveys consisting of marking off plots on the seafloor (1-3 m depth) with cable ties or stainless steel pins, collecting photographs of the plots and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images. New research would result only in minor, temporary effects (if any) because gear is temporarily deployed on the seafloor to mark off plots, removed once photos are taken.

The overall effects of the Preferred Alternative on invertebrates would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1. The RAMP survey under all alternatives would potentially collect samples of ESA-listed corals which are considered an adverse effect for those individuals collected. However, overall, no population-level effects on coral species would occur as a result of collecting such a small number of samples. To the contrary, by collecting coral samples, research aims to contribute towards improved conservation measures for coral species.

The Modified Research Alternative includes potential spatial/temporal restrictions on where and when PIFSC research could occur. Spatial/temporal restrictions may reduce impacts on invertebrates in certain areas such as marine protected areas if such closures were determined to be effective mitigation measures. Such restrictions could also reduce overall research fishing effort in important habitats and limit the ability of PIFSC to sample invertebrate species as prescribed in their research plans. However, specific determinations about potential research restrictions have not been made and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Preferred Alternative. Overall effects on invertebrates would therefore be similar even if research was conducted in somewhat different places and times. Thus, overall impacts to invertebrates under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

In addition to these minor adverse effects, each of the three research alternatives would contribute to long-term beneficial effects on invertebrate species throughout the Pacific Islands Region through the contribution of PIFSC fisheries research. Specifically, the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing and planning conservation strategies, and detecting ecosystem shifts.

Under the No Research Alternative, there would be no direct effects of PIFSC fisheries and ecosystem research on invertebrates through physical damage, directed take of coral, mortality, changes in species composition, and contamination. However, the loss of scientific information about invertebrates would impede the ability of fisheries managers to effectively assess and monitor stocks, set harvest limits, or develop necessary regulations to protect vulnerable stocks. For non-commercial species (e.g., various corals), the absence of new fieldwork conducted and funded by PIFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers. Although other data are available to support resource management decisions, the interruption or cessation of long-term data series on commercially valuable invertebrate stocks could lead to increased uncertainty and changes in some management scenarios. Management authorities would lose important information needed to establish sustainable harvest limits and help conserve and restore benthic habitats. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on invertebrate stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact of the No Research Alternative on commercially important invertebrate stocks would be considered moderate adverse according to the impact criteria in Table 4.1-1.

4.6.8 Summary of Effects on the Social and Economic Environment

The effects of PIFSC fisheries and ecosystem research on the social and economic environment are expected to be very similar under all three research alternatives. Each of these alternatives would include important scientific contributions to sustainable fisheries management for some of the most diverse and important commercial and recreational fisheries throughout the Pacific Island region, which benefits commercial and non-commercial fisheries and the communities that support them. These industries have regionally large economic footprints, generate millions of dollars' worth of sales and thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. Millions of non-commercial fishers also participate and support fishing service industries. PIFSC fisheries research activities would also have minor to moderate beneficial impacts to the economies of fishing communities through direct employment, purchase of fuel, vessel charters, and supplies. Continued PIFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers. The overall effects of PIFSC-affiliated research would be long-term, distributed widely across the Pacific Island region, and would be considered minor to moderately beneficial to the social and economic environment for all three research alternatives.

The impacts of the No Research Alternative would be the inverse of the three research alternatives. It would likely have minor to moderate adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas (i.e., underutilized stocks and lost opportunity) or an increased risk of overfishing, followed by reductions in commercial and non-commercial fisheries harvests. The lack of scientific information would also compromise efforts to rebuild overfished stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would adversely affect the ability of NMFS to comply with its obligations under the MSA. It would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No Research Alternative would also have long-term adverse impacts on the scientific information PIFSC contributes to meet U.S. obligations for living marine resource management under international treaties.

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5.1 INTRODUCTION AND ANALYSIS METHODOLOGY

The CEQ defines cumulative impact as:

> *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).*

Cumulative effects are assessed by aggregating the potential direct and indirect effects of the proposed action with the impacts of past, present, and reasonably foreseeable future actions (RFFAs) in the vicinity of the project. The ultimate goal of identifying potential cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the project alternatives. As suggested by the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act (1997)*, the following basic types of cumulative effects are also considered:

- Additive – the sum total impact resulting from more than one action,
- Countervailing – adverse impacts that are offset by beneficial impacts, and
- Synergistic – when the total impact is greater than the sum of the effects taken independently.

Cumulative effects may result from the incremental accumulation of similar effects or the synergistic interaction of different effects. Repeated actions may cause effects to build up over time, or different actions may produce effects that interact to produce cumulative impacts greater than (or less than) the sum of the effects of the individual actions.

As directed by CEQ's NEPA regulations (40 CFR 1502.16), direct and indirect impacts on specific physical, biological, and social resources are discussed in combination with varying levels of effects, ranging from negligible to major. While the effects of individual actions may be only minor, substantial cumulative effects may result from multiple actions occurring in the same geographic area. The implementing regulations of NEPA require analysis of cumulative effects in order to alert decision makers of the full consequences of all actions affecting a resource component and assess the relative contribution of the proposed action and alternatives.

Chapter 3 of this PEA provides baseline information on the physical, biological, and social components of the environment that may be affected by PIFSC research activities, including summaries of historic activities within the four PIFSC research areas. Chapter 4 provides an analysis of the direct and indirect effects on these resources of the four alternatives considered in this EA. Because the first three alternatives involve the continuation of PIFSC research activities (referred to collectively as the action alternatives) and contribute similar effects to the cumulative effects on most resources, they are generally considered together in the following Chapter 5 analysis. The contribution of the No Research Alternative to cumulative effects is quite different and is considered separately for each resource.

5.1.1 Analysis Methodology

The cumulative effects analysis methodology is similar to the effect assessment methodology for direct and indirect effects in Section 4.1. It consists of the following steps:

1. Define the geographic area and timeframe. These may vary between resource components.
2. Identify external actions 15, including:
    a. Past actions that have already occurred and resulted in lasting effects (see Chapter 3),
    b. Present actions occurring within the same timeframe as the proposed action and alternatives (see Chapter 3), and
    c. Reasonably foreseeable future actions, which are planned and likely to occur (see Table 5.1-1).
3. Evaluate the direct and indirect effects of the alternatives along with the adverse and beneficial effects of external actions and rate the cumulative effect using the effects criteria table (Table 4.1-1).
4. Assess the relative contribution of the alternatives to the cumulative effects.

5.1.2 Geographic Area and Timeframe

The cumulative effects analysis considers external actions that influence the geographic areas where PIFSC surveys occur; these areas include the HARA, MARA, ASARA, and WCPRA, as described in Section 3.1 and illustrated in Figure 1.1-2. Some actions that originate outside of the PIFSC research areas, such as discharge of pollutants, or actions that influence populations of highly migratory species, could potentially contribute to cumulative effects within the geographic areas of interest; such actions are considered in the analysis of cumulative effects. Other actions considered in the analysis of cumulative effects may be geographically widespread, such as those that could potentially result in climate change or ocean acidification. Although discussions of past actions primarily focus on the last five years, the availability of existing information and the period of time that must be considered to understand the baseline conditions vary between resource components. All analyses project five years into the future from the date this PEA is finalized.

5.1.3 Reasonably Foreseeable Future Actions

Table 5.1-1 summarizes the RFFAs external to PIFSC fisheries research that are likely to occur in the next five years and the resources they are likely to affect. This information has been collected from a wide variety of sources, including recent NEPA documents covering the Pacific Islands marine environment, federal and state fishery agency websites and documents, U.S. Navy websites and documents, and a variety of documents concerning recreation and tourism, coastline development, and other activities. Wildlife management documents such as endangered species recovery plans and take reduction plans for sea turtles and marine mammals were also consulted to identify conservation concerns for different species and habitats.

Deciding whether to include actions that have already occurred, are ongoing, or are reasonably foreseeable in the cumulative impacts analysis depends on the resource being analyzed. Past,

[15] External actions are other human activities and natural occurrences that have resulted or will result in effects to the resource components that comprise the affected environment.

ongoing, and future actions must have some known or expected influence on the same resources that would be affected by the alternatives to be included in the cumulative impacts analysis. CEQ refers to this as the cause-and-effect method of connecting human activities and resources or ecosystems. The magnitude and extent of the effect of an action on a resource or ecosystem depends on whether the cumulative impacts exceed the capacity of the resource/ecosystem to sustain itself and remain productive over the long-term.

CEQ guidelines state that "it is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful." In general, actions can be excluded from the analysis of cumulative impacts if:

- The action is outside the geographic boundaries or time frame established for the cumulative impacts analysis.
- The action will not affect resources that are the subject of the cumulative impacts analysis.
- The action is not planned or is not reasonably foreseeable (e.g., formally proposed, planned, permitted, authorized, or funded).

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Table 5.1-1 Reasonably Foreseeable Future Actions (RFFAs) related to PIFSC Research Areas

Blank cells indicate no effects on that resource.

Action	PIFSC Research Area				Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	HARA	MARA	ASARA	WCPRA								
Other (Non-PIFSC) Scientific Research	X	X	X	X	Sea floor disturbance	Habitat disturbance	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource	Increased understanding of environment leading to better resource management
					Presence of additional vessel traffic and survey equipment	Contamination (spills, discharges)	Habitat disturbance	Behavioral disturbance or displacement	Loss from avian by-catch	Loss/injury from ship or small boat strikes	Loss or displacement due to habitat disturbance	
					Short-term turbidity increase		Behavioral disruptions	Loss/injury from ship strikes	Potential for ship collisions (lighting attraction)		Coral reef damage	
					Contamination (spills, discharges)		Removal of individuals and biomass	Noise responses			Removal of individuals and biomass	
					Generation of marine debris							
Federal and State Managed Fisheries	X	X	X	X	Seafloor disturbance	Habitat disturbance	Removal of managed targeted fisheries species	Loss/injury from ship strikes	Loss from avian by-catch	Loss/injury from ship or small boat strikes	Removal of individuals and biomass (e.g., crustaceans)	Provision of jobs and economic opportunity
					Generation of marine debris	Contamination (spills, discharges)	By-catch removal of non-target species	Loss/injury from entanglement/hooking	Potential for ship collisions (lighting attraction)	Loss/injury from turtle by-catch	Coral reef damage	Provision of food and industrial raw materials
					Presence of additional vessel traffic	Generation of marine debris	Habitat disturbance	Noise responses	Alteration or reduction of prey resources	Loss/injury from entanglement/hooking with fishing gear	Indirect loss or displacement due to habitat disturbance	Cost of operations and gear requirements
					Short-term turbidity increase		Behavioral disruption	Alteration or reduction of prey resources			Invasive species	Need for catch limits for resource management
					Contamination (spills, discharges)		Loss from capture by derelict gear	Behavioral disturbance or displacement				Need for time/area closures for resource management
					Re-suspension of disposal material		Invasive species					

Action	PIFSC Research Area				Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	HARA	MARA	ASARA	WCPRA								
Other Fishing Operations (Charter, Private, or Traditional)	X	X	X	X	Presence of additional vessel traffic	Habitat disturbance	Removal of managed targeted fisheries species	Loss/injury from ship strikes	Loss from avian by-catch	Loss/injury from ship strikes	Direct loss or displacement	Direct provision of jobs and economic opportunity
					Seafloor disturbance	Contamination (spills, discharges)	By-catch removal of non-target species	Loss/injury from entanglement/hooking	Potential for ship collisions (lighting attraction)	Loss/injury from turtle by-catch	Indirect loss or displacement due to habitat disturbance	Indirect support of tourist/resort economy
					Generation of marine debris	Generation of marine debris	Habitat disturbance	Noise responses	Alteration or reduction of prey resources	Loss/injury from entanglement/hooking with fishing gear	Coral reef damage	Provision of recreational opportunities
					Short-term turbidity increase		Behavioral disruption	Alteration or reduction of prey resources				Provision of food
					Contamination (spills, discharges)		Loss from capture by derelict gear	Behavioral disturbance or displacement				
Recreation and Tourism	X	X	X	X	Presence of additional vessel traffic	Habitat disturbance	Behavioral Disruption	Noise responses	Noise responses	Loss/injury from ship strikes	Loss or displacement due to habitat disturbance	Provision of jobs and economic opportunity
					Generation of Marine debris	Generation of Marine debris	Habitat disturbance	Behavioral disturbance or displacement	Potential for ship collisions (lighting attraction)	Noise responses	Loss/injury due to contamination	Provision of recreational opportunities
								Loss/injury from ship strikes	Loss/injury due to ingestion/entanglement in marine debris	Displacement	Invasive species (Cruise ship ballast water)	
								Loss/injury due to ingestion or entanglement in marine debris		Loss/injury due to ingestion/entanglement in marine debris		
Military Operations	X	X	Army reserve unit and Coast Guard	X	Contamination of water and sediment	Contamination (spills, discharges)	Noise effects (stress, altered behavior, auditory damage)	Loss/injury from ship strikes	Injury/loss due to entanglement in marine debris	Noise effects, (stress, altered behavior, auditory damage)	Injury/loss due to contamination	Temporary and localized disruption of fishing due to operations
					Generation of marine debris, including munitions	Generation of marine debris, including munitions	Mortality near detonation	Noise effects (stress, altered behavior, auditory damage)	Potential for loss from ship collisions (lighting attraction)	Loss/injury from ship strikes	Mortality near detonation	Maintaining National Defense
					Presence of additional vessel traffic		Loss/injury from contamination	Behavioral disturbance	Behavioral disturbance	Loss/injury from ingestion/entanglement in marine debris	Coral reef damage	
							Contamination of fish for human consumption	Displacement	Mortality near detonation	Mortality near detonation	Invasive species	
								Mortality near detonation	Displacement			
								Injury/loss due to ingestion or entanglement in marine debris				

Action	PIFSC Research Area				Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	HARA	MARA	ASARA	WCPRA								
Vessel Traffic (Shipping)	X	X	X	X	Contamination of water and sediment	Increased risk from invasive species due to long-distance shipping activity	Loss due to competition or predation from invasive species	Loss/injury from ship strikes	Loss/injury from contamination	Loss/injury from contamination	Invasive species	Direct provision of jobs and economic opportunity
					Re-suspension of sediment	Contamination (spills, discharges)	Loss/injury from contamination	Displacement	Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss due to competition or predation from invasive species	
							Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/injury due to ingestion/entanglement in marine debris	Loss/injury due to ingestion/entanglement in marine debris	Loss/injury from contamination	
								Behavioral disturbance	Loss from ship collisions (lighting attraction)			
								Loss/injury due to ingestion/entanglement in marine debris				
								Disruption of migration patterns				
Vessel Traffic (Other)	X	X	X	X	Contamination of water and sediment	Increased risk from invasive species due to long-distance shipping activity	Loss due to competition or predation from invasive species	Loss/injury from ship strikes	Loss/injury from contamination	Loss/injury from contamination	Loss due to competition or predation from invasive species	
					Re-suspension of sediment	Contamination (spills, discharges)	Loss/injury from contamination	Displacement	Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/injury from contamination	
							Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/injury due to ingestion/entanglement in marine debris	Loss/injury due to ingestion/entanglement in marine debris		
								Behavioral disturbance	Loss from ship collisions (lighting attraction)			
								Loss/injury due to ingestion/entanglement in marine debris				
Ocean Disposal and Discharges	X	X	X		Sea floor disturbance	Contamination	Bioaccumulation of contaminants	Bioaccumulation of contaminants	Bioaccumulation of contaminants	Bioaccumulation of contaminants	Bioaccumulation of contaminants	Potential indirect impact on subsistence resources
					Increased sedimentation	Disturbance of benthic habitats Sea floor disturbance	Loss/injury from contamination	Loss/injury from contamination	Loss/injury from contamination	Loss/injury from contamination	Loss/injury from contamination	
					Increased turbidity	Increased sedimentation	Habitat disturbance	Loss/injury from ship strikes	Alteration or reduction of prey resources	Alteration or reduction of prey resources	Habitat disturbance	
					Toxic contamination Eutrophication			Alteration or reduction of prey resources	Habitat disturbance	Habitat disturbance		
								Habitat disturbance				
Dredging	X	X	X		Sea floor disturbance	Sea floor disturbance	Loss of habitat due to sea floor disturbance	Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/displacement due to turbidity	

Action	PIFSC Research Area				Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	HARA	MARA	ASARA	WCPRA								
					Increased turbidity	Increased turbidity	Displacement due to turbidity	Loss/injury from ship strikes	Habitat disturbance/alteration	Mortality by entrainment in dredge	Indirect loss or displacement due to habitat disturbance	
					Contamination of water and sediment			Habitat disturbance/alteration	Alteration or reduction of prey resources	Habitat disturbance/alteration	Coral reef damage	
								Alteration or reduction of prey resources		Alteration or reduction of prey resources		
Coastline Development	X	X	X		Sea floor disturbance	Sea floor disturbance	Loss/alteration of habitat due to shoreline disturbance	Loss/alteration of habitat due to shoreline disturbance	Loss/alteration of habitat due to shoreline disturbance	Loss/alteration of habitat due to shoreline disturbance	Coral reef damage	Direct provision of jobs and economic opportunity
					Increased turbidity	Increased turbidity		Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)		Loss/displacement due to turbidity	
											Indirect loss or displacement due to habitat disturbance	
Geophysical/ Geotechnical Activities	X	X			Sea floor disturbance	Sea floor disturbance	Habitat disturbance	Acoustic effects from noise	Loss from ship collisions (lighting attraction)	Loss/injury from ship strikes	Habitat disturbance	
					Localized increased turbidity		Acoustic effects from noise	Loss/injury from ship strikes	Behavioral disturbance	Behavioral disturbance	Localized benthos disturbance	
								Behavioral disturbance				
Sea Turtle Conservation Measures	X	X	X							Decreased serious injury and mortality		Cost to fisheries, gear modifications
										Habitat protection		
Marine Mammal Conservation Measures	X	X	X					Decreased serious injury and mortality				Cost to fisheries
								Habitat protection				Displacement of personnel from fishing and other marine activities
												Need for time/area closures
Climate Change	X	X	X	X	Sea level rise, saltwater infusion in estuaries and coastal habitats	Sea level rise, saltwater infusion in estuaries and coastal habitats	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Rising water levels in coastal areas

Action	PIFSC Research Area				Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	HARA	MARA	ASARA	WCPRA								
					Increased erosion and siltation	Increased erosion and siltation						Potential changes in fisheries due to ecosystem changes
					Increased water temperatures	Increased water temperatures						New regulations on greenhouse gas emissions
					More extreme storm events	More extreme storm events						Incentives for higher vessel fuel efficiency
Ocean Acidification	X	X	X	X	Increased pCO_2	Decreased calcification among food web organisms	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Decreased calcification, shell hardening impaired	Potential effects on fisheries, especially for invertebrate species
					Decreased pH	Change in primary production	Potential direct adverse effects on growth, reproduction, development				Potential adverse effects on prey, availability of nutritional minerals	
											Coral bleaching	
Natural Events (Tsunami, Volcano, Earthquake, Hurricane)	X	X	X	X	Saltwater infusion in estuaries and coastal habitats		Habitat disturbance	Habitat disturbance	Habitat disturbance	Habitat disturbance	Coral reef damage	Cost to fisheries
					Increased erosion and siltation		Variable effects on different species	Variable effects on different species	Variable effects on different species	Variable effects on different species	Variable effects on different species	Job loss
					Turbidity							
					Contamination							

List of supporting documents for PIFSC RFFA table:

Hawaiian Monk Seal Recovery Actions PEIS 2011

Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region FEIS 2005

http://www.fpir.noaa.gov/

Fishery Ecosystem Plan for the Mariana Archipelago 2009

Guam and CNMI Military Relocation EIS 2010

Fishery Ecosystem Plan for the American Samoa Archipelago 2009

http://www.epa.gov/region9/water/dredging/disposalsites.html

Fishery Ecosystem Plan for the Pacific Remote Island Areas 2009

Maritime Shipping Routes and Strategic Passages – https://transportgeography.org/wp-content/uploads/Map_Strategic_Passages.pdf

Final PEIS for Hawaiian Monk Seal Recovery Actions 2014

5.2 CUMULATIVE EFFECTS ON THE PHYSICAL ENVIRONMENT

Activities external to PIFSC fisheries research that could potentially affect the physical environment in the HARA, MARA, ASARA, and WCPRA may include other scientific research, federal and state managed fisheries, other fishing operations, military operations, vessel traffic, ocean-based recreation, ocean disposal and discharges, dredging, coastal development, geophysical activities, climate change, ocean acidification, and natural disasters. The potential effects of these activities are summarized in Table 5.1-1 and include:

- Seafloor disturbance
- Presence of additional vessel traffic and survey equipment
- Generation of marine debris
- Contamination of water and sediments
- Increased turbidity and sedimentation and re-suspension of sediments
- Effects of climate changes such as water temperatures and sea level rise
- Increased pCO_2 and decreased pH
- Effects of natural disasters such as increased erosion and siltation

5.2.1 External Factors in the PIFSC Research Areas

Activities that may adversely affect the physical environment of the HARA have occurred and are expected to continue to occur in the future. Due to higher development activities in this research area, the HARA has had the most adverse cumulative effects. Sources of impacts from these activities to the physical environment of the HARA are identified in Table 5.1-1.

Past activities that affected the seafloor in the HARA included other scientific research, commercial and non-commercial fisheries, military operations, ocean disposal and discharges, dredging operations, coastline development, and geophysical and geotechnical operations. These activities will also continue to influence the seafloor habitat in the HARA. Non-PIFSC scientific research activities include, but are not limited to, impacts from trawl sampling gear, diver surveys, and pot fishing studies. However, these activities provide beneficial contributions to biological resources and fisheries management considerations.

Current activities that potentially disturb the seafloor include not only fishing and aquaculture activities, but also heavy industrial activities such as channel dredging and construction of various nearshore and offshore developments, as well as military operations using heavy ordnance. These activities cause re-suspension of sediments into the water column, changes in bathymetric contours, and potential loss of benthic habitat. These activities also directly or indirectly introduce marine debris into the water (e.g., monofilament fishing line, nets, plastic) that often ends up on the seafloor or wrapped onto a shallow reef.

Contamination from spills and discharges can accumulate in the seafloor and marine life and have a toxic effect on the plants, animals, and humans through the food chain (NOAA 2010d). There are huge numbers of potential sources of both direct and indirect marine contamination, including tankers and other marine vessels, derelict fishing gear, military operations, ocean dumping, airborne deposition, and runoff from industrial and agricultural sources on land. Some chemical compounds, such as polychlorinated biphenyl and pesticides, can persist for many years while others, such as petroleum products, breakdown relatively quickly. Similarly, marine debris can affect the physical environment (NOAA 2010c) but most of these effects are manifested through impacts to biological systems, which are discussed in other sections of this document. Pollution is a long-term and widespread issue in the marine environment, although it varies substantially in intensity on a local basis. In recent years there has been a concerted national and international effort to reduce pollution of ocean environments through restrictions on discharges and design features of ocean-going vessels that reduce the probability and severity of spills. As a result, although the historic problems remain, recent incidents involving unauthorized spills or discharges have either been localized and limited or, if large and widespread, have generated cleanup and mitigation responses. For the waters in the Pacific Islands Region around individual islands and atolls, ocean mixing is generally high and as a result, discharges are diluted relatively quickly. Broadly speaking therefore, the cumulative effects of pollution and contamination on water quality of the PIFSC research area is expected to be minor to moderate and adverse from sources external to fisheries research.

Climate change may affect the marine environment in a variety of ways, including changes in sea level, changes in water temperatures, more frequent or extreme weather events, and alteration of ocean currents. These changes and others are expected to continue over the reasonably foreseeable future and could aggregate with the effects of industrial activity to impact the physical environment. These changes contribute in turn to changes in the population and distribution of marine fish, mammals, seabirds, and turtles; changes in the population and distribution of fishery resources harvested in commercial fisheries, with related socioeconomic effects; and changes in FMPs or FEPs to address potential climate change effects.

In addition to changes in air and water temperatures, a related effect of climate change is increased acidification in the ocean caused by dissolved carbon dioxide (CO_2). Changes in the acidity of the world's oceans are expected to continue and accelerate over the reasonably foreseeable future (USGS 2011). Ocean acidification can harm organisms that build shells of calcium carbonate, including calcareous phytoplankton and zooplankton, corals, bryozoans, mollusks, and crustaceans. These organisms provide shellfish resources for humans, play vital roles in marine food webs, generate sand for beaches and add to the physical structure of the ocean floor (NRC 2010). Although the dynamics of climate change and the potential magnitude and timing of its effects are poorly understood, there is general acknowledgement that the potential impacts resulting from climate change could be substantial.

5.2.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on the physical environment in the PIFSC research areas are discussed in sections 4.2.1, 4.3.1, and 4.4.1. Direct and indirect effects to benthic habitat (seafloor disturbance) and removal of organisms that produce structure would be minor and adverse. Because no ocean disposal or discharges would be authorized for PIFSC research activities under the research alternatives, there would be no contribution to cumulative effects from this action. There is the potential for accidental spills to occur or for research fishing gear or instruments to be lost. However, given the high degree of emphasis placed on safety and emergency preparedness on NOAA Corps vessels and USCG requirements for training and safety equipment on commercial vessels, the magnitude of these potential spills is likely to be very small and the contribution of fisheries research to the cumulative effects of contamination is considered minor. Additionally, the accidental loss of research fishing gear or instruments during PIFSC surveys is rare. Given the relatively low effort of research activities over a very large geographic area, compared to all of the commercial and non-commercial activities in the Pacific Islands Region, the PIFSC contribution to adverse impacts to the physical environment would be relatively minor. Furthermore, the Marine Debris Research and Removal Survey activities remove tons of derelict fishing gear each year from the Pacific Islands Region, resulting in a beneficial impact on the physical environment.

Although CO_2 emissions from PIFSC research vessels would contribute to atmospheric CO_2 levels, the contribution would be minor compared to other natural and anthropogenic CO_2 sources. When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the PIFSC research areas, PIFSC research activities would make a minor additive contribution to cumulative adverse effects on the physical environment under each of the research alternatives.

Fisheries research programs contribute to the understanding of changes in the physical environment, including those associated with climate change and ocean acidification. Continued fisheries research programs with long-term data sets are essential to understanding changes in the physical and biological environment and allowing NMFS to take appropriate management actions. Understanding changes in the physical environment that may affect ESA-listed species is particularly useful. PIFSC fisheries research therefore makes a beneficial contribution to cumulative effects on the physical environment.

5.2.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate the risk of direct adverse impacts to physical resources within the PIFSC research areas resulting from PIFSC research activities. However, many of PIFSC projects that would be eliminated under this alternative generate a great deal of information that, when combined with research conducted by other branches of NOAA and other agencies and institutions not included in this PEA, is used to monitor the effects of climate change, ocean acidification, and other changes in the physical environment. It may also be used by resource managers to limit fishing-related impacts to physical habitat such as disturbance of benthic habitat from dredging and other bottom-contact gear. Without the input of PIFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect physical properties of the environment would become less effective. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty relating to future management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on physical resources would be minor to moderate depending on how well other agencies would be able to compensate for the loss of PIFSC research.

5.3 CUMULATIVE EFFECTS ON SPECIAL RESOURCE AREAS AND EFH

Activities external to PIFSC fisheries research that could potentially affect special resource areas in the HARA, MARA, ASARA, and WCPRA may include commercial and non-commercial fisheries, coastal development, coastal recreation, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Contamination resulting from spills or discharges
- Presence of additional vessel traffic
- Habitat disturbances
- Increased risk of invasive species introductions resulting from long-distance shipping activity
- Effects of climate change such as increased water temperatures and sea level rise
- Effects of ocean acidification such as decreased calcification among food web organisms

5.3.1 External Factors in the PIFSC Research Areas

As described in Section 3.2, Special Resource Areas include EFH, HAPC, and MPAs including MNMs, and NMSs. The cumulative effects of activities that disturb the seafloor in special resource areas are similar to those discussed for the physical environment in Section 5.2.1. Cumulative impacts to biological resources within special resource areas are discussed in Sections 5.4 through 5.8. Cumulative effects from, dredging, military operations, and geophysical exploration would be considered as part of the federal permitting processes required for these activities. Contributions to cumulative effects from such activities would be limited by permit conditions and mitigation measures required by permitting agencies.

Adverse impacts from fishing, especially those using bottom-contact fishing gear, could be substantial in heavily fished areas and could affect EFH and component HAPC areas to various degrees. Detailed descriptions of specific prohibited gear types by area are provided in Section 3.1.2.1. The cumulative effect from all external sources of disturbance to special resource areas is expected to be minor to moderate.

5.3.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on special resource areas in the Pacific are discussed in Sections 4.2.2, 4.3.2, and 4.4.2. When aggregated with the impacts of past, present, and reasonably foreseeable future actions in the vicinity of the project, PIFSC research activities would make a minor additive contribution to cumulative adverse impacts to special resource areas in the HARA, MARA, ASARA, and WCPRA under each of the research alternatives. While there are no intentional discharges of pollutants from fisheries research vessels there is potential for accidental spills to occur. However, the magnitude of these potential spills is likely to be very small and the contribution of fisheries research to the cumulative effects of contamination is considered minor.

PIFSC fisheries research programs contribute to understanding the status of special resource areas, including changes to EFH associated with climate change and ocean acidification. Continued fisheries research programs with long-term data sets are essential to understanding changes in the physical and biological environment within special resource areas, which by definition have special management needs. Furthermore, many special resource areas have been identified as valuable reference sites to compare existing marine resources with relatively low- or no-impact ecosystems that are also habitat for rare species. PIFSC fisheries research therefore has a beneficial contribution to cumulative effects on special resource areas in addition to the minor adverse effects.

5.3.3 Contribution of the No Research Alternative

The No Research Alternative would result in elimination of any direct impacts from PIFSC fisheries research to special resource areas that could potentially occur under each of the research alternatives. However, PIFSC research activities proposed under the research alternatives would generate information important to resource managers to monitor species and habitat recovery, environmental changes, and the effectiveness of conservation measures for special resource areas. This type of information is especially important for management of special resource areas designated to protect and conserve natural resources that are susceptible to natural fluctuations and anthropogenic impacts. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios that may affect a few local areas. Through these indirect effects on future management decisions, the contribution of this alternative to cumulative impacts on special resource areas, including MNMs and NMSs, would be minor adverse.

5.4 CUMULATIVE EFFECTS ON FISH

Activities external to PIFSC fisheries research that could potentially affect fish species in the HARA, MARA, ASARA, and WCPRA may include commercial and recreational fisheries, other scientific research, military operations, vessel traffic, ocean disposal and discharges, dredging, coastal development, geophysical/geotechnical activities, climate change, and ocean acidification. These activities and potential effects are summarized in Table 5.1-1 and include:

- Habitat disturbances
- Behavioral disruptions
- Removal of managed targeted fisheries species
- Bycatch removal of non-target species
- Invasive species
- Noise effects
- Loss/injury from contamination
- Loss due to competition or predation from invasive species
- Loss of habitat and displacement from seafloor disturbance, shoreline alteration, or turbidity
- Ecosystem level changes

5.4.1 External Factors in the PIFSC Research Areas

5.4.1.1 ESA-listed Species

As discussed in Section 4.2.3.1, there are three fish species in the project area listed as threatened or endangered under the ESA: the Indo-West Pacific DPS scalloped hammerhead shark, the oceanic whitetip shark, and the giant manta ray. Only four scalloped hammerhead sharks have been caught by PIFSC, all of which belonged to the non-ESA-listed Central Pacific DPS. Furthermore, all four of these captures were released alive with no resulting mortality. No takes of oceanic white tip sharks or giant manta rays have occurred during PIFSC research.

The past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on Indo-West Pacific DPS scalloped hammerhead sharks in the PIFSC research areas external to PIFSC fisheries research are intentional and incidental takes in commercial and non-commercial fisheries. Scalloped hammerhead sharks are taken as bycatch in the Hawai‘i-based pelagic longline fishery which targets tunas and billfish. Fishery observer data from 1995 to 2006 indicate a low catch number of scalloped hammerhead sharks (56 individuals from 26,507 total sets). More recent data from 2009 to 2011 indicates even fewer caught individuals (Miller et al. 2013, Walsh et al. 2009).

The activities external to PIFSC fisheries research affecting scalloped hammerhead sharks will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable but are also likely to continue into and beyond the foreseeable future.

5.4.1.2 Target and Other Species

Target species are those fish which are managed for commercial and recreational fisheries and are the subject of PIFSC research surveys for stock assessment purposes or are often caught as incidental bycatch. These fisheries are the primary past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on these species in PIFSC research areas external to PIFSC fisheries research. Natural population fluctuations and periodic short-term and longer-term climate changes also affect population viability and stock sizes.

The numerous target species in PIFSC research areas are managed through the WPRFMC and several FMPs. The analysis of effects in Chapter 4 focuses on those species most frequently caught (in quantities of 100 lbs. or more) in PIFSC research activities and species that are considered overfished (Tables 4.2-1 through 4.2-4). The cumulative effects analysis takes a similar approach.

The striped marlin is the only overfished target species encountered during PIFSC surveys (Table 4.2-5). Annual commercial catch of this species for 2013 was 983,440 lbs. A stock that is overfished is one whose biomass level is sufficiently depleted to jeopardize the stock's ability to produce at Maximum Sustainable Yield (NMFS 2012). Other overfished stocks occur in PIFSC research areas but have not been caught during surveys, including the Hancock Seamount Groundfish Complex and bluefin tuna.

The activities external to PIFSC fisheries research affecting target and other species will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures and management schemes. The potential effects of climate variability are unpredictable but are also likely to continue into and beyond the foreseeable future.

5.4.2 Contribution of the Research Alternatives

5.4.2.1 ESA-listed Species

As discussed above, listed fish species have not been taken during PIFSC research activities. When considered in conjunction with commercial and recreational fisheries and other external activities affecting ESA-listed scalloped hammerhead sharks, oceanic white tip sharks, and giant manta rays in PIFSC research areas, the contribution of PIFSC fisheries and ecosystem research to cumulative effects would be considered minor adverse.

5.4.2.2 Target and Other Species

The average catch of target species under the Status Quo Alternative during PIFSC research surveys in all research areas (Tables 4.2-1 to Table 4.2-5) is orders of magnitude smaller than commercial harvest levels. For example, the PIFSC average annual catch of broadbill swordfish under the Status Quo Alternative in the HARA (212 lbs.) is the equivalent of <0.01 percent of the 2013 commercial landings. For all of the species listed in Tables 4.2-1 through 4.2-4 for which ACLs is established or commercial catch levels are known, research catch is less than three percent of commercial takes or ACLs. The average catch of target species under the Preferred Alternative during PIFSC research surveys in all research areas (Tables 4.3-1 and 4.3-2) is orders of magnitude smaller than most commercial harvest levels. For some species, such as bluefin trevally, bicolor parrotfish, and blue shark, the estimated research catch exceeds three percent of ACLs or commercial catch. However, the magnitude of research mortality for these species is still small relative to the estimated populations of these fish. For target species in all research areas under the research alternatives, mortality from PIFSC research surveys would be considered minor on the population level.

While mortality to target and other fish species is a direct effect of PIFSC surveys, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of fish taken in commercial and recreational fisheries, which are just fractions of the total populations for these species.

When considered in conjunction with commercial and recreational fisheries and other external activities affecting target and other species in the HARA, MARA, ASARA, and WCPRA, the contribution of PIFSC fisheries and ecosystem research to cumulative effects would be minor adverse under all the research alternatives. PIFSC fisheries research also has beneficial contributions to fish species through its contribution to sustainable fisheries management decisions and would help to address a range of adverse cumulative effects.

5.4.3 Contribution of the No Research Alternative

5.4.3.1 ESA-listed Species

Under the No Research Alternative, PIFSC would no longer conduct or fund research in the project area, so would not indirectly contribute to cumulative effects on ESA-listed scalloped hammerhead sharks, oceanic white tip sharks, and giant manta rays in this region. In the absence of research surveys, important scientific information would not be collected about the prey of these species, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. This lack of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild overfished stocks. The indirect contribution of the No Research Alternative to cumulative effects on ESA-listed fish is difficult to ascertain but would likely impact long-term monitoring and management capabilities.

5.4.3.2 Target and Other Species

Under the No Research Alternative, PIFSC would no longer conduct or fund research in the HARA, MARA, ASARA, or WCPRA. In the absence of research surveys, important scientific information would not be collected about the status of fish stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. This lack of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild overfished stocks. PIFSC research also provides information on ecosystem characteristics important for monitoring potential effects from climate change and increases in ocean acidification, which could impact the population and distribution of many fish species. The indirect effects of the No Research Alternative are uncertain and the magnitude of such effects would depend on the availability of alternative sources of data on fish stocks and the marine environment from state agencies, academic institutions, tribal research cooperatives, and other research entities. However, none of these alternative sources of data are likely to be able to replace the scope of work conducted by PIFSC and this could result in adverse effects on fish stocks through a lack of information essential for informed decision making and conservation of fish, their prey, and habitats. The indirect contribution of the No Research Alternative to cumulative effects on any one species is difficult to ascertain but would likely impact long-term monitoring and management capabilities for ESA-listed species, so would be considered minor to moderate adverse.

5.5 CUMULATIVE EFFECTS ON MARINE MAMMALS

Activities external to PIFSC fisheries research that may potentially affect marine mammals in the HARA, MARA, ASARA, and PRIRA include commercial and recreational fisheries, vessel traffic, ocean discharges, dredging, geophysical activities and oil extraction, other scientific research, military operations, conservation measures, and climate change. These activities and potential effects are summarized in Table 5.5-1 and include:

- Disturbance/behavioral changes or physical effects from anthropogenic noise (e.g., marine vessels of all types, military readiness operations, navigational equipment, construction)
- Injury or mortality due to vessel collisions, entanglement in fishing gear, and contamination of the marine environment
- Changes in food availability due to prey removal, ecosystem change, or habitat degradation
- Contamination from discharges

5.5.1 ESA-listed Species

External Factors in the PIFSC Research Areas

The endangered marine mammal species in the PIFSC research areas include the false killer whale—MHI insular stock, sperm whale, blue whale, fin whale, sei whale, north Pacific right whale, and Hawaiian monk seal. With the exception of the false killer whale, commercial whaling was the greatest historical source of mortality for the endangered whale species found in the PIFSC research areas (Carretta and Barlow 2011 and citations therein, Perry et al. 1999). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2006). Blue whales were protected in 1966 (NMFS 1998, Perry et al. 1999). The International Whaling Commission (IWC) banned hunting of fin whales throughout the North Pacific in 1976 (Perry et al. 1999) and hunting of sei whales in the eastern North Pacific ended after 1971 and after 1975 in the western North Pacific (Perry et al. 1999). Although right whales received legal protection from commercial whaling in 1935 (Perry et al. 1999), illegal whaling by the Soviet Union continued into the 1960s and nearly extirpated North Pacific right whales in the Gulf of Alaska (Wade et al. 2011).

Human-related mortality has caused two major declines of the Hawaiian monk seal (Ragen and Levigne 1999). In the 1800s, this species was decimated by sealers, crews of wrecked vessels, and guano and feather hunters (Dill and Bryan 1912; Wetmore 1925; Bailey 1952; Clapp and Woodward 1972). Following a period of at least partial recovery in the first half of the 20th century (Rice 1960), most subpopulations again declined. This second decline has not been fully explained, but long-term trends at several sites appear to have been driven both by variable oceanic productivity (represented by the Pacific Decadal Oscillation) and by human disturbance (Baker et al. 2012, Ragen 1999, Kenyon 1972, Gerrodette and Gilmartin 1990). Currently, human activities in the NWHIs are limited and human disturbance is relatively rare, but the intentional killing of seals in the MHIs is a relatively new and alarming trend and human/seal interactions have become an important issue in the MHIs (Carretta et al. 2015).

In 2009, three Hawaiian monk seals (including a pregnant female) were shot and killed in the MHIs (Baker et al. 2012). In 2010, a juvenile female seal was found dead on Kaua‘i due to multiple skull fractures caused by blunt force trauma. Whether this was an intentional killing or an accidental occurrence (e.g., boat strike) is not known. In 2011, two seals were found dead in the same general area of Molokaʻi, with skull fractures from blunt force trauma. It is extremely unlikely that all carcasses of intentionally killed monk seals are discovered and reported. Studies of the recovery rates of carcasses for other marine mammal species have shown that the probability of detecting and documenting most deaths (whether from human or natural causes) is quite low (Peltier et al. 2012; Williams et al. 2011; Perrin et al. 2011; Punt and Wade 2010).

Other past, present, and reasonably foreseeable future conservation concerns and threats to recovery are outlined in the respective recovery, take reduction and/or management plans for the ESA-listed species and are cited as follows: false killer whales (https://www.fisheries.noaa.gov/species/false-killer-whale#conservation-management), sperm whales (https://www.fisheries.noaa.gov/species/sperm-whale#conservation-management), blue whales (https://www.fisheries.noaa.gov/species/blue-whale#conservation-management), fin whales (https://www.fisheries.noaa.gov/species/fin-whale#conservation-management), sei whales (https://www.fisheries.noaa.gov/species/sei-whale#conservation-management), North Pacific right whales (https://www.fisheries.noaa.gov/species/north-pacific-right-whale#conservation-management), and Hawaiian monk seals (https://www.fisheries.noaa.gov/species/hawaiian-monk-seal#conservation-management).

Noted conservation concerns and threats for these species include vessel collisions, entanglement in fishing gear, anthropogenic noise, vessel/human disturbance, disease, habitat degradation, competition with fisheries for prey, climate change, and pollutants (including contaminants and oil spills) and pathogens.

Vessel collisions are a threat to endangered large whales, particularly blue and fin whales. The contribution of ship strikes to the annual average anthropogenic sources of mortality is noted in Section 3.2.2 under the respective species descriptions. The PIFSC research areas include numerous shipping lanes, vessel traffic and shipping ports, including six major ports, five in the Hawaiian Islands and one in Guam. In addition to the high densities of commercial maritime traffic, there are large naval bases (e.g., Pearl Harbor, Naval Base Guam), military installations (e.g., Johnston Atoll), and USCG Stations on Oʻahu and Hawaiʻi Island. There have been more than 80 confirmed contacts between vessels and whales in Hawaiian waters over the past 40 years and three quarters of those cases have occurred in the last decade.

Entanglement in fishing gear is a common conservation concern for ESA-listed marine mammals worldwide. One sperm whale was observed either hooked or entangled in the Hawaiʻi-based DSLL fishery; the lines were cut and the whale swam away with a hook and some line still attached (Bradford and Forney 2014). This species is listed as “endangered” under the ESA and thus by definition, depleted under the MMPA.

The potential effects of commercial fisheries on prey availability are not clear. Direct competition with fisheries for prey is unlikely for blue, fin, and sei whales whose diet consists of 80-100 percent large zooplankton, primarily krill (Barlow et al. 2008). Sperm whales consume about 60 percent large squid, and a mix of various fish, small squid, and benthic invertebrates. Krill is not commercially harvested, nor are most of the other prey items (Barlow et al. 2008). However, prey consumed by false killer whales include commercially valuable species, such as yellowfin tuna (*Thunnus albacares*), albacore tuna (*T. alalunga*), skipjack tuna (*Katsuwonus pelamis*), broadbill swordfish (*Xiphias gladius*), dolphin fish (or mahimahi, *Coryphaena hippurus*), wahoo (or ono, *Acanthocybium solandri*), and lustrous pomfret (or monchong, *Eumegistus illustrus*) (Baird 2009b).

Military operations within the PIFSC research areas are potential sources of behavioral and habitat disturbance, injury, and mortality. Sonar, active acoustic sources, airguns, weapons firing, explosives, and vessel and aircraft noise could result in Level A or Level B harassment of marine mammals, and vessel collisions and explosives could result in injury or mortality of marine mammals. The Navy coordinated with NMFS, through the consultation and permitting processes, on mitigation measures for all of these activities (U.S. Navy 2018).

Climate change impacts on ESA-listed species are possible through changes in habitat and food availability. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted, which could, ultimately, affect ESA-listed species (NMFS 2010b, NMFS 2011a).

With the exception of the historical sources of population decline, all of the aforementioned effects are likely to continue into the foreseeable future (see Table 5.5-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed marine mammals are discussed in Sections 4.2.4, 4.3.4, 4.4.4, and 4.5.4. The three research alternatives considered in this PEA include similar scopes of research; the primary differences lie in the number and types of associated mitigation measures for protected species. Although ESA-listed marine mammals continue to be affected by numerous factors external to PIFSC fisheries research and the resulting cumulative effects, contribution to these effects from PIFSC fisheries research activities is comparatively small.

The direct and indirect effects of vessel collisions with marine mammals are discussed in Section 4.2.4. Although there is always risk of vessel strikes during research cruises, the volume of ship traffic generated by PIFSC fisheries and ecosystem research is miniscule compared to the number of other vessels transiting the Pacific Islands Region. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to ESA-listed species (or any other species of marine mammals) due to ship strikes is considered a remote possibility.

There is no documented history of marine mammals being injured or killed due to entanglement or other interactions with research gears during PIFSC research activities. However, based on documented interactions of some ESA-listed species with analogous commercial and non-commercial fisheries, PIFSC is requesting one M&SI take of a sperm whale in longline gear over the 5-year authorization period (see Table 4.2-7). For the Hawaiʻi stock of sperm whales, average annual M&SI from all sources is currently 6.9 percent of PBR and the PIFSC requested take, if it occurs, would add an additional 2 percent of PBR and would minimally contribute to the total estimated M&SI from all anthropogenic sources relative to the stock's PBR (Table 5.5-1).

The potential effects from the use of active acoustic devices for PIFSC research activities would likely have rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from PIFSC research would be minor adverse.

Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species, particularly the planktivorous or largely planktivorous species.

When considered in conjunction with commercial and recreational fisheries, and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the PIFSC research areas, the contribution of PIFSC fisheries research activities to cumulative effects on ESA-listed marine mammals would be minor adverse under all three research alternatives. Additionally, ecosystem research conducted by PIFSC has beneficial effects on marine mammal populations by providing scientific information important to the conservation and management of marine mammals and their prey species.

Contribution of the No Research Alternative

Under the No Research Alternative, PIFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this PEA, so would not directly contribute to cumulative effects on ESA-listed marine mammals in the PIFSC research areas. Indirectly, however, the loss of information obtained through this research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and analysis of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species given the availability of other sources of marine mammal and ecosystem information but could impact monitoring and management capabilities for ESA-listed marine mammals in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the PIFSC research areas, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals would be minor adverse.

Table 5.5-1 Cumulative M&SI Compared to PBR with Requested Take from PIFSC and Other NMFS FSCs for All Stocks of Marine Mammals Shared with PIFSC Request

This table summarizes the known M&S) from all sources (primarily commercial fishing) compared to PBR for each stock of marine mammal requested for incidental take by PIFSC during fisheries and ecosystem research. The requested take from other NMFS FSCs for stocks shared with the PIFSC request are also shown. The Alaska FSC did not request takes for any shared stocks with PIFSC. All population estimates, PBR values, and total annual M&SI data are from the most recent stock assessment reports (Carreta et al. 2015 and Allen and Angliss 2015). U=unknown.

Common Name – Stock	Minimum Population Estimate	PBR	Average Annual M&SI from All Sources [A]	Average Annual M&SI as % of PBR	PIFSC Average Annual Take Request	Southwest FSC Average Annual Take Request	Northwest FSC Average Annual Take Request	Total FSC Average Annual Take Request	Total FSC Average Annual Take Request as % of PBR
Beaked whale, Blainville's – Hawaiʿi stock	1,088	11	0	**0**	0.2			0.2	**1.8%**
Beaked whale, Cuvier's – Hawaiʿi pelagic stock	1,142	11.4	0	**0**	0.2			0.2	**1.8%**
Bottlenose dolphin – Hawaiʿi pelagic stock	3,755	38	3.3	**8.7%**	0.6			0.6	**1.6%**
False killer whale – Hawaiʿi pelagic stock or unspecified [B, C]	935	9.4	22.9	**243.6%**	0.2			0.2	**2.1%**
Humpback whale – Central North Pacific stock	7,890	82.8	15.9	**19.2%**	0.4			0.4	**0.5%**
Kogia spp. (Pygmy and dwarf sperm whale – Hawaiʿi stocks)	U	Undetermined	0	**0**	0.2	0.2	0.2	0.6	**U**
Pantropical spotted dolphin – all stocks [D]	11, 508	115	0.6	**0.5%**	0.6			0.6	**0.5%**
Pygmy killer whale – Hawaiʿi stock	2,274	23	0	**0**	0.2			0.2	**0.9%**
Risso's dolphin – Hawaiʿi stock	5,207	42	5.1	**12.1%**	0.2	2.6	1.6	4.4	**10.5%**

Common Name – Stock	Minimum Population Estimate	PBR	Average Annual M&SI from All Sources [A]	Average Annual M&SI as % of PBR	PIFSC Average Annual Take Request	Southwest FSC Average Annual Take Request	Northwest FSC Average Annual Take Request	Total FSC Average Annual Take Request	Total FSC Average Annual Take Request as % of PBR
Rough-toothed dolphin – Hawaiʿi stock	4,581	46	U	**U**	0.6			0.6	**1.3%**
Short-finned pilot whale – Hawaiʿi stock	8,782	70	0.8	**1.1%**	0.2		0.2	0.4	**0.6%**
Sperm whale – Hawaiʿi stock [C]	2,539	10.2	0.7	**6.9%**	0.2			0.2	**2.0%**
Spinner dolphin, all stocks [E]	329	3.3	U	**U**	0.4			0.4	**12.1%**
Striped dolphin – Hawaiʿi stock	15,391	154	U	**U**	0.6			0.6	**0.3%**

A – Total M&SI includes combined estimates of commercial and non-commercial fisheries interactions, ship strikes, and entanglements in unidentified gear from within and outside U.S. EEZs. All estimates are considered smaller than actual M&SI due to unobserved fisheries and other uncertainties in detecting injured or killed animals.

B – Strategic stock based on total M&SI exceeding PBR. PIFSC fisheries and ecosystem research would not occur within the ranges of other false killer whale stocks.

C – Listed as endangered under the ESA.

D – Information presented only for Hawaiʿi pelagic stock, which is the only stock with estimates of population and PBR.

E – Information presented only for the O‘ahu/ "4-Islands Region" stock, which is the smallest stock for which population and PBR estimates are available. This is used to provide the most conservative impact

5.5.2 Other Cetaceans

External Factors in the PIFSC Research Areas

The cetacean species included in this section are not listed as threatened or endangered. They are all subject to similar types of effects from external activities as described above for ESA-listed species. With the exception of minke and Bryde's whales, the non-ESA listed cetaceans in the PIFSC research areas are odontocetes. Habitats are wide ranging, as are preferred prey items. For example, humpback whales consume roughly 50 percent large zooplankton, along with small pelagic and miscellaneous fish. Interactions with commercial fisheries are likely to have the greatest effect on these species and are generally well-documented (Section 3.2.2).

A photographic-based scar study of the humpback whales of American Samoa has been initiated and there is some indication of healed entanglement and ship strike wounds, although perhaps not at the levels found in some Northern Hemisphere populations (D. Mattila and J. Robbins, unpublished data). Between 2008 and 2012, two humpback whales (Central North Pacific stock) were reported hooked or entangled in the Hawaiʻi-based shallow-set longline fishery (Allen and Angliss 2015).

Military operations in the PIFSC research areas are potential sources of behavioral and habitat disturbance, injury, and mortality. Sonar, active acoustic sources, airguns, weapons firing, explosives, and vessel and aircraft noise could result in Level A or Level B harassment of marine mammals, and vessel collisions and explosives could result in injury or mortality. The Navy coordinated with NMFS, through consultation and permitting processes, on mitigation measures (NMFS 2014f).

Climate change impacts are difficult to predict but will likely affect non ESA-listed cetaceans through changes in habitat, food availability, and general health factors such as the incidence of disease.

The activities external to PIFSC fisheries research affecting cetaceans are likely to continue into the foreseeable future (Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable but are also likely to continue into and beyond the foreseeable future.

In addition, research conducted by the Northwest Fisheries Science Center (NWFSC), Southwest Fisheries Science Center (SWFSC), and Alaska Fisheries Science Center (AFSC) involves some overlap of marine mammal species that migrate across the different research areas and is therefore considered in the set of external factors that contribute to cumulative effects in the PIFSC research areas (see Table 5.5-1). The NWFSC, SWFSC, and AFSC have conducted their own NEPA and MMPA compliance process and requested authorization for incidental take related to their respective Center's research (see Proposed Rule for the SWFSC, 80 FR 8166, 13 February 2015). In most cases, the overlap of species would not include the same stocks, but for the Risso's dolphin, pygmy sperm whale, and dwarf sperm whale, little is known about their distribution and migration patterns, so it is possible overlap could occur between stocks. Table 5.5-1 indicates the requested takes in the PIFSC research areas for species whose stocks could overlap with NWFSC and SWFSC research and are included in this cumulative effects analysis. Note that these are conservative estimates of takes and the actual level of take by both Centers is likely to be much less than these requested takes. In all cases, the contribution of the combined NMFS Fisheries

Science Center requests for incidental take, if they occurred, would make small contributions to the total M&SI for these cetacean species.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on non-ESA-listed cetaceans are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this PEA include similar scopes of research; the primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of PIFSC fisheries research activities to cumulative effects on non-ESA-listed species is likely to be small.

For species with an estimated PBR, the requested average annual M&SI take by PIFSC is well below 10 percent of PBR for almost all marine mammal species for which takes are requested except for spinner dolphins. For example, for the Central North Pacific stock of humpback whales, average annual M&SI from all sources is currently 19.2 percent of PBR and the PIFSC requested takes, if they occurred, would add an additional 0.5 percent of PBR. The take request for spinner dolphins is two over the five-year authorization period, which is 12.1 percent of PBR for the O‘ahu/ “4-Islands Region” stock, which is the smallest stock for which population and PBR estimates are available and would be considered moderate in magnitude. This small stock is used to provide the most conservative estimate of impact but it is unlikely that all future takes of this species, if they occurred, would be from this one stock. Given the lack of historical takes of this species and stock, and the mitigation measures in place, PIFSC does not believe this requested level of take would actually occur.

Although two species for which takes are requested have no PBR calculated, the Centers have included them in their take requests. However, due to their small numbers, the limited research efforts in the restricted geographic ranges, it is very unlikely that future incidental takes would occur at the requested levels. According to the impact criteria described in Table 4.1-1, the level of mortality of the species considered here, if they occurred, would be considered minor in magnitude.

The potential effects from use of active acoustic devices for research activities would likely involve infrequent and temporary behavioral disturbance and avoidance effects, particularly for the mid- and high-frequency hearing odontocetes. Relative to the volume of other ship traffic and anthropogenic sources of acoustic disturbance, the contribution of noise from PIFSC research would be minor.

Although there is some overlap in prey of non-ESA-listed cetaceans and the species collected during PIFSC research surveys, the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species. The contribution of research catches to the effects on cetaceans through competition for prey, is therefore considered minor adverse.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the PIFSC research areas, the contribution of PIFSC-affiliated fisheries research to cumulative effects on cetaceans would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, PIFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this PEA, so would not directly contribute to cumulative effects on non-ESA-listed cetaceans in the PIFSC research areas. Indirectly, however, the loss of information obtained through this research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and monitoring of ecological trends. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species but could impact monitoring and management capabilities for cetaceans in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the PIFSC research areas, the contribution of the No Research Alternative to cumulative effects would be minor adverse.

5.6 CUMULATIVE EFFECTS ON BIRDS

Activities external to PIFSC fisheries research that could potentially affect birds in the HARA, MARA, ASARA, and WCPRA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Mortality from avian by-catch
- Potential for ship collisions
- Alteration or reduction of prey resources
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance

5.6.1 External Factors in the PIFSC Research Areas

Seabirds in the HARA, MARA, ASARA, and WCPRA are affected by numerous past and present human-caused and natural factors.

Anthropogenic factors include: mortality in longline fisheries, ingestion of plastic debris, human use and development of nesting habitat, attraction to and disorientation by artificial lights leading to exhausted birds landing in dangerous situations and colliding with power lines and other structures, habitat destruction, predation by non-native terrestrial mammals, nesting habitat loss and degradation from invasive species, pollution, competition with fisheries for prey species, underwater explosions from industrial and military operations, entanglement in debris, ingestion of marine debris, vessel collisions, and hunting. Some seabird species travel long distances over the ocean and have many potentially adverse interactions with humans and their activities, such as commercial and recreational fisheries, and oil spills from transport vessels and offshore oil wells at locations outside the PIFSC research areas. Human activities on land can also affect them at sea or at inland nest sites, such as coastal development and transportation, dock construction, marine pollution, and dredging, as well as agricultural and urban runoff contamination and land clearing for resource development. Climate change is also likely having effects on seabirds through changes in their prey abundance and distribution, although climate change may have adverse effects on some species while others may actually benefit.

Natural factors include: threats to their nesting habitat, predation on adults, eggs, and young by birds and mammals, and habitat loss due to encroachment of vegetation. Natural factors such as changes in ocean currents, prey availability, and severe weather can drive population fluctuations for many species (Ainley and Hyrenbach 2007).

The factors that have affected seabirds in the California Current Research Area (CCRA) in the past are likely to do so in the future. Reasonably foreseeable future actions include continuation and possible expansion of fisheries activities, military operations, marine vessel traffic, ocean disposal and discharge, climate change, and ocean acidification.

For some species (e.g., ESA-listed species), cumulative effects resulting from external anthropogenic factors (past actions, present actions, and RFFAs) have caused declines in populations that are considered major conservation concerns. For many other species, population trends are not well known and most populations tend to fluctuate normally due to natural factors. Cumulative effects on these species from anthropogenic sources could be minor.

5.6.2 Contribution of the Research Alternatives

None of the three research alternatives are likely to contribute more than minor adverse effects to the cumulative effects on seabirds. Currently, there are no recorded instances of any bird mortalities resulting from fisheries and ecosystem research activities conducted and funded by PIFSC, and likewise, no mortalities would be expected to occur as a result of activities proposed under any of the three research alternatives. It is possible that seabird mortality could occur as a result of ship strikes or interaction with fishing gear, but it is likely that such adverse interactions with seabirds would be rare and would affect small numbers of birds.

PIFSC fisheries and ecosystem research activities proposed under the three research alternatives would remove very small quantities of potential food for seabirds. The dispersal of research effort over wide areas of sea and the relatively small number of research surveys over time makes it very unlikely that any measurable impacts to the abundance or distribution of seabird prey would occur as a result of research activities proposed under the three research alternatives. This is especially true for the small size classes of fish and pelagic invertebrates favored by most seabirds because of their large biomasses and the minimal amounts taken in research samples (Sections 4.2.3 and 4.2.7). For the same reasons, the amount of food made available through research activities is unlikely to have more than temporary and highly localized beneficial effects on seabirds.

In contrast, ecosystem research conducted by PIFSC has beneficial contributions to seabirds by providing scientific information important to seabird conservation and management. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting seabirds in the PIFSC research areas, the contribution of PIFSC fisheries research to the cumulative effects on seabirds in the PIFSC research areas is considered minor adverse for all species.

5.6.3 Contribution of the No Research Alternative

The lack of research under this alternative would eliminate any direct effects on seabirds in the PIFSC research areas. However, some of the PIFSC projects that would be eliminated under this alternative would include bird observers as part of the cruise operations, or opportunistically when space is available, and generate a great deal of information on the abundance, distribution, and feeding behaviors of seabirds in the PIFSC research areas. The loss of this information could indirectly affect resource management decisions concerning the conservation of seabirds. There are too many unknown variables to estimate the level of impact this lack of information would have on any particular species of seabirds but the contribution of this alternative to cumulative impacts on seabirds in the CCRA would likely be minor adverse.

5.7 CUMULATIVE EFFECTS ON SEA TURTLES

Activities external to PIFSC fisheries research that could potentially affect sea turtles in the HARA, MARA, ASARA, and WCPRA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Mortality and injury from by-catch in fisheries
- Collisions with ships or small boats
- Alteration or reduction of prey resources through fisheries and climate change
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance from marine vessels and coastal development
- Habitat loss or degradation

5.7.1 External Factors in the PIFSC Research Areas

Sea turtles are susceptible to impacts resulting from natural and anthropogenic factors, both on land and in the water (Table 5.1-1). Effects on breeding beaches involve habitat degradation, habitat loss, injury, and mortality through numerous mechanisms: beach erosion, beach armoring and nourishment, rising sea levels in association with climate change, artificial lighting, increases in human presence, beach cleaning, recreational beach equipment, beach driving, coastal construction, disturbance of beach vegetation, and poaching. Increases in human presence near nesting beaches have led to the introduction of non-native predators including dogs and rats, which may feed on turtle eggs and hatchlings. Adverse impacts to sea turtles also involve habitat degradation, injury, and mortality through numerous mechanisms: coastal development and transportation, dock construction, marine pollution, dredging, underwater explosions, offshore artificial lighting, entanglement in debris (e.g., monofilament, derelict nets), ingestion of marine debris, fishery interactions, boat collisions, and poaching. Increases in diseases such as fibropapilloma tumors have also been observed on sea turtles around Hawaiʻi.

Threats to sea turtles in the PIFSC research areas include incidental capture, injury, and mortality during commercial fishing operations. This conservation issue has been the subject of numerous conservation engineering studies. Use of circle hooks instead of 'J' hooks in commercial pelagic longline fisheries has reduced sea turtle mortalities. The implementation of time/area restrictions in commercial trawl fisheries has also reduced the level of sea turtle captures and mortality in trawl fisheries. However, capture and entanglement in several types of fishing gear continues to be a major conservation concern (NMFS 2014d).

Multiple past and present actions have affected sea turtles in the PIFSC research areas and many of these impact producing factors are likely to continue for the foreseeable future. All species of sea turtles that occur in the PIFSC research areas are threatened or endangered and have therefore been subject to major population-level cumulative effects.

5.7.2 Contribution of the Research Alternatives

Fisheries research activities conducted and funded by PIFSC have had no recorded interactions with any sea turtles and removal of potential sea turtle prey is very small and localized. None of the research alternatives are likely to contribute more than minor adverse effects to the cumulative effects on these species. In contrast, ecosystem research conducted by PIFSC has beneficial effects on sea turtle populations by providing scientific information important to sea turtle conservation and management. Similarly, removal of marine debris has a minor beneficial effect on sea turtles populations by reducing potential capture or entanglement. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting sea turtles in the PIFSC research areas, the contribution of PIFSC fisheries research to the cumulative effects on sea turtles in the PIFSC research areas is considered minor adverse for all species.

5.7.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct impacts to sea turtles that could potentially occur under the research alternatives. However, the elimination of PIFSC fisheries and ecosystem research would also substantially reduce the collection of data important for monitoring the ecological status of the environment important to sea turtles. PIFSC research has also supported management and conservation of designated sea turtle critical habitat. Under the No Research Alternative, the loss of information currently provided by PIFSC research activities would have a minor to moderate contribution to adverse cumulative impacts to sea turtles in the PIFSC research areas through indirect effects on management decisions important to the conservation and recovery of these species.

5.8 CUMULATIVE EFFECTS ON INVERTEBRATES

Activities external to PIFSC fisheries research that could potentially affect invertebrates in the HARA, MARA, ASARA, and WCPRA may include other scientific research, commercial and recreational fisheries, recreation and tourism, military operations, vessel traffic, disposal and discharges, dredging, coastline development, geophysical activities, climate change and ocean acidification, and natural events. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Loss or displacement due to habitat disturbance, turbidity, or contamination
- Coral reef damage and bleaching
- Localized benthos disturbance
- Competition or predation from invasive species
- Removal and mortality of individuals and biomass
- Creation of new hard substrate habitats on structures
- Bioaccumulation of contaminants
- Disruption due to changes in water temperature resulting from climate change
- Decreased calcification due to ocean acidification

5.8.1 External Factors in the PIFSC Research Areas

Marine invertebrates continue to be susceptible to natural and anthropogenic effects including exploitation through commercial and recreational fishing, habitat degradation, pollution, and climate change. Because marine invertebrates do not regulate their body temperature, changes in water temperature may affect the distribution of certain species as well as affect growth rates, reproductive ability and survival (Harley et al. 2006, Fogarty et al. 2007). In addition, warmer water temperatures affect pH, dissolved oxygen, and conductivity of sea water, all of which may have adverse effects on invertebrate species.

Degradation of invertebrate habitat can occur as a result of commercial and recreational fisheries that involve gear coming into contact with the sea floor (See Section 4.2.7). Other sources of habitat disruption identified in the RFFAs (Table 5.1-1) include recreation and tourism, military operations, ocean disposal, dredging, and coastline development. In addition, pollution can negatively affect water quality and chemistry. While intentional discharges of pollutants (including fuel and oil) are relatively rare, accidental discharges may be rather common in some areas and have the potential to cause habitat degradation or direct mortality of invertebrates. Effects include decreased foraging ability and reproductive success and increased mortality (Milligan et al. 2009). Most accidental discharges are likely to be small and localized but some accidental discharges with large vessels or industrial activities may affect large geographic areas and impact benthic habitats for years.

Overexploitation of undersized or immature individuals can have serious implications for the sustainability of stocks, and the overall body size of individuals in a fished population may also change with intense fishing pressure on a single size class (Donaldson et al. 2010). Some commercially and recreationally valuable species of invertebrates (e.g., spiny and slipper lobster) have had population declines in the past due to overharvest. The NWHI lobster fishery was closed in 2000 and remains closed due to historical overfishing (50 CFR Part 665). Commercial and recreational fishing is likely to be the dominant factor in cumulative effects on these species in the future, although climate change may also have substantial effects on some species.

Extreme weather events (e.g., cyclones, hurricanes), vessel groundings, and coastal construction activities represent a chronic threat to live coral habitat. Effects of weather events include coral fragmentation, sediment deposition onto coral colonies, introduction of marine debris, and coral bleaching through hyposaline conditions caused by intense rain events. Vessel groundings physically destroy or injure corals in ways similar to cyclones. Vessel anchors can also cause similar types of damage to corals, but the effects are often smaller in scale and more frequently inflicted. Coastal construction and development can increase local turbidity levels and harm corals or slow growth (Brainard et al. 2011).

5.8.2 Contribution of the Research Alternatives

PIFSC research surveys remove small numbers of invertebrates from all four research areas, primarily lobsters, coral fragments, and miscellaneous sessile invertebrates. Mortality resulting from PIFSC fisheries research under each of the research alternatives would make minor contributions to adverse cumulative effects on invertebrates. The contributions of PIFSC research activities to habitat contamination, climate change, and ocean acidification are expected to be insubstantial. PIFSC fisheries research would contribute to future management decisions related to invertebrate populations in all four research areas where commercial and recreational fisheries target coral and lobsters. When combined with the impacts of past, present, and reasonably foreseeable future actions, the direct contribution of PIFSC research activities to cumulative effects on invertebrates would be minor and potentially adverse under each of the research alternatives. However, research conducted by PIFSC on invertebrates in all four research areas contributes to sustainable management of certain species and this contribution to cumulative effects would be beneficial.

5.8.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct impacts to invertebrates that could potentially occur under the research alternatives. However, increased adverse effects could result indirectly from a loss of scientific information necessary for sustainable fisheries management and conservation of invertebrates and their habitats. Data from PIFSC research activities are used to inform science-based decisions related to the management of commercially and recreationally fished invertebrates in all four research areas. Without the input of PIFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect physical properties of the environment would soon become obsolete. Resource management agencies would have to adequately compensate for this loss of information through changes in management scenarios based on greater uncertainty. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but it would likely impact long-term monitoring and management capabilities for commercially important invertebrates in the research areas. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting invertebrates in the HARA, MARA, ASARA, and WCPRA, the contribution of the No Research Alternative to cumulative effects on invertebrates would be minor to moderate.

5.9 CUMULATIVE EFFECTS ON THE SOCIAL AND ECONOMIC ENVIRONMENT

Activities external to PIFSC fisheries research that could potentially affect the social and economic environment in the HARA, MARA, ASARA, and WCPRA may include commercial and non-commercial fisheries, shipping, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Provision of jobs and economic opportunity
- Changes in commercial fishing opportunities
- Economic costs of changes in resource availability due to climate change and ocean acidification

5.9.1 External Factors in the PIFSC Research Areas

This section describes the contribution of PIFSC research activities to cumulative effects on the social and economic environment from past, present, and RFFAs. The intent of this section is to describe the contribution of PIFSC fisheries research activities to the social and economic environment of fishing communities throughout the Pacific Ocean both internationally and domestically. The cumulative effects of fisheries research and management associated with the PIFSC research area are closely related to socioeconomic conditions of Hawai‘i and other Pacific Island territories, and nations. Overall, as stated in Section 3.3.3, in 2012 Hawai‘i’s seafood industry generated $855 million in sales impacts, $262 million in income impacts, and approximately 11,000 full- and part-time jobs (NMFS 2014b). Potential future socioeconomic cumulative effects from developments in non-fishing industries, such as tourism, oil extraction, shipping commerce, or climate change cannot be feasibly estimated with available data but would be expected to dominate the economy in the future.

In regard to fishing opportunity, cumulative fishing and non-fishing industry actions would be more noticeable in coastal communities. Specific fisheries management decisions, to which the PIFSC research program contributes, could also have an effect over time. Reductions in certain stocks as a result of ocean ecosystem changes, or overfishing, which results in commercial or recreational area closures, would result in noticeable changes in the socioeconomic status of communities.

RFFAs that could contribute to cumulative effects to the social and economic environment include updates to species take reduction plans, and fishery management measures. Species take reduction plans could include measures that would lead to increased costs for fishermen through required gear modifications. These plans could also call for time and/or area closures that could affect fishing fleet locations.

5.9.2 External Factors on Cultural Resources

The cumulative effects on social and cultural issues for fishing communities and related industries closely parallel the effects on the socio-economics of commercially or non-commercially exploited fish and invertebrates. These include both natural factors such as climate change (including changes in ocean characteristics), and activities associated with offshore development, contamination, and commercial and non-commercial fishing. Since much of these communities’ cultural ties are centered around a seafaring lifestyle and can be dependent on the abundance and location of commercially or non-commercial exploitable fish and invertebrates, factors that influence fish and invertebrate stocks also influence the cultural well-being of the fishing communities. Therefore, the effects of overfishing and the resultant declines in fish stocks, followed by the imposition of sometimes severe limits on fishing opportunities under FMPs, could potentially have major adverse social and cultural effects on fishing communities in the Pacific Island Region.

Likewise, historic cultural resources such as sites listed on the NRHP, shipwrecks, burial sites, and fishponds, could be influenced by external factors such as increased vessel traffic, recreation and tourism, military operations, or other scientific research activities. The resulting effects would potentially interact with the effects of PIFSC research activities proposed under each of the action alternatives, resulting in additive or possible synergistic impacts to historic cultural resources.

In a similar fashion, culturally important marine resources within the PIFSC research areas, such as sea turtles and sharks, would be influenced by factors described in Section 5.4 (Cumulative Effects to Fish) and Section 5.7 (Cumulative Effects to Sea Turtles). The effects to sharks, sea turtles, and other culturally important contemporary marine resources would potentially interact with the effects of PIFSC research activities proposed under each of the action alternatives, resulting in additive or possible synergistic impacts to contemporary cultural resources.

The importance of federally managed fisheries in the social and cultural environment of Pacific Island communities varies substantially from place to place. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in the Pacific Island Region, the contribution of the research alternatives to cumulative effects on the sociocultural environment would be similar, moderate and beneficial, in that continued research would support science-based sustainable fisheries management, and provide information important to the assessment of potential effects on fishing communities from climate change, recreation and tourism endeavors, as well as military operations.

5.9.3 Contribution of the Research Alternatives

The fundamental purpose of fisheries management is to monitor and counteract the contribution of commercial and non-commercial fishing to the adverse cumulative effects on fish stocks from past, present, and reasonably foreseeable actions. PIFSC research is one of the most effective mechanisms to monitor the status of fish stocks and changes in the marine environment, providing substantial beneficial contributions to cumulative effects through scientific input to fishery management and other environmental decision-making processes. Continuation of this research would provide consistent data to allow evaluation of fish stock trends and the effects of actions not related to fishing.

In all research alternatives, at-sea and laboratory research, and cooperative fisheries research activities that are currently funded by PIFSC would continue. This would help promote sustainable fish populations and have substantial benefits for local economies dependent on stable fishing opportunities. Long-term sustainable catches would be promoted, increasing stability in the fishing communities and reducing boom and bust cycles related to over-exploitation of target species.

In addition, research results that identify effects not related to commercial or non-commercial fishing that could threaten species recoveries and sustainable yield levels would be identified in sufficient time to take corrective action before population level effects would be noticed by fishers in the form of reduced abundance and lower catches. The cumulative effect to the social and economic environment of Pacific Island Region fisheries as a result of Alternatives 1 and 2 would have the same relative contribution, which is minor to moderate beneficial considering all past, present, and RFFAs. Mitigation measures in Alternative 3 that reduce the ability of PIFSC to sample fish and invertebrate stocks in certain places and times could represent a slightly reduced benefit, as at-sea sampling operations would be reduced from the current level of comprehensiveness.

The socioeconomic effects of non-fishing industry actions are likely to dominate any cumulative effects on the socioeconomic environment of the HARA, MARA, ASARA, and WCPRA. The research alternatives would contribute minor to moderate beneficial effects to the cumulative effects because PIFSC research provides a substantial portion of the information needed to determine if fisheries management actions are successful, and therefore balance the needs for stock recovery and sustainable catch quotas that minimize impacts to fishing communities. Likewise, PIFSC research activities provide information essential to the sustainable management of ecosystems that support culturally important historic and contemporary marine resources. The at-sea surveys also provide measures to detect the result of cumulative changes contributed by non-fishing industries and climate change. The contribution of the research alternatives to cumulative effects on the socioeconomic environment and cultural resources would be minor to moderate and beneficial in that PIFSC research reduces the potential for negative cumulative effects on commercial and non-commercial fisheries, as well as potential impacts to historic and contemporary cultural resources.

5.9.4 Contribution of the No Research Alternative

Under the No Research Alternative, PIFSC would not contribute to the information base needed for sustainable management of fisheries and culturally important historic and contemporary marine resources. Fisheries research activities conducted by state and private organizations are not likely to be sufficient to identify trends in target fish stocks and set sustainable fishery harvest limits without the contribution from PIFSC. Some commercially and culturally important species would likely receive attention from state and private research efforts, so potential adverse effects would not likely be uniform across the fishing communities. Some fishers that target commercially-important species may continue to benefit from sustainable fisheries management without the contribution from PIFSC activities, but others may be affected by lack of information on their target species. Lack of consistent data input into the fisheries management process would have moderate adverse effects on the quality of the management analyses, and subsequently to the value of the management process. This lack of consistent data input would also result in potentially adverse effects to the management of contemporary cultural resources, as well as decreased levels of information potentially useful to sustain the preservation of historic cultural resources. Elimination of at-sea operations would reduce science-based input into fisheries management decisions, which would increase the potential for negative cumulative effects on socioeconomic and cultural resources.

The No Research Alternative would contribute a moderate adverse effect to the cumulative effects on socioeconomic and cultural environment. This is due to the discontinuance of at-sea research efforts of PIFSC, many of which are designed to detect and anticipate cumulative effects on fisheries resources. These activities are important for fisheries management decisions that strongly influence the socioeconomic conditions of fishing communities, as well as the preservation of historic and contemporary cultural resources.

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6.1 THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

In 1976, Congress passed the MSA (16 U.S.C. 1801, et seq.). This law authorizes the United States to manage its fishery resources in an area extending from the seaward boundary of a state's territorial sea (generally 3 nm [5.6 km] from shore) out to 200 nm (370 km) from shore. This area is termed EEZ). The MSA was updated in 2006 and is now known as the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act.

Two of the main purposes of the MSA are to promote domestic commercial and recreational fishing under sound conservation and management principles, and to provide for FMPs. The FMPs are intended to achieve and maintain, on a continuing basis, the optimum yield from each fishery. The MSA standards require that FMPs contain certain conservation and management measures. The standards include measures necessary to prevent overfishing; rebuilding overfished stocks; ensuring conservation; facilitating long-term protection of EFH; and realizing the full potential of the nation's fishery resources. Furthermore, the MSA also declares that the National Fishery Conservation and Management Program must utilize the best scientific information available, is responsive to the needs of interested and affected states and citizens, considers efficiency, and draws upon federal, state, and academic capabilities in carrying out research, administration, management, and enforcement.

Certain stocks of fish have declined to the point where their survival is impacted, and other stocks of fish have been substantially reduced in number such that they could become similarly affected as a consequence of (a) increased fishing pressure, (b) the inadequacy of fishery resource conservation and management practices and controls, or (c) direct and indirect habitat losses which have resulted in a diminished capacity to support existing fishing levels.

The fisheries and ecosystem research activities conducted by PIFSC are designed to meet the requirements of the MSA by providing the best scientific information available to fishery conservation and management scientists and managers. This supports a management program that is able to respond to changing ecosystem conditions and manages risk by developing science-based decision tools. NMFS emphasizes that according to the MSA definition of fishing, scientific research activities are not fishing (74 FR 42787, August 25, 2009). There are several PIFSC research projects that may use contracted fishing vessels for research purposes in the future. In order to avoid confusion about the nature of the activity, commercial fishing versus scientific research, PIFSC may seek to obtain a Letter of Acknowledgement for research conducted on chartered fishing vessels. Per 50 CFR 600.745, persons planning to conduct scientific research activities in the EEZ are encouraged to request a Letter of Acknowledgement from the Regional Administrator or Science Director. If the Regional Administrator or Science Director determines that the activity does not constitute scientific research (50 CFR 600.512) but rather fishing, then an EFP may be required.

The U.S. Commission on Ocean Policy has identified the need for more holistic assessments of the status of marine ecosystems. The President's Ocean Action Plan has endorsed the concept of marine Ecosystem-Based Management. Sustained ecosystem monitoring programs are essential for tracking the health of marine ecosystems as part of this overall approach. The individual PIFSC surveys comprise a broader ecosystem monitoring program that meets this emerging critical need.

The EFH provisions of the MSA require federal agencies to consult with NMFS when their actions or activities may adversely affect habitat identified by regional fishery management councils or NMFS as EFH. In addition, NMFS must provide recommendations for conserving and enhancing EFH, which is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". There is no separate permit or authorization process; EFH consultation is typically addressed during the NEPA process and incorporated into other permits.

An EFH programmatic consultation was initiated between PIRO and PIFSC to address the potential adverse effects from numerous marine research activities on EFH. The scope of the EFH Programmatic Agreement, dated February 2020, was limited to activities that may adversely affect, but will not have a substantial adverse effect individually or cumulatively on EFH. The Programmatic Agreement (which is included in Appendix C of the PEA), requested conservation recommendations (CRs) for physical impacts to benthic habitat, invasive species, and sedimentation, turbidity, and chemicals.

Section 404 of the MSA requires the Secretary of Commerce to initiate and maintain, in cooperation with the Fishery Management Councils, a comprehensive program of fishery research to carry out and further the purposes, policy, and provisions of the MSA. Substantial parts of the proposed action meet the MSA's definition of scientific research activity, and the proposed action is part of a comprehensive program to address this requirement.

1996 amendments to the MSA require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities:

> *Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

The Sustainable Fisheries Act of 1996 (Public Law 104-297) is also an amendment to the MSA. Sections 104 and 105 clarify issues surrounding highly migratory fish, and the international agreements that govern fisheries. Among the topics covered by these sections are fishing in international waters of the Atlantic and Pacific oceans; fishing in the Bering Sea, shared with Russia; and congressional rules setting time limits on approval of international fishing treaties. Sections 116 to 406 of the Sustainable Fisheries Act describe the management measures and research necessary to implement the act. These sections specify the agencies responsible for research and the nature of the research to be conducted in each of several specific fishing areas, including the Pacific Ocean.

6.2 MARINE MAMMAL PROTECTION ACT

The MMPA of 1972 (16 U.S.C. 1361 et seq.), as amended, prohibits the "take"16 of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States The primary management objective of the MMPA is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in concert with the provisions of the ESA. The secretary is required to give full consideration to all factors regarding regulations applicable to the take of marine mammals, including the conservation, development, and utilization of fishery resources, and the economic and technological feasibility of implementing the regulations.

Section 101(a)(5)(A-D) of the MMPA provides a mechanism for allowing, upon request, the "incidental," but not intentional, taking, of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals) within a specified geographic region. The NMFS OPR processes applications for incidental takes of small numbers of marine mammals. Authorization for incidental takes may be granted if NMFS finds a negligible impact on the species or stock(s), and if the methods, mitigation, monitoring and reporting for takes are permissible.

The purpose of issuing ITAs is to provide an exemption to the take prohibition in the MMPA, and to ensure that the action complies with the MMPA and NMFS's implementing regulations. ITAs may be issued as either: (1) regulations and associated LOA under Section 101(a)(5)(A) of the MMPA; or (2) IHAs under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for serious injury and/or mortality or where any such potential can be negated through required mitigation measures. Pursuant to Section 101(a)(5)(A) of the MMPA, NMFS, upon application from PIFSC, may propose regulations to govern the unintentional taking of marine mammals, by harassment, incidental to the proposed fisheries research activities by PIFSC in the Pacific Ocean. The issuance of MMPA incidental take regulations and associated LOA to PIFSC is a federal action, thereby requiring NMFS to analyze the effects of the action on the human environment pursuant to NEPA and NOAA's NEPA procedures.

After an application is submitted, the NMFS OPR may authorize incidental takes of marine mammals through either a one-year IHA, or through an LOA, which may cover activities for up to 5 years. PIFSC will be applying for an LOA for the small number of incidental takes of marine mammals that could occur during their fisheries research surveys. This PEA will provide informational support for that LOA application and provide NEPA compliance for the authorization.

[16] The MMPA defines take as: "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." Harassment means any act of pursuit, torment, or annoyance which, 1) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or 2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment).

6.3 ENDANGERED SPECIES ACT

The ESA of 1973 as amended (16 U.S.C. 1531, et seq.), provides for the conservation of endangered and threatened species of fish, wildlife, and plants. The statute is administered jointly by NMFS and the USFWS, with some exceptions—NMFS oversees marine mammal species, marine and anadromous fish species, and marine plant species; and the USFWS oversees walrus, sea otter, seabird species, and terrestrial and freshwater wildlife and plant species.

The listing of a species as threatened or endangered is based on the biological health of that species. Threatened species are those likely to become endangered in the foreseeable future (16 U.S.C. 1532[20]). Endangered species are those in danger of becoming extinct throughout all or a significant portion of their range (16 U.S.C. 1532[20]). Species can be listed as endangered without first being listed as threatened.

In addition to listing species under the ESA, the appropriate expert agency (NMFS or USFWS) must designate critical habitat of the newly listed species within a year of its listing to the "maximum extent prudent and determinable" (16 U.S.C. 1533[b] [1] [A]). The ESA defines critical habitat as those specific areas that are essential to the conservation of a listed species and that may be in need of special consideration. Federal agencies are prohibited from undertaking actions that destroy or adversely modify designated critical habitat. Some species, primarily cetaceans (whales), which were listed in 1969 under the Endangered Species Conservation Act and carried forward as endangered under the ESA, have not received critical habitat designations.

Federal agencies have an affirmative mandate to conserve listed species. An assurance of this is that federal actions, activities, or authorizations must be in compliance with the provisions of the ESA. Section 7 of the ESA provides a mechanism for consultation by the federal action agency with the appropriate expert agency. Informal consultations are conducted for federal actions that have no adverse effects on the listed species and typically result in letters of concurrence from the expert agency. In cases where a proposed action may affect listed species or critical habitat, the action agency prepares a biological assessment to determine if a proposed action would adversely affect listed species or modify critical habitat. The biological assessment contains an analysis based on biological studies of the likely effects of the action on the species or habitat. The expert agency either concurs with the assessment or provides its own analysis to continue the consultation.

If the action agency or expert agency concludes that a proposed action may have adverse effects on a listed species, including take17 of any listed species, they must enter formal consultations under section 7 of the ESA. The expert agency must then write a BiOp that determines whether a proposed action places the listed species in jeopardy of extinction or adversely modifies its critical habitat. If the BiOp concludes the proposed (or ongoing) action will cause jeopardy to the species or adversely modify its critical habitat, it must also include reasonable and prudent alternatives that would modify the action so it no longer poses jeopardy to the listed species. These reasonable and prudent alternatives must be incorporated into the federal action if it is to proceed. Regardless of whether the BiOp reaches a jeopardy or no jeopardy conclusion, it often contains a series of mandatory and/or recommended management measures the action agency must implement to further reduce the negative impacts to the listed species and critical habitat (50 CFR 402.24[j]). If

[17] The ESA defines take as: to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct." (16 U.S.C. 1538[a][1][B])

a proposed action would likely involve the taking of any listed species, the expert agency may append an ITS to the BiOp to authorize the amount of take that is expected to occur from normal promulgation of the action. PIFSC will use this PEA to initiate section 7 consultation on the proposed action with the Protected Resource Offices of both NMFS and USFWS, as applicable.

Section 4(f) of the ESA directs NMFS to develop and implement recovery plans for threatened and endangered species, unless such a plan would not promote conservation of the species. According to the statute, these plans must incorporate, at a minimum:

- a description of site-specific management actions necessary to achieve recovery of the species
- objective, measurable criteria which, when met, would result in a determination that the species be removed from the list
- estimates of the time and costs required to achieve the plan's goal

NMFS' Program on Cooperative Conservation with States (section 6 of the ESA) was developed to assist states that have a cooperative agreement with NMFS in developing and implementing their conservation program for species listed in that agreement, including providing funding for management, research and monitoring that has a direct conservation benefit to the species. Conservation actions may also be carried out by federal agencies as part of their obligations under section 7(a)(1) of the ESA, or as a means to minimize activities that adversely affect a species as part of an interagency consultation. States, local agencies, and private entities may conduct conservation actions as a means to minimize or mitigate "incidental take" of species as part of a Conservation Plan under section 10 of the ESA.

In order to meet these requirements and to support recovery plan development, PIFSC conducts research aimed at determining recovery criteria and assessing threats that may potentially impede the recovery of threatened and endangered species. In addition, these activities enable NMFS, state and local agencies, and private entities to fulfill the conservation requirements outlined within the ESA. See Section 2.3 for a summary of ESA section 7 consultation efforts to date.

6.4 MIGRATORY BIRD TREATY ACT

The MBTA protects approximately 836 species of migratory bird species from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations (i.e., for hunting and subsistence activities). Compliance with the MBTA does not require a permit or authorization; however, the USFWS often requests that other agencies incorporate MBTA mitigation measures as stipulations in their permits. In addition, a Draft Memorandum of Understanding (MOU) between NMFS and USFWS focuses on avoiding and minimizing, to the extent practicable, adverse impacts on migratory birds through enhanced interagency collaboration. In compliance with the MOU, PIFSC has identified and evaluated the impacts of the proposed actions on migratory birds. NMFS will provide a copy of this PEA to the USFWS and will consider all comments from USFWS concerning compliance with the MBTA as necessary.

6.5 FISH AND WILDLIFE COORDINATION ACT

The FWCA requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies (16 U.S.C. 661 1934). Specific provisions involve conservation or expansion of migratory bird habitats related to water body impoundments or other modifications. FWCA requires consultation among agencies and the incorporation of recommended conservation measures if feasible but does not involve a separate permit or authorization process. NMFS provided a copy of the DPEA to the state fish and wildlife agencies in every state affected by the fisheries research activities examined in this PEA. NMFS received no comments from these agencies.

6.6 NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the NHPA requires Federal agencies to take into account the effects of their undertakings, which could include any project funded, licensed, permitted, or assisted by the federal government, on historic properties. Federal agencies must allow the SHPO and the Advisory Council on Historic Preservation, a federal agency, to comment on a project. In an April 2014 letter, PIFSC initiated coordination and consultation with the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (Native Hawaiian Organizations listed in the U.S. Department of Interior Native Hawaiian Organization Notification List and identified as organizations with interests in natural resource management and conservation). The 2014 letter provided notification of the agency’s intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC. In November 2015, PIFSC continued Section 106 consultation obligations in a follow-up letter to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and the 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on PIFSC’s website. PIFSC received five public comments from the following organizations: State of Hawai‘i Department of Land and Natural Resources, Office of Hawaiian Affairs, USFWS, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai‘i State Historic Preservation Division nor any other entities regarding cultural properties or impacts to such properties from the research activities in the area of potential effect.

On November 2, 2021 follow-up letters were sent to the historic preservation offices and 27 interested parties. The 2021 follow-up letters stated that: based on the analysis in the PEA (October 2021) and additional details in the follow-up letters, PIFSC does not expect research activities would have the potential to cause effects on historic properties, even assuming such historic properties were present in the area of activity. The letters also explained Best Management Practices (BMPs) to be followed while conducting activities within all research areas to avoid any impacts. The letters noted that: “NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.” The Guam Historic Preservation Office provided comments on December 12, 2021, requesting more information including a map of the Area of Potential Effects (APE) for Guam. On February 11, 2022, PIFSC provided a map showing the APE for Guam and submitted all additional information requested and no additional questions were received from the Guam Historic Preservation Office. No other historic preservation office or interested parties commented on PIFSC's follow up letter.

6.7 EXECUTIVE ORDER 13158, MARINE PROTECTED AREAS

The purpose of this order is to strengthen and expand the Nation's system of MPAs to enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. The order encourages federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA.

6.8 EXECUTIVE ORDER 12989, ENVIRONMENTAL JUSTICE

EO 12898 directs federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law. No such effects are identified in this PEA.

6.9 EXECUTIVE ORDER 12114, ENVIRONMENTAL EFFECTS ABROAD OF MAJOR FEDERAL ACTIONS

EO 12114, Environmental Effects Abroad of Major Federal Actions, requires federal agencies to assess whether federal actions have the potential to "significantly affect" the environment of the global commons or the environment of a foreign nation not participating with the United States or "otherwise involved in the action." PIFSC participates in several fisheries technology development projects in foreign territorial seas that include bycatch reduction, EM, coral reef research and monitoring, and other fishing technology research projects. These projects take place within 12 nm of the foreign country. These projects collect data necessary to evaluate the efficacy of various fisheries technologies. For example, bycatch reduction projects are designed to develop and refine gear technologies that have shown potential to reduce bycatch interactions in fisheries (e.g., net, trawl, seine, longline, handline, or hook-and-line fisheries). By collaborating with local (in-country) fishers, international scientists and managers, NGOs, universities, and government fishery scientists, PIFSC contributes to such fisheries research in a manner that is conducted under typical fishing operations and without increasing fishing effort in the fishery. Depending upon the project and the location, the respective foreign governments or fishery agencies may participate directly or indirectly in these research activities (e.g., research partnerships, approved permit, agreements).

6.10 INFORMATION QUALITY ACT

Pursuant to NOAA guidelines implementing Section 515 of Public Law 106-554 (the Data Quality Act), all information products released to the public must first undergo a Pre-Dissemination

Review to ensure and maximize the quality, objectivity, utility, and integrity of the information (including statistical information) disseminated by or for federal agencies. The following sections address these requirements.

6.10.1 Utility

The information presented in this document is helpful to the intended users (the affected public) by presenting a clear description of the purpose and need of a proposed action, the measures proposed, and the impacts of those measures. This document is the principal means by which the information contained herein is available to the public. The information provided in this document is based on the most recent available information from the relevant data sources. The development of this document and the decisions made by NMFS to propose an action are the result of a multi-stage public process. This document is available in several formats, including printed publication and CD-ROM, upon request.

6.10.2 Integrity

Prior to dissemination, information associated with an action, independent of the specific intended distribution mechanism, is safeguarded from improper access, modification, or destruction, to a degree commensurate with the risk and magnitude of harm that could result from the loss, misuse, or unauthorized access to or modification of such information. All electronic information disseminated by NMFS adheres to the standards set out in Appendix III, "Security of Automated Information Resources," of Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Act. All confidential information (e.g., dealer purchase reports) is safeguarded pursuant to the Privacy Act; Titles 13, 15, and 22 of the U.S.C. (confidentiality of census, business, and financial information); the Confidentiality of Statistics provisions of the MSA; and NAO 216-100, Protection of Confidential Fisheries Statistics.

6.10.3 Objectivity

For purposes of the Pre-Dissemination Review, this document is considered to be a "Natural Resource Plan." Accordingly, the document adheres to the published standards of the MSA; Operational Guidelines of the FMP Process; EFH Guidelines; National Standard Guidelines; and NAO 216-6A, Compliance with the Environmental Review Procedures for Implementing the National Environmental Policy Act, Executive Orders 12114, Environmental Effects Abroad of Major Federal Actions; l1988 and 13690, Floodplain Management and 11990, Protection of Wetlands. This document uses information of known quality from sources acceptable to the relevant scientific and technical communities. Stock status (including estimates of biomass and fishing mortality) are subject to peer-review through Stock Assessment Review Committees or on updates of those assessments prepared by scientists of PIFSC. Landing information is based on information collected through the PIFSC Commercial Fisheries database. In addition to these sources, other information is presented that has been accepted and published in peer-reviewed journals or by scientific organizations.

Despite current data limitations, the measures proposed for this action were selected based upon the best scientific information available. The data used in the analyses provide the best available information on the landings of the relevant species in the Pacific Islands Region.

The supporting science and analyses, upon which the policy choices are based, have been documented. All supporting materials, information, data, and analyses within this document have been, to the maximum extent practicable, properly referenced according to commonly accepted standards for scientific literature to ensure transparency.

The review process used in preparation of this document involved staff from PIFSC and NMFS Pacific Islands Regional Office. PIFSC's technical review was conducted by senior level scientists with specialties in population dynamics, stock assessment methods, demersal resources, population biology, and the social sciences. All stock assessment data used in this document have been subjected to the Stock Assessment Workshop/Stock Assessment Review Committee review process. Review was conducted by those with expertise in fisheries management and policy, habitat conservation, protected species, and compliance with the applicable law.

6.11 EXECUTIVE ORDER 13112, INVASIVE SPECIES

This order (64 CFR 6183, February 3, 1999) directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. The Executive Order established the National Invasive Species Council.

6.12 NATIONAL MARINE SANCTUARIES ACT

The Marine Protection, Research and Sanctuaries Act (MPRSA) (16 U.S.C. 1431) prohibits all ocean dumping (except that allowed by permits) in any ocean waters under U.S. jurisdiction, by any U.S. vessel, or by any vessel sailing from a U.S. port. MPRSA authorizes the Secretary of Commerce (through NOAA) to coordinate a research and monitoring program with the U.S. Environmental Protection Agency (EPA) and the USCG. The MPRSA established nine regional marine research boards for the purpose of developing comprehensive marine research plans, considering water quality and ecosystem conditions and research and monitoring priorities and objectives in each region. It also launched a national coastal water quality monitoring program that directs the EPA and NOAA together to implement a long-term program to collect and analyze scientific data on the environmental quality of coastal ecosystems, including ambient water quality, health and quality of living resources, sources of environmental degradation, and data on trends. Results of these actions are used to provide the information required to devise and execute effective programs under the Clean Water Act and CZMA.

The National Marine Sanctuaries Act (also known as Title III of the MPRSA) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. The primary objective is to protect marine resources, such as coral reefs, sunken historical vessels, or unique habitats.

Section 304(d) requires interagency consultation between the NOAA ONMS and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource." In compliance with the MPRSA, PIFSC identified and evaluated the impacts of the proposed actions on NMSs. On March 13, 2016 PIFSC requested that consultation be initiated with the Office of National Marine Sanctuaries (ONMS) for activities in the Hawaiian Islands

Humpback Whale National Marine Sanctuary (HIWNMS) and the National Marine Sanctuary of American Samoa (NMSAS).To protect sanctuary resources, ONMS provided PIFSC with specific recommendations for each sanctuary. The recommendations for HIWNMS address notification of near misses with humpback whales, issues related to timing of and types of gear deployed, derelict or unattended gear, use of active acoustic equipment (must be 22 kilohertz or lower), monitoring protocols for humpback whales during vessel operations, and use of Uncrewed Aircraft Systems. For NMSAS, PIFSC must: annually report the actual biomass of all fish and invertebrate species taken from within the sanctuary, and any interactions with marine mammals, sea turtles, sea birds, and historic and cultural resources; test and calibrate less invasive sampling methodologies, and eventually transition to non-extractive sampling methods whenever possible; and not conduct the insular fish life history program within Fagatele Bay and the Aunu‘u Research Zone.

6.13 COASTAL ZONE MANAGEMENT ACT

The principal objective of the CZMA is to encourage and assist states in developing coastal management programs, to coordinate state activities, and to safeguard regional and national interest in the coastal zone. Section 307(c) of the CZMA requires federal activity affecting the land or water uses or natural resources of a state’s coastal zone to be consistent with that state’s approved coastal management program, to the maximum extent practicable. NMFS provided a copy of the DPEA and a consistency determination to the state of Hawai'i, Guam, CNMI, and American Samoa. Responses agreeing with were received from all CZMA programs except American Samoa. If an entity failed to respond within sixty days, the state’s agreement was presumed. CZMA consultation letters are provided in Appendix C.

6.14 PACIFIC INTERNATIONAL CONVENTIONS, TREATIES, AND LAWS

PIFSC participates in international forums for the assessment of the status of some stocks in accordance with the relevant rules of international law. NMFS, working through PIFSC, conducts research to support U.S. commitments to international fisheries management, including provision of stock assessment and management advice for the conventions and treaties outlined below.

6.14.1 Tunas Convention Act

The Tunas Convention Act of 1950 (16 U.S.C. 951-961; Act of September 7, 1950, as amended) addresses and codifies the obligations of the United States under the IATTC and authorizes the Secretary of Commerce to issue regulations for implementing recommendations of the Commission. The act permits limiting the size and quantity of catches and limiting or prohibiting incidental catch of regulated species.

The IATTC was established in 1949 to monitor the long-term conservation and sustainable use of tunas, billfish, dolphins, turtles, non-target finfish, sharks, and others) that may be affected either directly or indirectly by fishing operations. In 2003, the Convention’s scope was broadened, and is now known as the Antigua Convention. The Antigua Convention applies to waters of the Pacific Ocean including areas off California, Oregon, and Washington, and encompasses significant U.S.

fisheries, such as the troll fishery targeting albacore. The IATTC is currently made up of 21 nations and fishing entities. The Secretary of Commerce has directed NMFS to conduct research and provide scientific input into stock assessments and conservation and management recommendations for target and non-target stocks in the convention area.

The ISC was established in 1995 for the purpose of enhancing scientific research and cooperation for conservation and rational utilization of tuna and tuna-like species of the North Pacific Ocean. Through a Memorandum of Understanding, the ISC provides scientific support for the work of the Northern Committee of the WCPFC. As a member, the United States supports obligations to the Committee through scientific research conducted by NMFS.

6.14.2 International Whaling Commission

The IWC was established in 1946. It is composed of members from 89 countries. In 1986 the IWC introduced zero catch limits for commercial whaling, which remains today. The IWC sets catch limits for aboriginal subsistence whaling. It also addresses the conservation of whales and promotes the recovery of depleted whale populations by reviewing ship strikes or entanglement events, habitat, and protocols for whale watching. The Whaling Convention Act of 1949 (16 U.S.C. 916-9161; Act of August 9, 1950, as amended) authorizes the secretary of commerce via NOAA and NMFS to provide and collect scientific data and enforce the provisions of the International Convention for the Regulation of Whaling and to issue regulations necessary for this purpose.

6.14.3 Fishermen's Protective Act

The Fishermen's Protective Act of 1967 (22 U.S.C. 1971-1980; Pub. L. 90-482, as amended) authorizes the Secretary of Commerce to establish an insurance fund for the reimbursement of owners or charterers of fishing vessels which incur damage, loss, or destruction while engaged in any fishery under U.S. exclusive management or are damaged by a vessel other than a U.S. vessel. The 1971 Pelly Amendment to the Fishermen's Protective Act authorizes the Secretary of Commerce, upon determination that foreign nationals are conducting fishing operations in a way that diminishes the effectiveness of international fishery conservation programs, to certify such to the President. The Secretary also has the responsibility to certify to the President when foreign nationals are engaging in trade or taking in a manner which diminishes the effectiveness of any international program for endangered or threatened species.

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[Note: This work was primarily completed by consultants from URS Corporation in Anchorage, Alaska. In October 2014, URS was purchased by AECOM, Inc. and the final stages of the project were completed by some of the listed personnel as AECOM staff, although the service contract remained under the URS name.]

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FINAL

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research Conducted and Funded by the

Pacific Islands Fisheries Science Center

March 2023

Appendix A

PIFSC Research Gear and Vessel Descriptions

Prepared for the National Marine Fisheries Service by:

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Table of Contents

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1. Trawl Nets

A trawl is a funnel-shaped net towed behind a boat to capture fish. The codend, or 'bag,' is the fine-meshed portion of the net most distant from the towing vessel where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh to enable estimates of the size and age distributions of fish in a particular area. The body of a trawl net is generally constructed of relatively coarse mesh that functions to gather schooling fish so that they can be collected in the codend. The opening of the net, called the 'mouth', is extended horizontally by large panels of wide mesh called 'wings' (Figure A-1). The mouth of the net is held open by hydrodynamic force exerted on the trawl doors attached to the wings of the net. As the net is towed through the water, the force of the water spreads the trawl doors horizontally apart.

The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or 'warps,' to winches on the deck of the vessel. The cables are played out until the net reaches the fishing depth. Commercial trawl vessels travel at speeds between two and five knots while towing the net for time periods up to several hours. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. At the end of the tow the net is retrieved and the contents of the codend are emptied onto the deck. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into the research vessel and the trawl gear monitor the position and status of the net, speed of the tow, and other variables important to the research design.

Most PIFSC research trawling activities utilize 'pelagic' trawls, which are designed to operate at various depths within the water column. Because pelagic trawl nets are not designed to contact the seafloor, they do not have bobbins or roller gear, which are often used to protect the foot rope of a 'bottom' trawl net as it is dragged along the bottom.

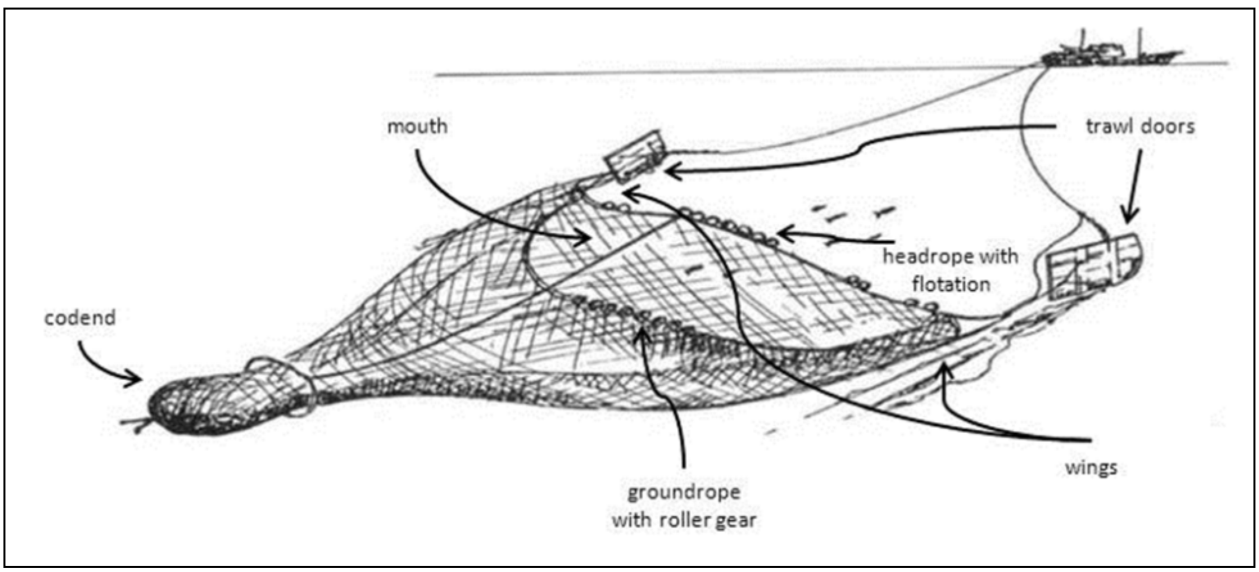


Figure A-1 General schematic of a trawl net

Cobb Trawl: The PIFSC uses a "Stauffer" modified Cobb midwater trawl (Cobb trawl) to sample pelagic species as well as pelagic stages of insular fish species in the Hawaiian Archipelago. Target species are snapper and, grouper species within the 0-175 m depth range. Sampling of pelagic species is conducted using a Cobb trawl with a mouth opening of about 686 m^2 (Figure A-2). For the codend, a 1 m diameter stainless steel ring and 1mm Nitex mesh plankton net is sewn to the rear-most portion of the outer net body near where the inner liner terminates. The plankton net terminates into a zipper-attached ~10 liter capacity canvas bag which serves as the codend and holds the catch contents of the trawl.

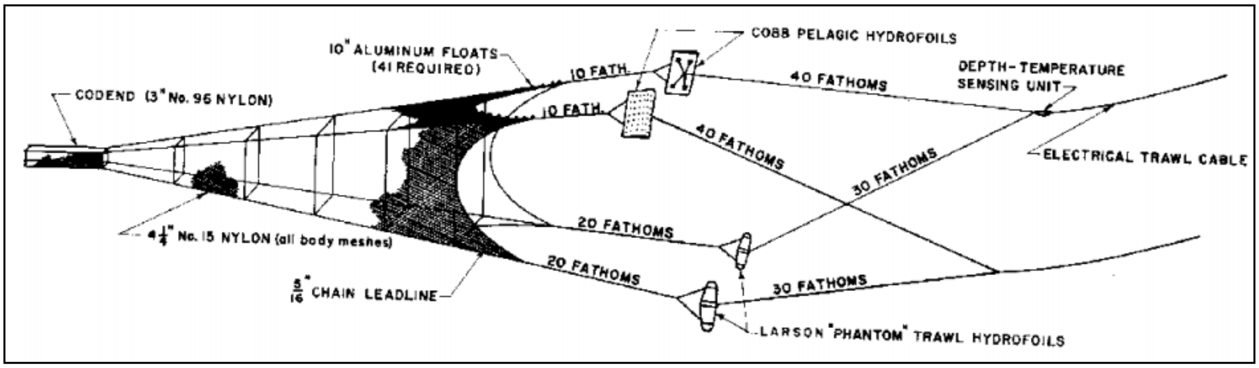


Figure A-2 **Cobb trawl**

2. Plankton Nets

PIFSC research activities include the use of plankton sampling nets that employ very fine mesh to sample plankton and fish eggs from various parts of the water column. Plankton net mesh sizes generally range from 20 to 500 micrometers. Plankton sampling nets usually consist of fine mesh attached to a rigid frame. The frame spreads the mouth of the net to cover a known surface area. Many plankton nets have a removable collection container at the codend where the sample is concentrated. When the net is retrieved, the collecting bucket can be detached and easily transported to a laboratory. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Often, plankton nets are equipped with instruments such as flow meters or pitch sensors to provide researchers with additional information about the tow or to ensure plankton nets are deployed consistently.

Isaacs-Kidd Trawl: The Isaacs-Kidd trawl is used to collect midwater or surface biological specimens larger than those taken by standard plankton nets. The net is attached to a wide, V-shaped, rigid diving vane that keeps the mouth of the net open and maintains the net at depth for extended periods (Yasook et al. 2007) (Figure A-3). The Isaacs-Kidd trawl is a long, round net approximately 6.5 m (21.3 ft) long, with a series of hoops decreasing in size from the mouth of the net to the codend, which maintain the shape of the net during towing (Yasook et al. 2007). The PIFSC uses two sizes of Isaacs-Kidd trawls for various research purposes, a 6-ft wide model and a 10-ft wide model. These nets may be towed either at the surface of the water or at various midwater depths depending on research protocols or where acoustic signals indicate the presence of study organisms.

Figure A-3 Isaacs-Kidd 6-ft trawl

Neuston Net: Neuston nets are used to collect zooplankton that live in the top few centimeters of the sea surface (the neuston layer). This specialized net has a rectangular mouth opening usually 2 or 3 times as wide as deep (e.g., 1 meter by 1/2 meter, or 60 cm by 20 cm) (Figure A-4). Neuston nets sometimes use hollow piping for construction of the net frame to aid in flotation. They are generally towed half submerged at 1-2 knots from the side of the vessel on a boom to avoid the ship's wake.

Figure A-4 Neuston net

<u>Bongo Net</u>: A bongo net looks like two ring nets whose frames are yoked together and allows replicate samples to be collected concurrently (Figure A-5). Bongo nets are towed through the water to sample plankton over a range of depths. During each plankton tow, the bongo net is deployed to the desired depth and is then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample. Some bongo nets can be opened and closed with remote control to enable the collection of samples from particular depth ranges. A group of depth-specific bongo net samples can be used to establish the vertical distribution of zooplankton species in the water column at a site.

Credit: Morgan Busby, Alaska Fisheries Science Center

Figure A-5 Bongo net

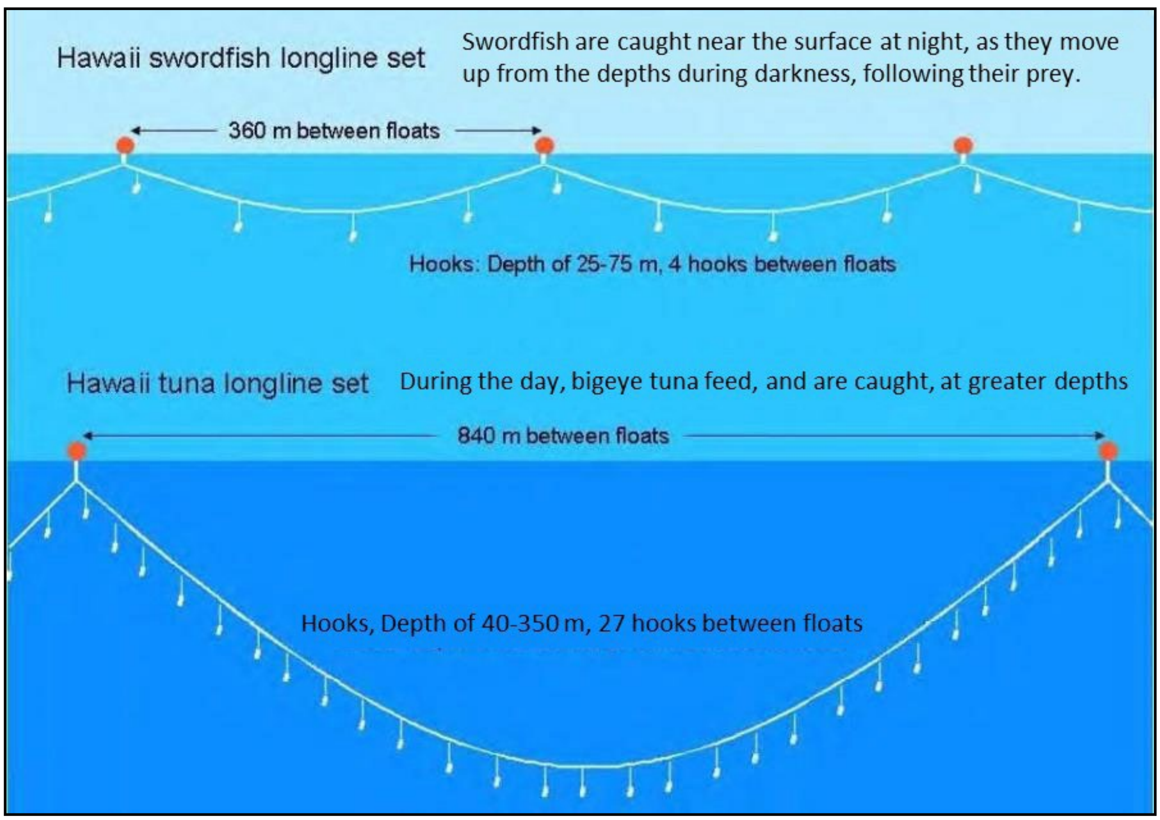
Plankton Drop Net: Plankton drop nets are small hand held nets made up of fine mesh attached to a metal hoop with a long rope attached for retrieval (Figure A-6). These nets are used for stationary surface sampling of the surrounding water.

Figure A-6 Plankton drop net

One Meter Ring Net: A ring net is generic plankton net, made by attaching a net of any mesh size to a metal ring of any diameter. There are 1 m, .75 meter, .25 meter and .5 meter nets that are used regularly. The most common zooplankton ring net is 1 meter in diameter and of mesh size .333mm, also known as a 'meter net'

3. Longline

Longline vessels fish with baited hooks attached to a mainline or 'groundline'. The length of the longline and the number of hooks depend on the species targeted, the size of the vessel, and the purpose of the fishing activity. The PIFSC uses pelagic longline gear deployed at various depths to target different species and to avoid non-target species. Deep-set gear is deployed at depths greater than 100 m and is used to target tunas, e.g., bigeye tuna. Shallow-set gear is deployed at depths less than 100 m and is used to target swordfish. Both types of gear are used to test bycatch mitigation technology to reduce interaction and mortality of marine mammals, seabirds, and sea turtles in pelagic longline fisheries. The longline gear used by the PIFSC for research typically has 600 to 2000 hooks attached to a mainline of up to 60 miles in length. Hooks are attached to the mainline by another thinner line called a 'branchline'. The length of the branchline and the distance between branchlines depends on the purpose of the fishing activity. Buoys are used to keep pelagic longline gear suspended near the surface of the water, and flag buoys (or 'high flyers') equipped with radar reflectors, radio transmitters, and/or flashing lights are attached to each end of the mainline to enable the crew to find the line for retrieval (Figure A-7).



Credit: USFWS 2012

Figure A-7 Schematic example of shallow-set and deep-set pelagic longline gear

4. Trolling

Trolling is a type of hook-and-line fishing method where multiple lines are towed behind a boat to catch species such as salmon, mahi mahi and albacore tuna (Figure A-8). Gear used by the PIFSC have four troll lines each with 1-2 baited hooks towed at 4-6 knots.

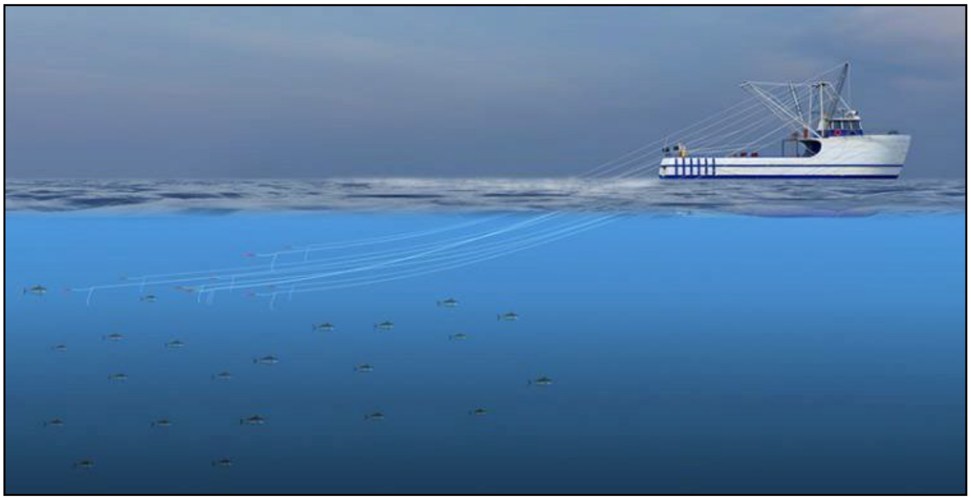


Figure A-8 Trolling

5. Hook-and-Line

The PIFSC uses various types of hook-and-line gear that include standard handlines, rods and reels with lures or bait, as well as electric or hydraulic reels (Figures A-9) with multiple lines and hooks. These set-ups may be used while stationary or mobile. The gear used in PIFSC bottomfish surveys consists of a main line constructed of Dacron or monofilament with a 2–4 kg weight attached to the end (Figure A-10). Several 40–60 cm sidelines with circle hooks are attached above the weight at 0.5–1 m intervals. A chum bag containing chopped fish or squid may be suspended above the highest of these hooks. The gear is retrieved using hydraulic or electric reels after several fish are hooked.

Figure A-9 Example of an electric reel used for bottomfishing

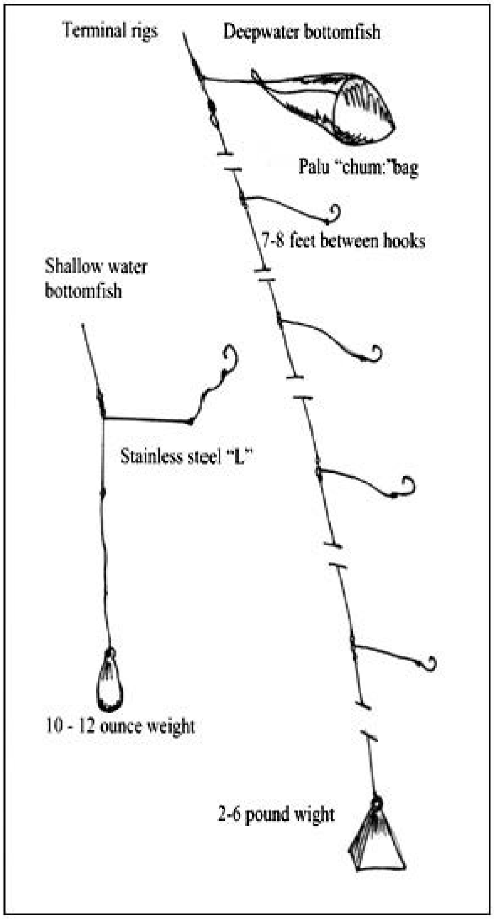


Figure A-10 Typical set-up for bottomfishing hook-and-line gear

6. Lobster Traps

Lobster traps are deployed in the Northwestern Hawaiian Islands to study the life history and population dynamics of lobster. The lobster traps consist of one string per site, with 8 or 20 traps per string, separated by 20 fathoms of ground line (Figure A-11). The traps are deployed within two separate depth regimes: 10-20 or 21-35 fathoms.

Figure A-11 Lobster traps being deployed

7. Miscellaneous Fishing Gear

Spear Gun: Spear guns are used by scuba divers to collect specimens for ecosystem surveys. There are two different types of spear guns, band powered and air powered. The band powered gun consists of a spear a stock and a handle with a trigger (Figure A-12). The air powered gun holds the spear inside of the barrel that contains air which is at ambient pressure until activated by a hand pump that increases the pressure.

Figure A-12 SCUBA diver with band powered spear gun

Slurp Gun: Slurp guns are clear plastic tubes designed to catch small fish by sliding a plunger backwards out of the tube (Figure A-13). The plunging action causes seawater, and hopefully the fish you are trying to catch, to be sucked into the tube via displacement. The diver caps the tube or covers it with a dip net and places the fish into a containment device (net bag, plastic bucket with holes, etc.).

Figure A-13 Slurp gun

Hand Net: A mesh bag attached to a hoop that is constructed of wood or metal. A hand net is used during the Pacific Reef Assessment and Monitoring Program to collect samples of coral, algae, and sessile invertebrates. During the PIFSC Lagoon Ecosystem Characterization a 12-in diameter small mesh hand net is also used to sample fish species.

Dip Net: A dip net is a bag net attached to a long rod that is used by hand to scoop fish or other organisms of interest from the water (Figure A-14). Dip nets come in various sizes, including a commonly utilized dip net with a diameter of 19 in and ¼ in mesh size.

Figure A-14 Dip net

Barbless Circle Hooks: The PIFSC began a barbless hook awareness program in 2004 in order to increase awareness about the benefits of reducing injury and mortality of non-target species using barbless hooks over barbed hooks. Figure A-15 shows a series of different sized circle hooks that are used in different fisheries, all of which have depressed barbs (barbless) except the top middle hook. On the top row, left to right, are size Mustad 20, 18, and 16. The bottom row, left to right, has hooks size Mustad 12 and 11. The PIFSC donations of barbless circle hooks are made primarily at shore-based fishing tournaments or other outreach events. Under this program the PIFSC donates up to 35,000 barbless hooks per year.

Figure A-15 Circle hooks of various sizes: all but the top center hook have depressed barbs

8. Unmanned Aerial Systems

Unmanned aerial systems (UAS) can be used to conduct aerial surveys and can reduce disturbance to marine mammals due to human, vessel, or manned aircraft presence. Using UAS to conduct aerial surveys also may increase the number of aerial surveys and could improve population assessments. PIFSC uses the APH-22 hexacopter (see Figure A-16).

Source: https://www.researchgate.net/figure/The-APH-22-hexacopter-Aerial-Imaging-Solutions-Old-Lyme-CT-that-was-used-to-fl-y-60_fig1_280310049

Figure A-16 APH-22 Hexacopter

9. Shark Tags

PIFSC researchers use several types of shark tags to support studies on Hawaiian monk seal predation, whale shark mortality, and other research. Types of shark tags used by the PIFSC include: Smart Position Transmitting tags (SPOT), survivorship pop-up archival transmitting tags (sPAT), mini pop-up archival transmitting tags (miniPAT), dart tags, and digital acoustic recording tags (DTAGS):

- SPOT tags are rugged, highly versatile location trackers built for marine applications. For studies of shark movements, they are usually attached to the dorsal fin. SPOT tags transmit a signal to the Argos satellite array whenever the dorsal fin breaks the surface of the water[1].
- sPAT tags are used to assess short-term survivorship of tagged animals[2]. They have a suite of sensors and algorithms that monitor the status of a tagged animal for up to 30 days. Reports are generated that identify the survivorship status of the tagged animal and provide on species response to the stress of capture, particularly on longline gear.
- MiniPATs are also pop-up archival transmitting tags[3]. They combine archival and Argos satellite technology. They track large-scale movements and behavior of fish and other animals that do not spend enough time at the surface to allow the use of real-time Argos satellite tags. Figure A-17 depicts a MiniPAT tag.
- Dart tags are used on moderate to large sharks and are about 10 cm long[4].
- DTAGs examine sound exposure, sound use, and behavior of tagged animals. They are attached by suction cup[5].

Figure A-17 MiniPAT Tag

[1] http://www.himb.hawaii.edu/ReefPredator/Tools.htm
[2] https://www.fisheries.noaa.gov/southeast/endangered-species-conservation/shark-and-sawfish-surveys-and-tagging#shark-tagging
[3] https://wildlifecomputers.com/our-tags/pop-up-satellite-tags-fish/minipat/
[4] https://www.fisheries.noaa.gov/southeast/endangered-species-conservation/shark-and-sawfish-surveys-and-tagging#shark-tagging
[5] https://www.fisheries.noaa.gov/west-coast/science-data/southern-resident-killer-whale-digital-acoustic-recording-tag-research

10. Tori Lines

Tori lines or streamer lines are used in trawl and longline fisheries to reduce seabird bycatch. They have been proven effective in reducing seabird bycatch (Goad 2017). Tori lines are usually attached over the vessel stern and have either short or long or a combination of brightly colored streamers (Figure A-18).

Photo courtesy of Bates College, Maine

Figure A-18 Tori Line

11. Reef Monitoring Devices

<u>Pneumatic/Hydraulic drill for coral coring</u>: The PIFSC uses two different types of drills to obtain core samples: pneumatic and hydraulic drills. The pneumatic drill is powered by air and is smaller and handheld (Figure A-19). The hydraulic drill is considerably larger, requiring two people to operate. The core samples collected by the PIFSC are approximately 4 cm in diameter and no more than 100 cm long. The samples are processed in the lab to study structure and biological properties of the coral (Figure A-20).

Source: http://pipa.neaq.org/2012/06/studying-climate-change-with-coral.html

Figure A-19 Coral core collection on a Pacific Reef Assessment and Monitoring Program (RAMP) cruise

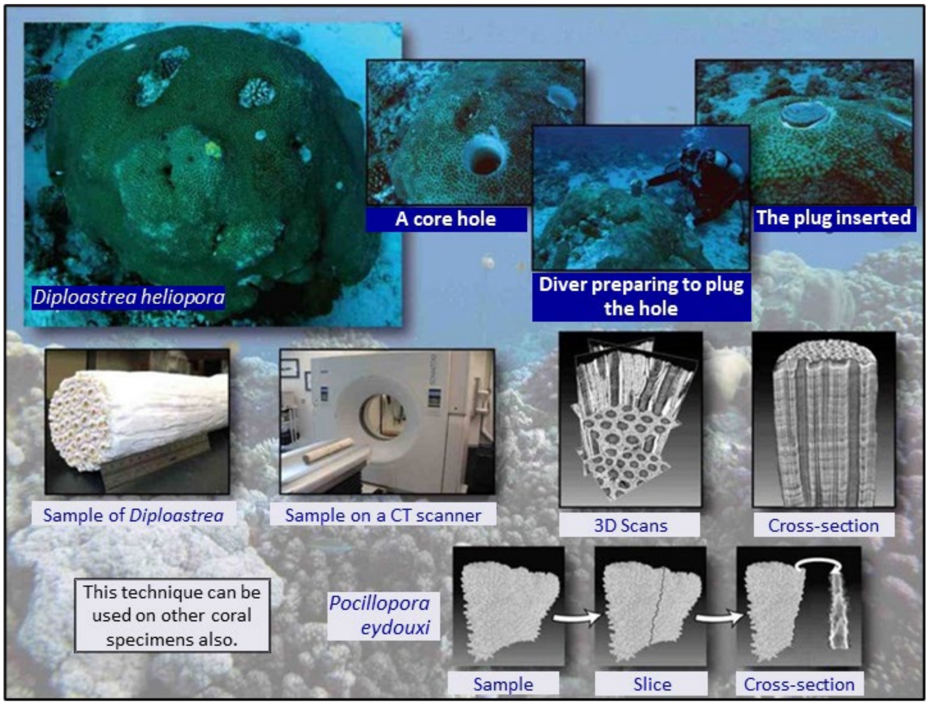


Photo courtesy of the Cohen Lab, Woods Hole Oceanographic Institution

Figure A-20 Diagram illustrating coral-coring process and core analysis

Calcification Acidification Units (CAU's): Rates of net calcium carbonate accretion are monitored with calcification accretion units (CAUs), which allow for recruitment and colonization of crustose coralline algae and hard corals. Each CAU consists of 2 gray PVC plates (10 x 10 cm) separated by a 1 cm spacer and mounted on a stainless steel rod installed by divers into the bottom (avoiding corals) (Figure A-21).

Surface Temperature Recorders (STRs): These recorders provide temperature time series data. They are weighted and strapped to solid substrate on the sea floor at depths up to 30m from by SCUBA divers. Sample intervals over time range from 30 seconds to 60 minutes. PIFSC deploys STRs at coral reef sites in remote Pacific Island areas to help assess how corals respond to thermal stress[6]

Wave Tide Recorders(WTRs): WTR provide a time series of temperature, wave and tide data at coral reef sites. Data is typically collected for a duration of 2 years[7]. Sensors include: Real-time clock, thermistor, and Digiquartz temperature-compensated pressure sensor. When a WTR is recovered, a new one is typically deployed in the same place.

Carbonate Sensing Units (SEAFET, SAMI) and Programmable Underwater Collection Units (PUCs):): SeaFet and SAMI are pH sensors often used in a "Carbonate Diurnal Suite" that also includes a PUC programmed to sample water at selected intervals[8]. The instruments together assess temporal variability in the carbonate levels at selected locations.

6 https://www.fisheries.noaa.gov/inport/item/21443
7 https://www.coris.noaa.gov/metadata/records/html/wtr26p390371070_20100226.html
8 https://www.soest.hawaii.edu/jimar/reports/JIMAR_Annual_Report_2015.pdf

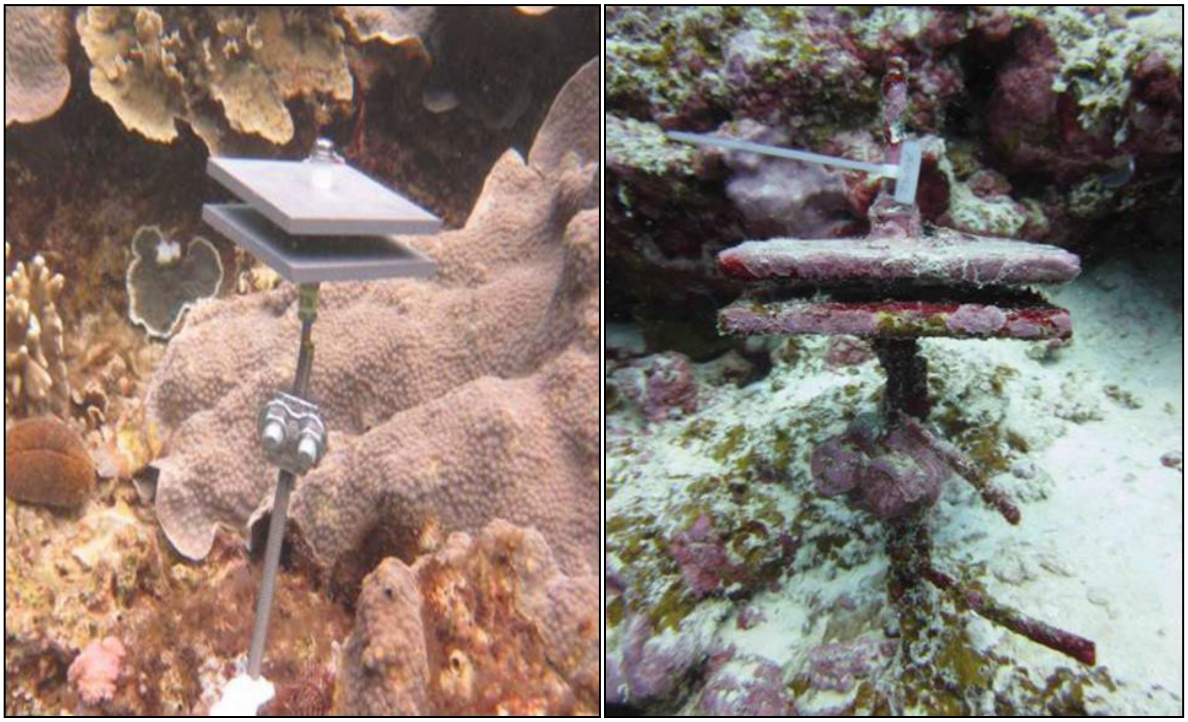


Figure A-21 Calcium acidification unit pre-deployment and two years after deployment

Autonomous Reef Monitoring Structures (ARMS): ARMS are used to examine the biodiversity and community structure of the cryptobiota community. The cryptobiota community is targeted for biodiversity and community composition measurements because it is the most numerically abundant and diverse community on a reef system (Ginsburg 1983). The ARMS used by the PIFSC for Pacific Reef Monitoring Assessments are 36 x 46 x 20 cm structures placed on pavement or rubble, secured to the bottom by stainless steel stakes and weights in proximity to coral reef structures (Figure A-22).

Figure A-22 ARMS structure three years after deployment

<u>Bioerosion Monitoring Unit (BMU)</u>: Bioerosion monitoring units are small blocks made up of coral structures which are layers of calcium carbonate. These units are frequently attached to CAUs for the measurement of coral erosion due to ocean acidification. The PIFSC uses 1 x 2 x 5 cm pieces of relic calcium carbonate and deploys them near reef structures for a period of 1-3 years (Figure A-23).

Figure A-23 Bioerosion monitoring block with CAU unit

12. Submersibles Pisces IV and Pisces V

The Pi*s*ces IV and Pi*s*ces V are three-person, battery-powered, submersibles with a maximum operating depth of 2000m (6,500 ft) (Figure A-24). The submersibles are equipped with HD and SD video cameras on a pan and tilt that allow the science observer to record detailed images of bottom terrain, sea life and sample collecting. Each of the submersibles is equipped with two mechanical arms that give the submersibles the ability perform very fine sampling of fragile marine organisms or operating samplers or scientific instruments. The submersibles have a hydraulically operated "sample tray" that can be configured with a variety of sample collecting boxes or instruments. The submersibles are equipped with a pinger receiver system that enables them to track a signal from 8 to 80Khz. This allows the submersibles to track each other or to locate lost instruments or relocate bottom monitoring sites marked with a pinger or transponder. The submersibles are launched and recovered with a specialized A-frame on the aft deck of their support vessel, the *Ka'imikai-o-Kanaloa*.

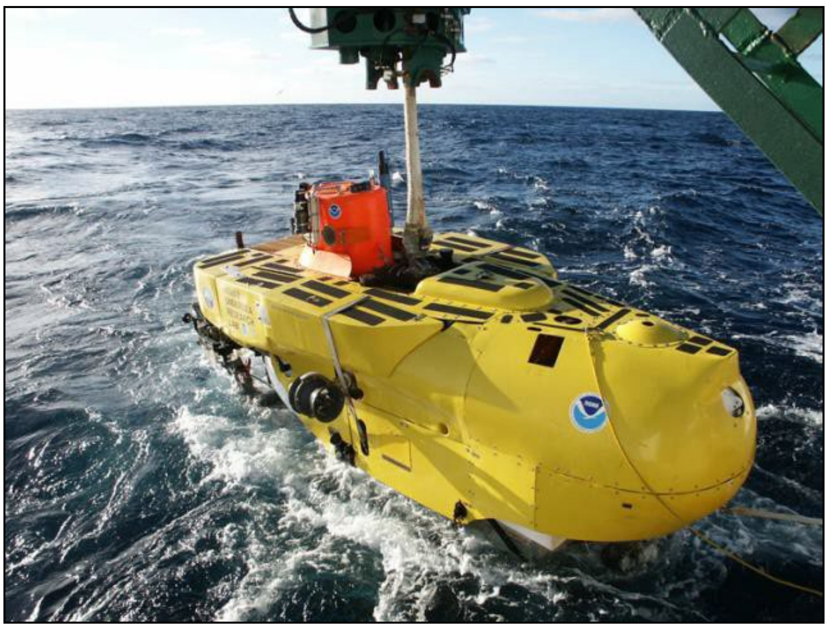
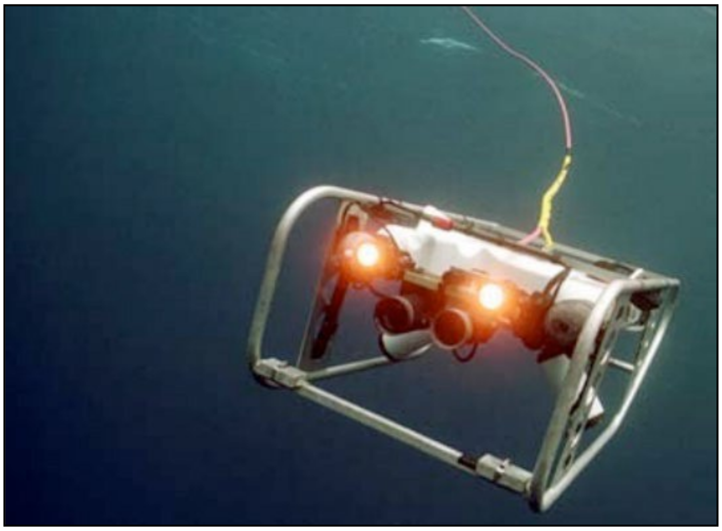


Figure A-24 Submersible

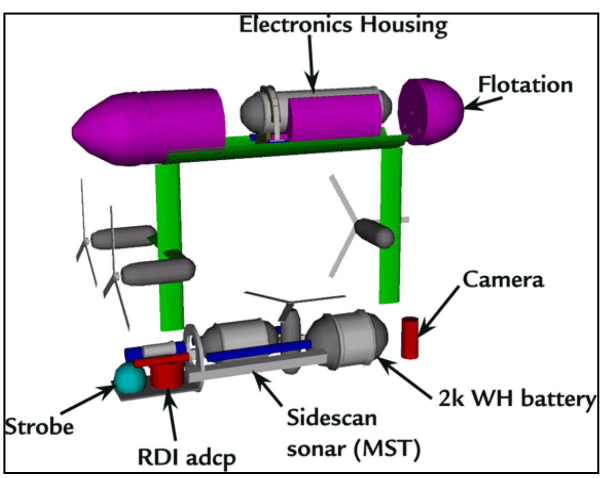
13. Remote Operated Vehicles (ROV), and Autonomous Underwater Vehicle (AUV)



<u>Super Phantom S2 ROV</u>: The Super Phantom S2 is a powerful, versatile, remotely operated vehicle (ROV) with high reliability and mobility (Figure A-25). This lightweight system can be deployed by two operators and is designed as an underwater platform which provides support services including color video, digital still photography, navigation instruments, lights and a powered tilt platform. A wide array of specialty tools and sampling devices are available. The basic configuration of the ROV provides color video, digital still photos, laser scaling device, position information of the ROV and support ship, vehicle heading, and vehicle depth.

Figure A-25 ROV Super Phantom

<u>The SeaBED-class AUV</u>: Unlike other more traditional AUV's, the SeaBED employs a twin-hull design that provides enhanced stability for low-speed photographic surveys (Figure A-26). SeaBED is designed to autonomously follow the terrain approximately 3 to 4 m above the sea floor, collecting high resolution color and black-and-white imagery while maintaining a forward speed of .25 - .5 m/sec. For this mission, SeaBed is also outfitted with a forward-looking stereo video camera system as well as a forward-looking imaging SONAR unit. The stereo-video system is similar to that used on the BRUVS and allows for accurate measures of fish abundance and size structure. The imaging SONAR unit is being tested as a means to assess fish assemblage outside the visual range of the cameras and in zero light situations including nocturnal or operations in depths to which light does not reach.



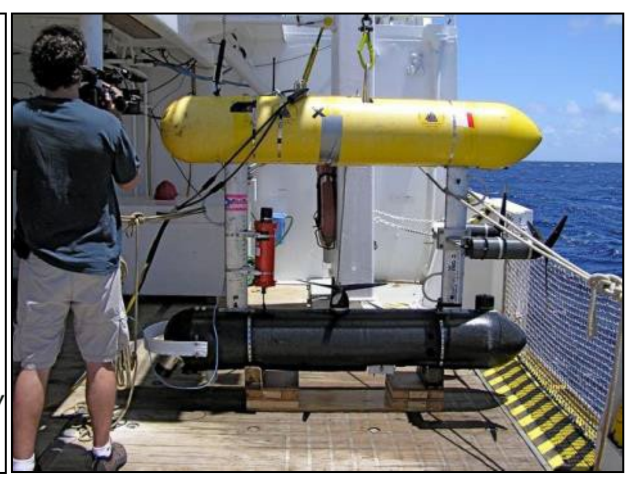


Figure A-26 The SeaBED-class AUV

SeaBED is approximately two meters long and weighs nearly 200 kg. It has two main pressure housings, a top hull and a bottom hull. The CPU electronics are located in the top hull, and the batteries, cameras, and sensors are located in the bottom hull, and all are connected by wet cabling that is routed through vertical struts. With a maximum depth range of 2,000 m, and maximum single-dive time of 6–8 hours, SeaBED can be used to survey habitats ranging from shallow coral reefs to deep groundfish environments.

The AUV is programmed while still aboard the ship. Programming parameters include navigational waypoints, speed, altitude to maintain above the seafloor, and frequency of photographs. Once submerged, the AUV does not resurface until the end of its mission. The AUV reports its position to the ship periodically in telemetry messages via acoustic MODEM. If any of these telemetry messages indicate an unexpected change in the AUV's planned mission, the mission can be aborted via acoustic MODEM message, resulting in the AUV returning to the surface for recovery.

The SeaBED AUV carries a forward-facing ROS Navigator black-and-white, low-light stereo-video camera system, two 5 megapixel, 12 bit dynamic range Prosilica GigE strobe-lighted cameras, one perpendicularly downward-looking and one forward looking (~35°). Imagery from the downward-looking camera can be analyzed to characterize the benthic communities while the forward-looking cameras are used to collect species-specific abundance and length information. Combined, these 2 imagery data sets can be used to create spatial species-specific abundance, biomass, and length-frequency distributions, along with the benthic communities around which they associate. An onboard Seabird model 49 FastCat CTD records temperature and salinity data along the AUV track, providing further environmental insight.

14. SeaGlider, or WaveGlider

Also known as Acoustic or Oceanographic Gliders (Figure A-27), these are autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle provide measure of cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide semi-continuous measurements for up to several months.

Photo credit: D’Spain, G.

Figure A-27 Oceanographic glider

15. Underwater Video Cameras

<u>BotCam</u>: The Bottom Camera or ("BotCam") system includes programmable control functions which allow for the activation of imaging systems, bait release mechanisms, image scaling indicators, and acoustic release to enable recovery of the camera (Figure A-28). The camera bait station can be deployed repetitively during a survey of a site or can sit dormant on the seafloor ready for activation at a preset time. Further, the stereo-video configuration of the camera system allows for the sizing and ranging of both fish and benthic features. Development of a field-tested deep-water camera bait station, coupled with a standard method to analyze the collected image data, will provide a cost-effective and non-extractive alternative method to assess the abundance and size composition of bottomfish populations in deepwater habitats.

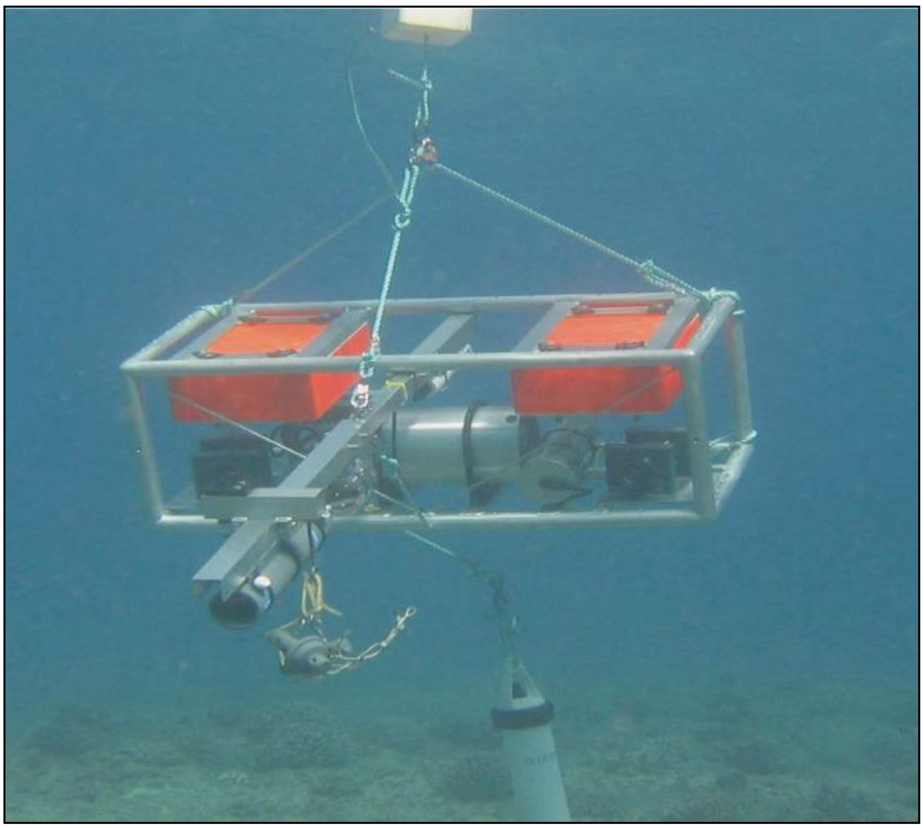


Figure A-28 BotCam

MOUSS: The MOUSS, or Modular Underwater Survey System, is a next generation BotCam that is currently under development (Figure A-29). MOUSS is rated to 500 m and uses highly light sensitive stereo-vision cameras that allow for the identification, enumeration, and sizing of individual fish at a range of 0-10 m from the system. In Hawaiian waters, the system can effectively identify individuals to a depth of 250 m using only ambient light. MOUSS is an evolution of the existing remote camera bait station (BotCam) developed in 2005 by PIFSC. MOUSS is an improvement over the older analogue because it is three times lighter (92 lbs versus 310 lbs), able to attach to different deployment platforms, and captures high-resolution digital footage. The size and weight reduction allows for hand deployment from cooperative research vessels and small boats while the use of high-resolution digital video allows for more accurate and precise fish identifications and measurements

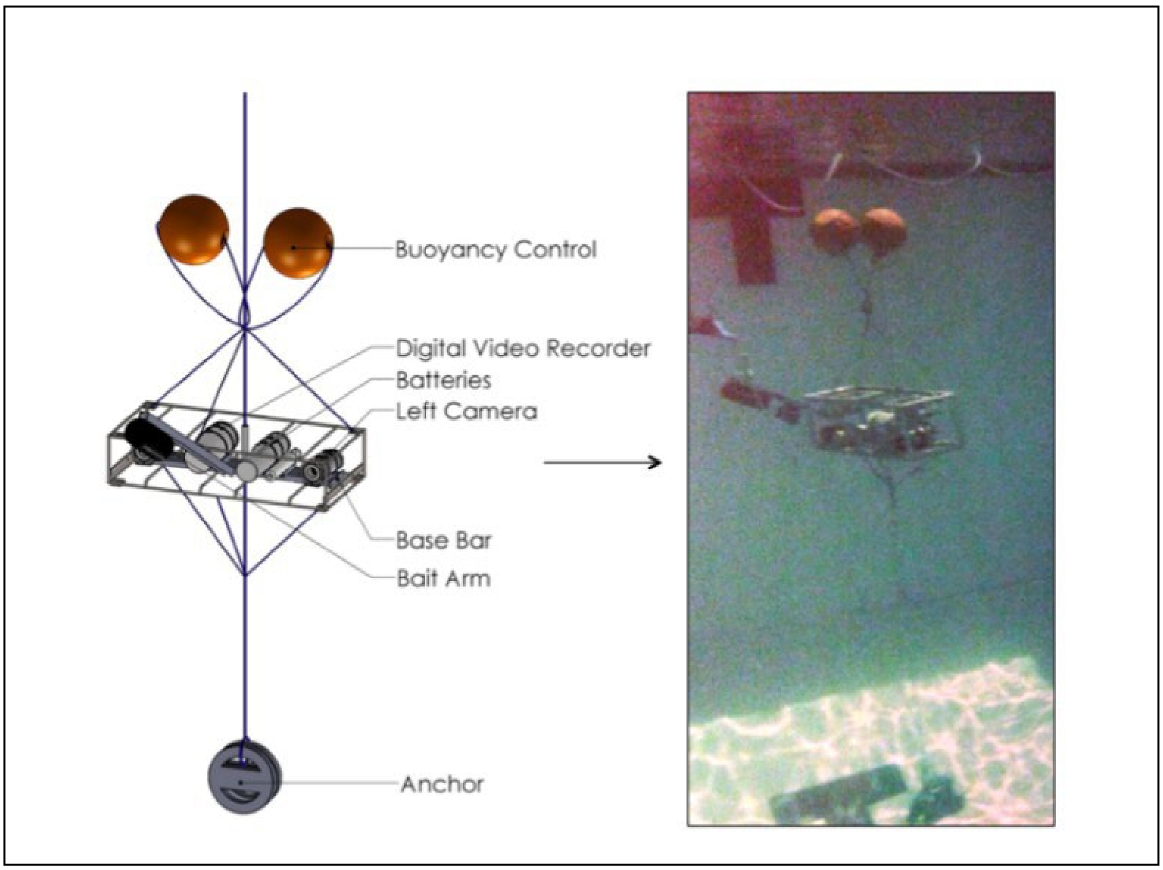


Figure A-29 MOUSS model (left) and prototype during pool test (right)

Baited Remote Underwater Video System (BRUVS): BRUVS are similar to the existing BotCam technology but are more suitable for deployment on coral reef systems because they are smaller, lighter, and can be deployed closer to a substrate (Figure A-30). Ecosystem Sciences Division (ESD – formerly the Coral Reef Ecosystem Division) uses BRUVS for reef surveys to depths of ~100 m. Each BRUVS uses high-definition video cameras mounted 0.7 m apart on a base bar that is inwardly converged at 8°. This stereo-video system allows us to identify fish species and to accurately and precisely determine fish sizes and their distances from the camera when the video images from these cameras are subsequently analyzed. The use of bait attracts a wide diversity of fish species into the field of view of the cameras, but researchers are also experimenting with unbaited deployments.

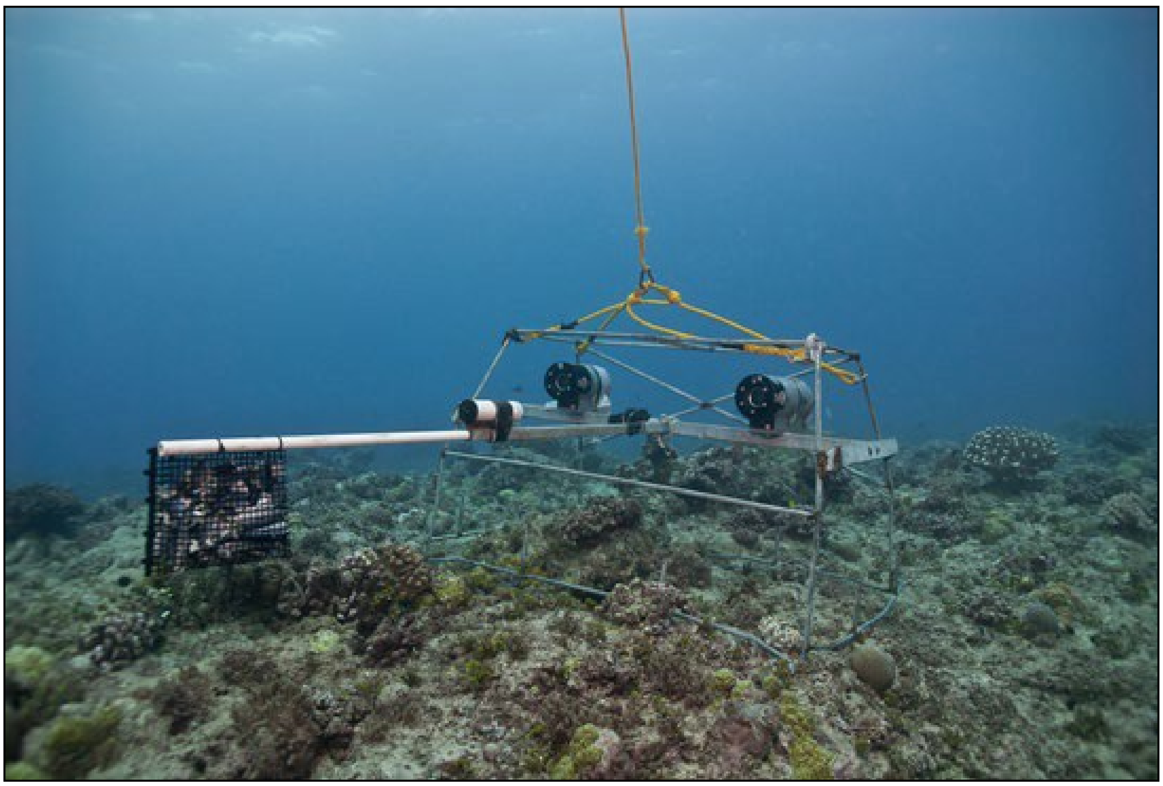
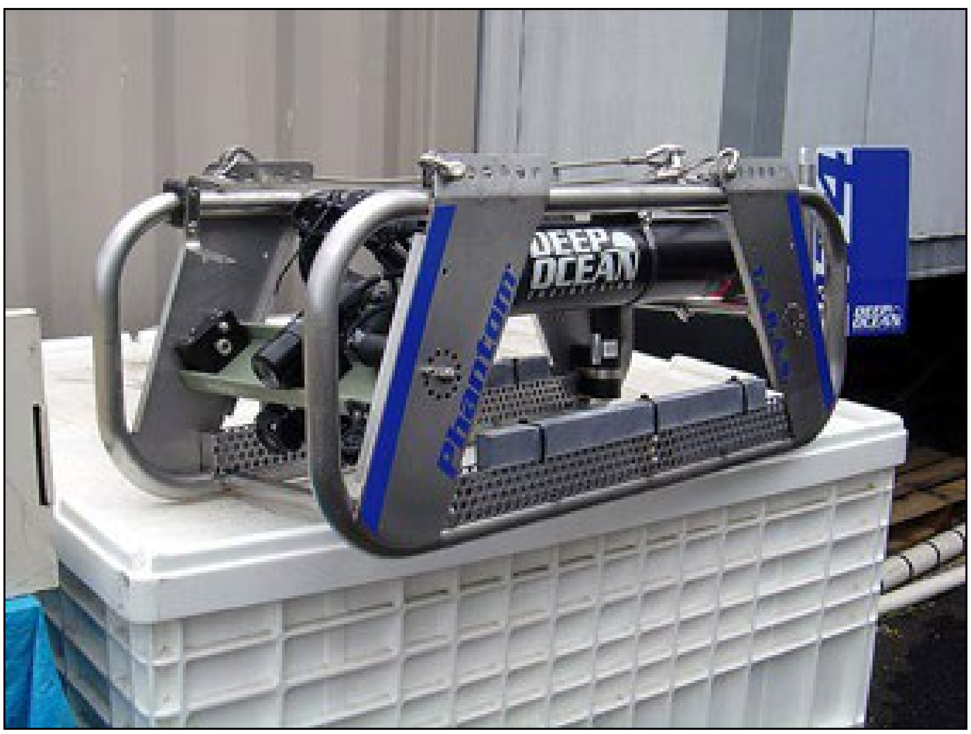


Figure A-30 BRUVS

Towed Optical Assessment Device (TOAD): The Towed Optical Assessment Device (TOAD) is a camera sled built around a stainless steel tubing frame (Figure A-31). It is equipped with a Deep Sea Power & Light (DSP&L) Multi SeaCam 2060 low-light color video camera angled downwards to provide imagery of the seabed while allowing some view of upcoming obstacles, and a downward-facing Ocean Imaging System 12000 digital still camera (consisting of a Nikon D90 digital SLR camera within an aluminum housing). Illumination is provided by two forward-facing 50 watt DSP&L LED Multi SeaLites for the video camera and a downward-facing strobe for the still camera. A pair of downward-facing DSP&L SeaLaser 100 parallel lasers provide scale for still imagery. The sled also has a Tritech PA200 altimeter to detect the height of the camera sled above the seafloor, and a pressure (depth) sensor and fluxgate compass, all installed inside an electronics bottle. The 75-lb camera sled is attached to a control console via umbilical cable that provides a real time feed from the video camera to an electronics console installed on the towing vessel. The TOAD is generally deployed from the vessel while it is drifting or slowly (≤ 1.5 knots) motoring above the seafloor. Operators manning the console adjust the length of cable out to keep the sled at an altitude of approximately 2 m above the seafloor to maximize imagery quality. Dives typically last from 5 to 20 minutes in duration but can run for several hours depending on the mission. Dive depths are most commonly between 20 – 100 m but have exceeded 200 m in depth in a few instances. Still imagery is the primary data recovered by the TOAD and enable PIFSC scientists to quantitatively characterize benthic communities and substrates. Images are typically taken at 15 second intervals and generally only every other photograph is classified.



Source: http://www.pifsc.noaa.gov/cred/survey_methods.php

Figure A-31 TOAD

16. Underwater Sound Playback System (Lubell LL916 piezoelectric)

The Lubell LL916 piezoelectric underwater sound playback system (Figure A-32) has a frequency response of 200Hz to 20kHz and comes with an underwater amplifier and projector. The PIFSC utilized the underwater speaker during their Cetacean Ecology studies to assist in calibration of the passive acoustic equipment. The speaker was suspended from a small boat or ship to a depth of about 100 meters and was set to transmit sound to passive acoustic recording devices in order to understand the detection distances and frequency–dependent variations in the device performances.

Figure A-32 Lubell LL916 piezoelectric underwater sound playback system

17. High-Frequency Acoustic Recording Package (HARP)

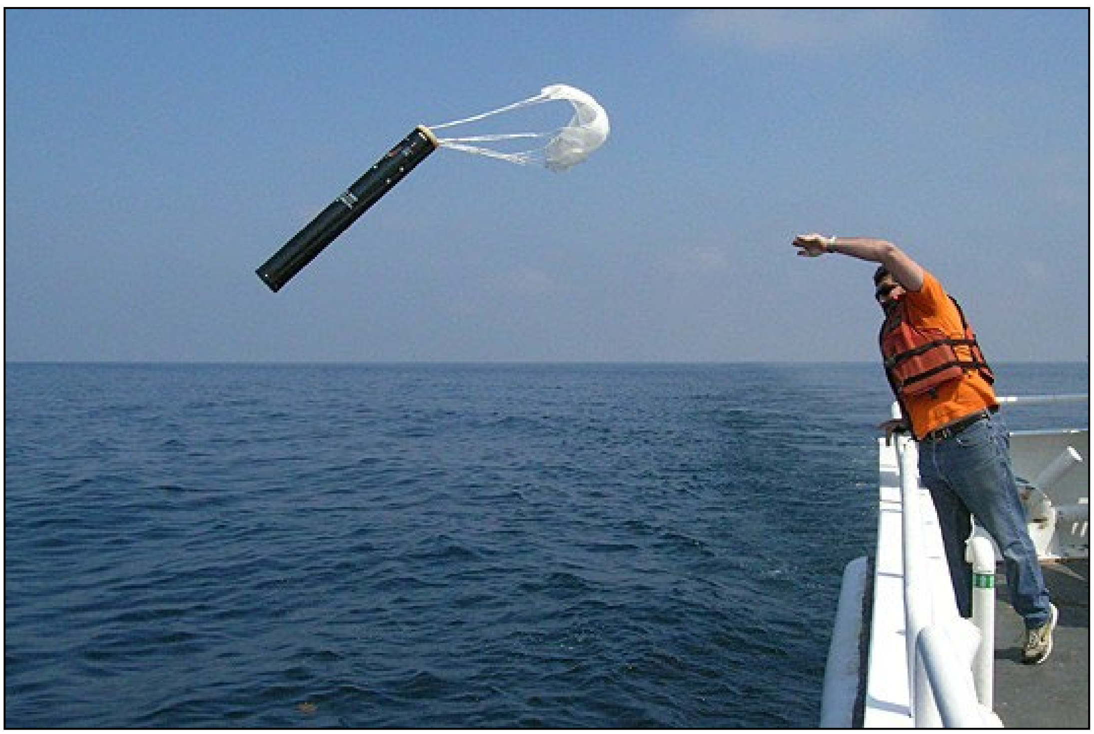
HARPs consist of three parts; hydrophones to convert sound pressure into a voltage signal that is amplified and filtered, a Data Acquisition System (DAS) that records and stores sound, and digital disk drives for recording onto disk (Figure A-33). The internal components of a HARP hydrophone include: two transducers, a signal conditioning electronics circuit board, and connector. These components are packaged in a thin-walled, pliable, polyurethane tube filled with oil to provide good acoustic coupling of the transducers with the seawater while protecting the circuit board from the environment. The seafloor instrument frames are compact arrangements of flotation, data recording electronics, batteries, ballast and release systems which free-fall to the seafloor, record sound for a specified period, and are recalled back to the sea surface for data retrieval and battery replenishment. Seafloor packages are easy to deploy and recover from typical oceanographic ships and mid-sized fishing vessels. In all configurations listed, the hydrophone sensor was designed to be tethered 10 m above the seafloor package which provides a quieter acoustic background for better sound recordings than near the sea surface.

Figure A-33 HARP

<u>Sonobuoy</u>: A sonobuoy is a relatively small expendable HARP system that can be dropped from a ship in order to study underwater acoustics (Figure A-34). Once the sonobuoy is deployed, a radio transmitter attached to a float remains on the surface for communication with the ship while one or more hydrophones below the surface record underwater acoustics.

Drifting Acoustic Spar Buoy Recorders: DASBRs are free-floating acoustic recorders that are deployed from a research vessel at various locations that are chosen based on the ocean currents[9]. They consist of floats, line, two hydrophones, and a data logger. And they must be retrieved to access the data (Figure A-35). The buoys can be anchored in depths up to depth of 150 meters. DASBRs are free floating and provide a quieter recording platform than the ship's towed array system. DASBRs are generally deployed for approximately one month at a time.

Tetrahedral Arrays: An acoustic array is used to listen to vocalizing marine mammals. A tetrahedral array consists of four hydrophones that are towed behind the ship while it is moving along the trackline[10]. These arrays can be towed at over 10 knots, and provide volumetric, real-time detection, classification, localization and storage of data. Tetrahedral arrays are used for mitigation monitoring, population studies and marine mammal research.

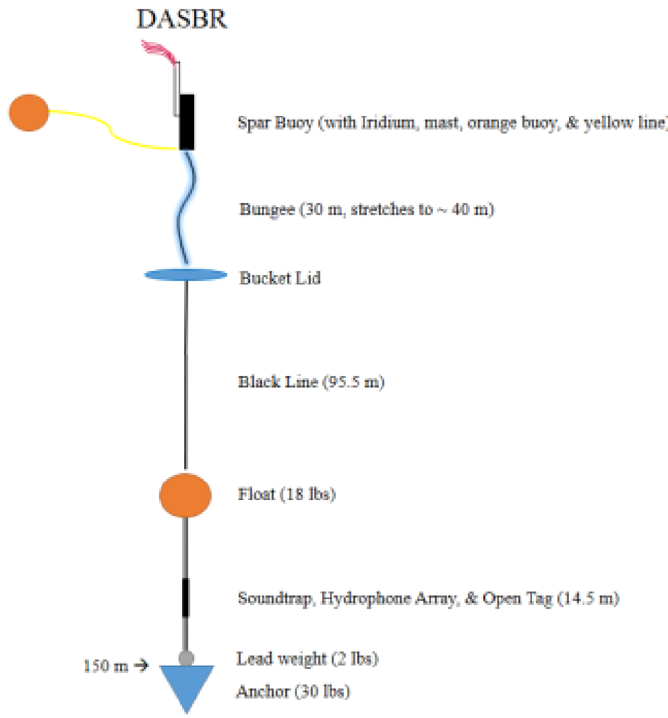


Source: https://www.whoi.edu/multimedia/a-new-sport/

Figure A-34 Sonobuoy being deployed

[9] https://www.fisheries.noaa.gov/science-blog/adrift-sea

[10] https://www.fisheries.noaa.gov/pacific-islands/about-us/whale-and-dolphin-surveys-pacific-islands#towed-passive-acoustic-surveys



Source: https://www.fisheries.noaa.gov/science-blog/adrift-sea

Figure A-35 DASBR Equipment Set Up

18. Ecological Acoustic Reader (EAR)

Passive acoustic data is collected using an Ecological Acoustic Recorder (EAR). The EAR is a microprocessor-based autonomous recorder that samples the ambient sound field on a programmable duty cycle. EARs are generally programmed to record for periods of 30 seconds every 15 minutes at a sampling rate of 25-40 kHz, although these settings are at times different depending on the site and target sounds. An event detector allows for loud sounds that fall within certain parameters to turn on the recorder during duty periods to capture a 15-second recording. Data obtained from each EAR are aurally and visually analyzed.

19. Active Acoustic Sources Used in PIFSC Fisheries and Ecosystem Research

A wide range of active acoustic sources are used in PIFSC fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus on and resolution of specific objects. Table A-1 shows important characteristics of these sources used on NOAA research vessels conducting PIFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output characteristics for predominant PIFSC acoustic sources

Abbreviations: kHz = kilohertz; dB re 1 µPa at 1 m = decibels referenced at one micro Pascal at one meter; ms = millisecond; Hz = hertz

Acoustic system	Operating frequencies (kHz)	Maximum source level (dB re 1 µPa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	18, 70, 120, 200	224	1 ms @ 1 Hz	Downward looking	7°
Simrad EM300 and EM3002D multibeam echosounder	30	237	0.7 to 15 ms @ 5 Hz	Downward looking	1°
ADCP Ocean Surveyor	75	223.6	1 ms @ 4 Hz	Downward looking (30° tilt)	4°
Netmind	30, 200	190	up to 0.3 ms @ 7 to 9 Hz	Trawl-mounted	50°

Single Frequency Sonars

Didson: The Didson sonars operate on a low frequency of 12 MHz that allows for high resolution for up to 30 m even in dark turbid waters. This type of sonar is used for fish imaging and identification.

Multi-frequency Sonars

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and they can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The PIFSC makes use of several multi frequency Echo-Sounders.

Simrad EK60: The Simrad EK60 is a split-beam echo sounder with built-in calibration. It is specifically suited for permanent installation onboard a research vessel. The Simrad EK60 can operate seven echo sounder frequencies simultaneously ranging from 18 to 710 kHz. the Simrad EK60 is comprised of one color display, one processor Unit (personal computer), an Ethernet switch, one or more transceiver units, and one or more transducers. A pole-mounted EK60 is used in the West Hawaii Integrated Ecosystem Assessment. The EK60 over the side pole operations are similar to the EK60 operations on the ship using the same frequencies and power/pulse length. The only difference between the two systems is that the portable 38 kHz on the over the side pole has a slightly wider beam angle than the ship's.

Simrad ES60: The Simrad ES60 is a split-beam echo sounder comprised of a color display, a processor unit, one or more transceiver units, one or more single beam transducers. The transceiver unit is normally mounted close to the transducer. This prevents noise from being picked up by a long transducer cable. It is connected to the processor unit with a standard Ethernet cable. The Simrad ES60 can operate on several echo sounder frequencies simultaneously ranging from 18 to 200 kHz.

Multi-beam Echosounder and Sonar

Multibeam echosounders (Figure A-36) and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal The depth and position of the reflecting surface can be determined from this curately calculated for the entire signal The use of multiple acoustic ‘beams’ allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The multibeam echosounders used by PIFSC are mounted to the hull of the research vessels and emit frequencies in the 3.5-260 kHz range.

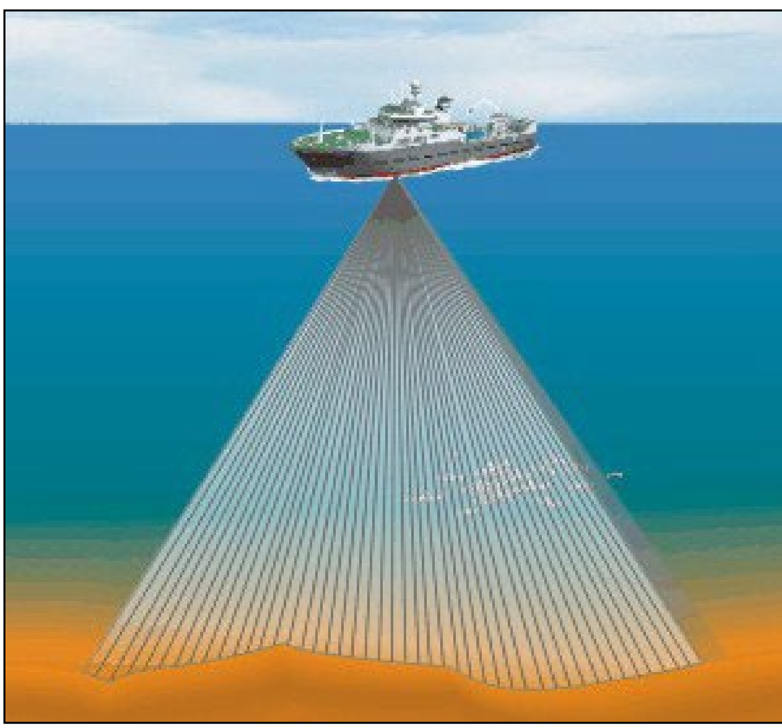


Figure A-36 Multibeam sonar

Trawl Mounted OES Netmind

The NetMind™ Trawl Monitoring System allows continuous monitoring of net dimensions during towing to assess consistency, maintain quality control, and provide swept area for biomass calculations (Figure A-37). The NetMind system is utilized on every tow possible. Towing protocols are not altered based on the real time NetMind display.

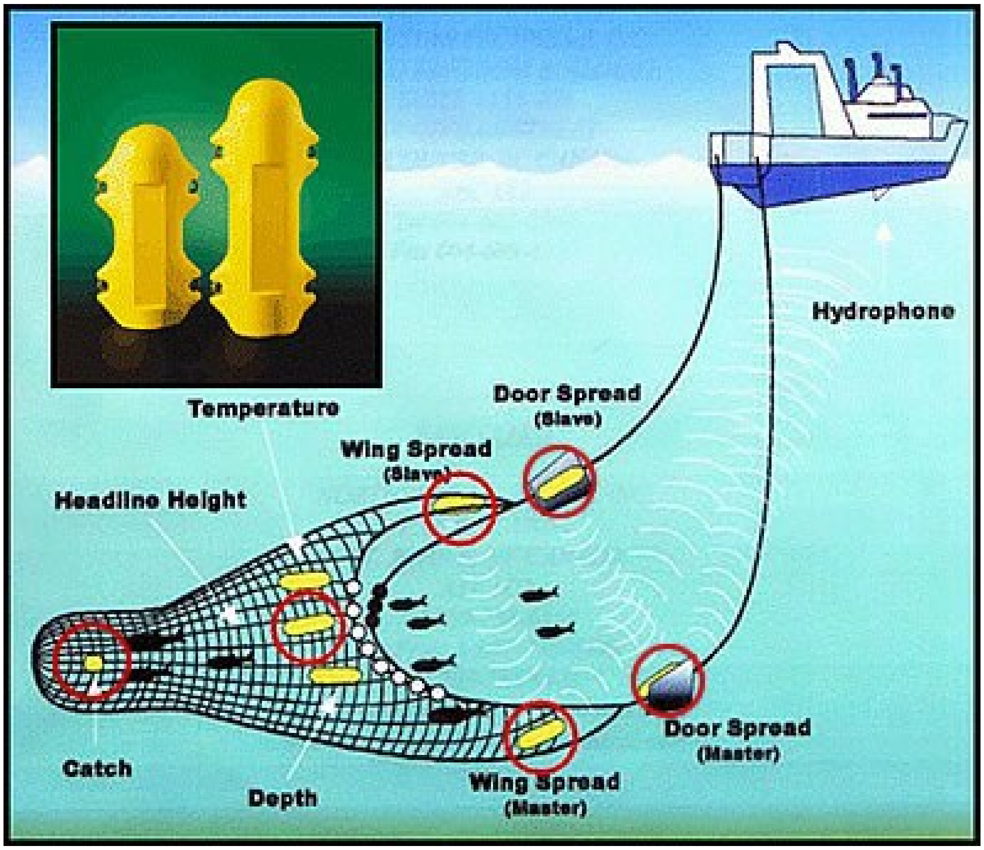


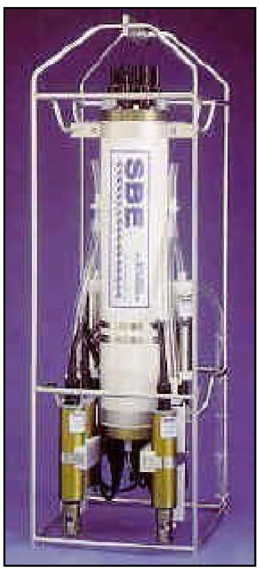
Figure A-37 NetMind

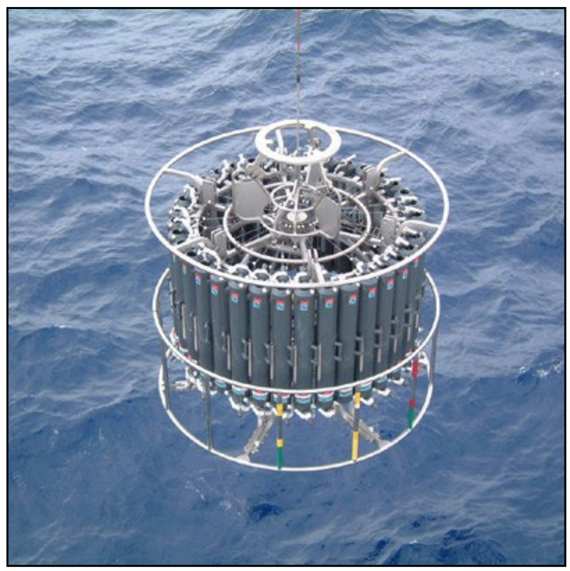
Acoustic Doppler Current Profiler (ADCP)

An Acoustic Doppler Current Profiler (ADCP) is a type of sonar used for measuring water current velocities simultaneously at a range of depths. An ADCP instrument can be mounted to a mooring or to the bottom of a boat. The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument (WHOI 2011). Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return and particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings (WHOI 2011).

20. Conductivity, Temperature, and Depth (CTD)

A CTD profiler is the primary research tool for determining chemical and physical properties of seawater. A shipboard CTD is made up of a set of small probes attached to a large (1 to 2 m in diameter) metal rosette wheel (Figure A-38). The rosette is lowered through the water column on a cable, and CTD data are observed in real time via a conducting cable connecting the CTD to a computer on the ship. The rosette also holds a series of sampling bottles that can be triggered to close at different depths in order to collect a suite of water samples that can be used to determine additional properties of the water over the depth of the CTD cast. A standard CTD cast, depending on water depth, requires two to five hours to complete (WHOI 2011). The data from a suite of samples collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.





Source: Sea-Bird Electronics, Bellevue WA

Figure A-38 Sea-Bird 911 plus CTD profiler and deployment on a sampling rosette.

Conductivity is measured as a proxy for salinity, or the concentration of salts dissolved in the seawater. Salinity is expressed in ‘practical salinity units’ (psu) which represent the sum of the concentrations of several different ions. Salinity is calculated from measurements of conductivity. Salinity influences the types of organisms that live in a body of water, as well as physical properties of the water. For instance, salinity influences the density and freezing point of seawater.

Temperature is generally measured using a high-sensitivity thermistor protected inside a thin walled stainless steel tube. The resistance across the thermistor is measured as the CTD profiler is lowered through the water column to give a continuous profile of the water temperature at all water depths.

The depth of the CTD sensor array is continuously monitored using a very sensitive electronic pressure sensor. Salinity, temperature, and depth data measured by the CTD instrument are essential for characterization of seawater properties.

21. Environmental DNA (eDNA)

eDNA analysis is the collection of traces of DNA found in the water column[11]. As they move through the ocean, traces of the DNA from marine organisms accumulates in the surrounding water. By analyzing eDNA traces, scientists are able to detect individual species and to ascertain the area's biodiversity without disturbing the animals. By combining eDNA sample data with acoustic recordings, scientists can better understand vocalization patterns in relation to group composition and sex. This type of information is valuable for rare or endangered marine mammal species such as beaked whales and false killer whales.

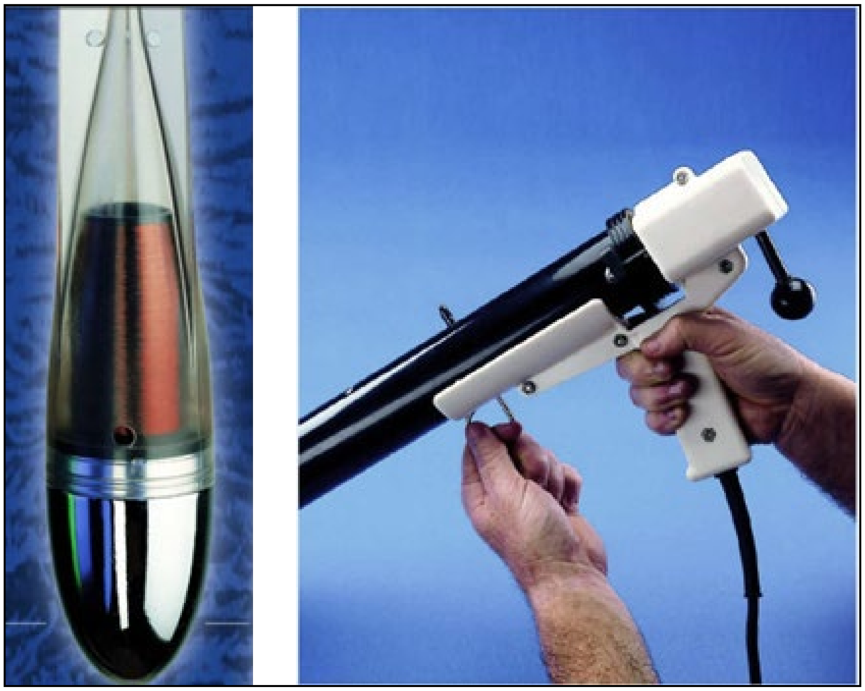
22. XBT (Expendable Bathythermograph)

A standard XBT/XSV system consists of an expendable probe, a data processing/recording system, and a launcher (Figure A-39). An electrical connection between the probe and the processor/recorder is made when the canister containing the probe is placed within the launcher and the launcher breech door is closed. Following launch, wire dereels from the probe as it descends vertically through the water. Simultaneously, wire dereels from a spool within the probe canister, compensating for any movement of the ship and allowing the probe to freefall from the sea surface unaffected by ship motion or sea state.

The XBT probes consist of a metal weight surrounding a temperature probe, attached to a copper wire that conducts the signal to the vessel. The copper wire is protected within a plastic housing. Probes are generally launched from the leeward side of the vessel and as far aft as possible. Launching from these locations helps obtain high reliability and minimizes the chances that the fine copper probe wire will come in contact with the ship's hull which may cause spikes in the data or a catastrophic wire break. A portable shipboard data acquisition system records, processes, and interprets the data the probes collect.

XBT drops occur at predetermined times along with surface chlorophyll sampling. Opportunistic drops may also occur. Typically, three XBT drops are made per survey day. XBT drops may be repeated if the displayed profile does not show a well-defined mixed layer and thermocline. Deep Blue probes are preferred, as they survey to a depth of 760 m and take approximately 2 minutes per drop. As the XBT probes are expendable, they are not retrieved and are left on the seafloor after data collection.

11 https://schmidtocean.org/cruise-log-post/massive-mysteries/



Source: Lockheed Martin Sippican Inc.

Figure A-39 Expendable XBT probe on the left; LM-3A hand-held launcher on the right

23. TDR (Time depth Recorders)

Memory based logging tools record their data against time. To provide a log in a standard format, it is necessary to also record the measured depth against time, then match and merge together the two time based data sets to produce a data record that includes the depth associated with each measured data point.

24. Vessels Used or Similar to Those Used for PIFSC Survey Activities

NOAA Ship *Oscar Elton Sette*

Source: http://www.omao.noaa.gov/learn/marine-operations/ships/oscar-elton-sette

Figure A-40 ***Oscar Elton Sette***

The NOAA Ship *Oscar Elton Sette* (Figure A-40) operates throughout the central and western Pacific, and conducts fisheries assessment surveys, physical and chemical oceanography, marine mammal projects and coral reef research. It collects fish and crustacean specimens using midwater trawls, longlines, and fish traps. Plankton, fish larvae and eggs are also collected with plankton nets and surface and midwater larval nets. The ship routinely conducts scuba diving missions for PIFSC. Ample deck space enables *Oscar Elton Sette* to carry a recompression chamber as an added safety margin for dive-intensive missions in remote regions. The ship is also actively involved in NMFS PIFSC marine debris cruises, which concentrate scientific efforts on the removal, classification and density of derelict fishing gear across the Pacific Islands Region.

University of Hawaiʿi research vessel *Ka'imikai-o-Kanaloa*

Source: https://www.hawaii.edu/news/2019/12/20/kok-research-vessel-retires/

Figure A-41 ***Ka'imikai-o-Kanaloa***

The University of Hawaiʿi research vessel *Ka'imikai-o-Kanoloa* or KoK (Figure A-41) is designed to operate in coastal blue and blue-water areas. Owned and operated by the University of Hawaii, at 223 feet, the KoK displaces 1,961 tons and can accommodate up to 13 crew and 19 scientists. The KoK can remain at sea for 50 days with a full crew and science party, cruising at a maximum speed of 11 knots. The KoK is well equipped for a range of general oceanographic research operations. A SeaBeam bathymetric mapping system is capable of charting the seafloor to depths of 11 kilometers. The vessel also has an Acoustic Doppler Current Profiler to measure profiles of water velocity relative to the ship, a Conductivity-Temperature-Depth system to measuring seawater parameters such as salinity and temperature, and an uncontaminated seawater system. Four laboratories are available for use on the ship: a rock lab for the storage and analysis of solid samples recovered from the ocean, a wet lab for chemical sample analyses, a clean lab, and a dry lab. The KoK's large, moveable A-Frame; trawl winch; and CTD winch allow for the launching of scientific equipment, such as the Pisces submersibles and other ROVs, permitting a variety of oceanographic operations to be conducted at sea. The KoK is equipped with a Trimble NAVTRAC in the bridge and Ashtech in the main lab. Both of these systems can receive Differential Global Positioning System (DGPS) signals. Vessel communications include HF (SSB) and VHF radios, INMARSAT-C satellite communications and Internet, and cellular phone.

NOAA Ship Okeanos Explorer

Source: http://www.omao.noaa.gov/learn/marine-operations/ships/okeanos-explorer

Figure A-42 ***Okeanos Explorer***

The NOAA Ship *Okeanos Explorer* (Figure A-42) is the only federally funded U.S. ship assigned to systematically explore our largely unknown ocean for the purpose of discovery and the advancement of knowledge. Telepresence, using real-time broadband satellite communications, connects the ship and its discoveries live with audiences ashore. Since the ship was commissioned on August 13, 2008, the *Okeanos Explorer* has traveled the globe, exploring the Indonesian 'Coral Triangle Region;' benthic environments in the Galápagos; the geology, marine life, and hydrothermal systems of the Mid-Cayman Rise within the Caribbean Sea; and deep-sea habitats and marine life in the northern Gulf of Mexico. Mapping activities along the West and Mid-Atlantic Coasts have furthered our knowledge of these previously unexplored areas, setting the stage for future in-depth exploration activities. The *Okeanos Explorer* is 224 feet in length and displaces 2,298.3 metric tons. The equipment aboard the *Okeanos Explorer* includes remotely operated vehicles, multibeam sonar for as deep as 6,000 meters, and telepresence capabilities.

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FINAL

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research
Conducted and Funded by the
Pacific Islands Fisheries Science Center

March 2023

Appendix B

Spatial Distribution of PIFSC Fisheries Research Effort by Gear Type

Prepared for the National Marine Fisheries Service by:

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Spatial Distribution of PIFSC Fisheries and Ecosystem Research Effort by Gear Type

This appendix provides a brief synopsis of PIFSC fisheries and ecosystem research effort by gear type and by research area for extractive or bottom-contact gear efforts (Remotely Operated Vehicles [ROVs], longline fishing, dipnet, trap gear, surface and midwater trawls, hook-and-line gear, camera drops, various coral monitoring units, and hand gear by divers). The level of effort at a particular research area can and often does vary from year to year. For example, many surveys only visit the MARA, ASARA, and WCPRA approximately once every three years, but the HARA can be surveyed every year. In addition, the seasonal timing of most research activities is variable from year to year depending on the availability of research vessels and other logistical considerations. The information in this appendix is therefore an approximation of a typical three-year survey cycle of PIFSC fisheries and ecosystem research based on the average level of gear deployment for all surveys and projects under the Status Quo Alternative. Tables B-1 through B-4 summarizes the research effort in each research area, with general descriptions of survey and gear types, along with effort levels. Figures B-1 through B-4 summarizes the general spatial effort in each research area for each major gear type. This allows the reader to judge the concentration of research by gear type in different PIFSC research areas. When combined with the tables referenced above, it provides a more complete understanding of the PIFSC research effort. See Table 2.2-1 and Appendix A for complete details on the gears used in PIFSC fisheries and ecosystem research.

Table B-1 PIFSC research effort by gear type in the HARA

Gear type	Surveys	Gear Description	Sampling Events	Effort
HAWAI'I ARCHIPELAGO RESEARCH AREA (HARA)				
Longline	Pelagic Longline Hook Trials	Pelagic longline and trolling; up to 60-mile mainline	Sum of all longline surveys total up to 130 operations per year with up to 130 trolling operations between longline operations	10-30 hr soak time
	Longline Gear Research	Pelagic longline; up to 60-mile mainline		10-30 hr soak time
	Marlin Longline	Pelagic longline and trolling; up to 60-mile mainline		10-30 hr soak time
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 knots (kts) towed for 60-240 minutes (min) at depths down to 250 meters (m)
	Kona Integrated Ecosystem Assessment Cruise	Stauffer Modified Cobb Net	15-20 tows per year	3 kts towed for 60-240 min at depths down to 200 m
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
	Kona Integrated Ecosystem Assessment Cruise	Isaacs-Kidd trawl, Neuston nets, ring net, Bongo nets, plankton drop net	15-20 tows per year	3kts towed for up to 50 min at depths down to 200 m
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook and line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	350 operations per year	1-30 min soak time
	Northwestern Hawaiian Islands Bottomfish Surveys	Electric or hydraulic reel	256 operations per year	1-30 minute soak time
	Insular Fish Abundance Estimation Comparison Surveys	Hand, electric, and/or hydraulic reels	≤ 540 operations per year	≤ 30 min soak time

Gear type	Surveys	Gear Description	Sampling Events	Effort
Hand gear by divers	Pacific Reef Assessment and Monitoring Program (RAMP)	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Approximately 20 fish specimens and up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	• Bioerosion Monitoring Units (BMUs) • Autonomous Reef Monitoring Structures (ARMS) • Sea Bird Electronics Temperature Recorders (STRs) • Calcification Acidification Units (CAUs) • Water Samplers (PUCs, RAS) • Carbonate Sensors (SEAFET, SAMI)	500 deployments per year	Deployed for 1-3 years
Camera drops	RAMP	Baited Remote Underwater Video Systems (BRUVS)	Up to 600 deployments per year	Deployed for approximately 1 hour (hr)
	Insular Fish Abundance Estimation Comparison Surveys	Underwater Video Camera (BotCam)	380 deployments per year	Deployed for 30-60 min at depths down to 350 m
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year
Trap gear	Northwestern Hawaiian Islands Lobster Surveys	Lobster traps	Up to 360 strings set per year	One string per site with 8 or 20 traps per string at depths of 10-20 or 20-35 fathoms

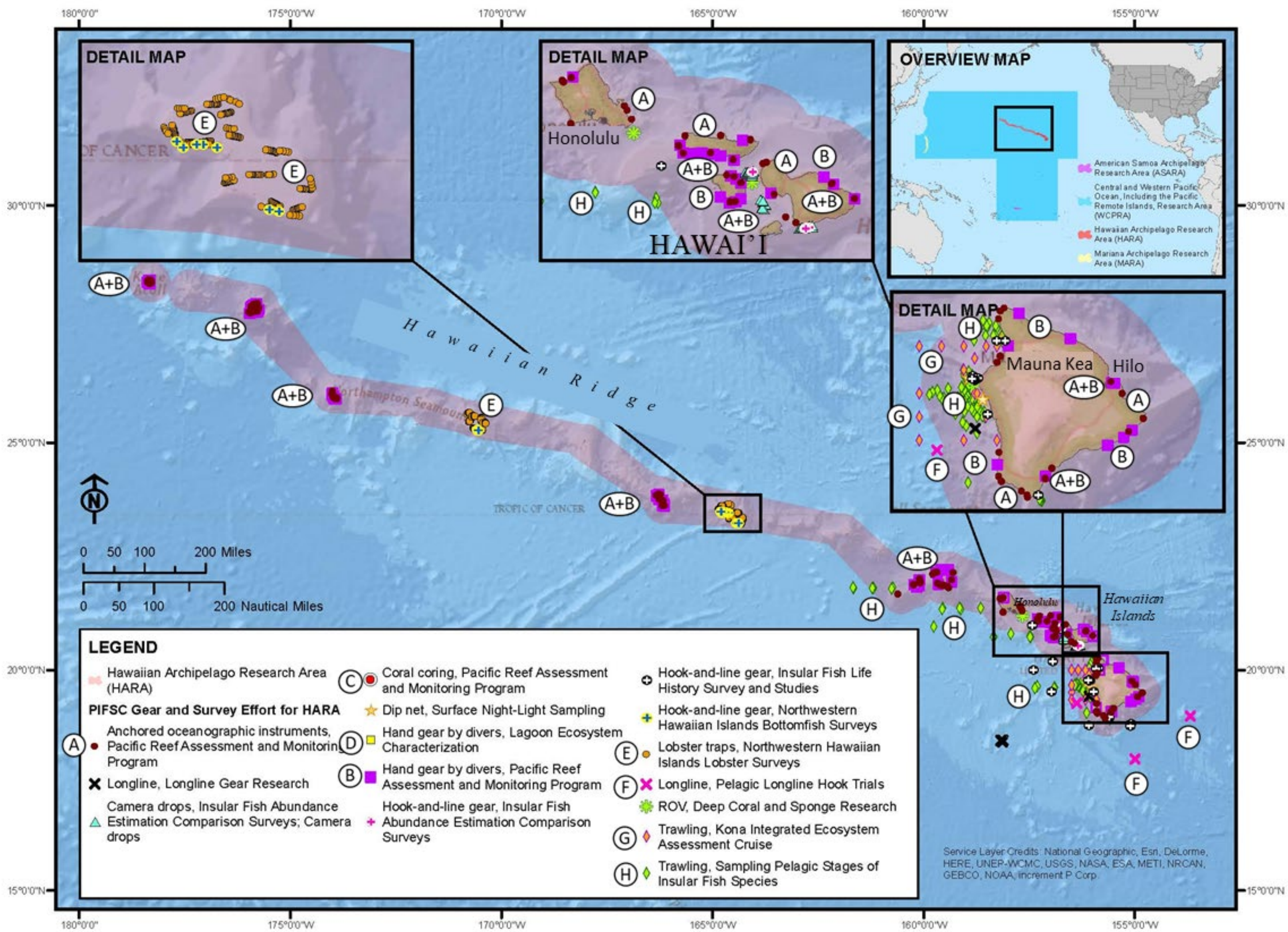

Figure B-1 **Distribution of PIFSC research effort in the HARA for an approximate three-year survey cycle under the Status Quo Alternative**

Table B-2 PIFSC research effort by gear type in the MARA

Gear type	Surveys	Gear Description	Sampling Events	Effort
MARIANA ARCHIPELAGO RESEARCH AREA (MARA)				
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 kts towed for 60-240 min at depths down to 250 meters m
	Mariana Resource Survey	Stauffer Modified Cobb Net	15-20 tows per year	3 kts
		Isaacs-Kidd midwater trawl	200 tows per year	
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
	Mariana Resource Survey	Isaacs-Kidd trawl, Neuston nets, ring net, and Bong nets	15-20 tows per year	3 kts towed for up to 60 min at depths down to 200 m
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook and line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	240 operations per year	1-30 min soak time
	Mariana Resource Survey	Electric or hydraulic reel	1000 sets per survey	Soaked for 10-60 min at depths of 200-600 m
Hand gear by divers	RAMP	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Approximately 20 fish specimens and up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
	Mariana Resource Survey	Spear gun	Up to 1000 reef fish per year	Ad hoc fish collections
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	BMUs, ARMS, STRs, CAUs, PUCs, RAS, SEAFET	500 deployments per year	Deployed for 1-3 year

Gear type	Surveys	Gear Description	Sampling Events	Effort
Camera drops	RAMP	BRUVS	Up to 600 deployments per year	Deployed for approximately 1 hr
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year
Trap gear	Mariana Resource Survey	Kona crab traps and lobster traps	Up to 400 strings set per year and 25 gear sets per cruise	Up to 10 Kona crab nets per string and soaked for 20 min Up to 20 lobster traps per string and soaked overnight

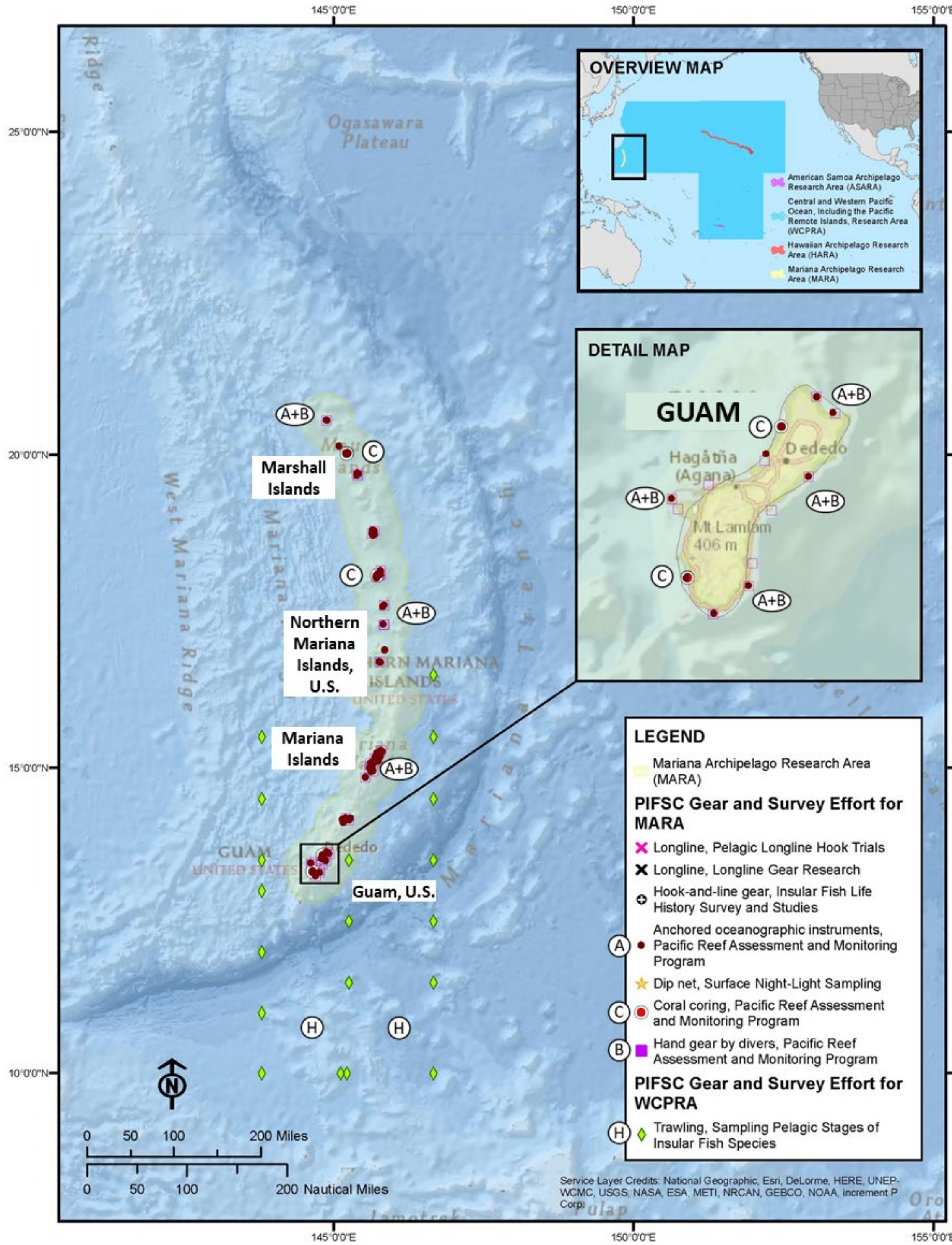

Figure B-2 **Distribution of PIFSC research effort in the MARA for an approximate three-year survey cycle under the Status Quo Alternative**

Table B-3 PIFSC research effort by gear type in the ASARA

Gear type	Surveys	Gear Description	Sampling Events	Effort
AMERICAN SAMOA ARCHIPELAGO RESEARCH AREA (ASARA)				
Longline	Longline Gear Research	Pelagic longline; up to 60-mile mainline	Sum of all longline surveys total up to 130 operations per year with up to 130 trolling operations between longline operations	10-30 hr soak time
	Marlin Longline	Pelagic longline and trolling; up to 60-mile mainline		10-30 hr soak time
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 kts towed for 60-240 min at depths down to 250 m
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook and line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	240 operations per year	1-30 min soak time
Hand gear by divers	RAMP	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Approximately 20 fish specimens and up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	BMUs, ARMS, STRs, CAUs, PUCs, RAS, SEAFET	500 deployments per year	Deployed for 1-3 year

Gear type	Surveys	Gear Description	Sampling Events	Effort
Camera drops	RAMP	BRUVS	Up to 600 deployments per year	Deployed for approximately 1 hr
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year

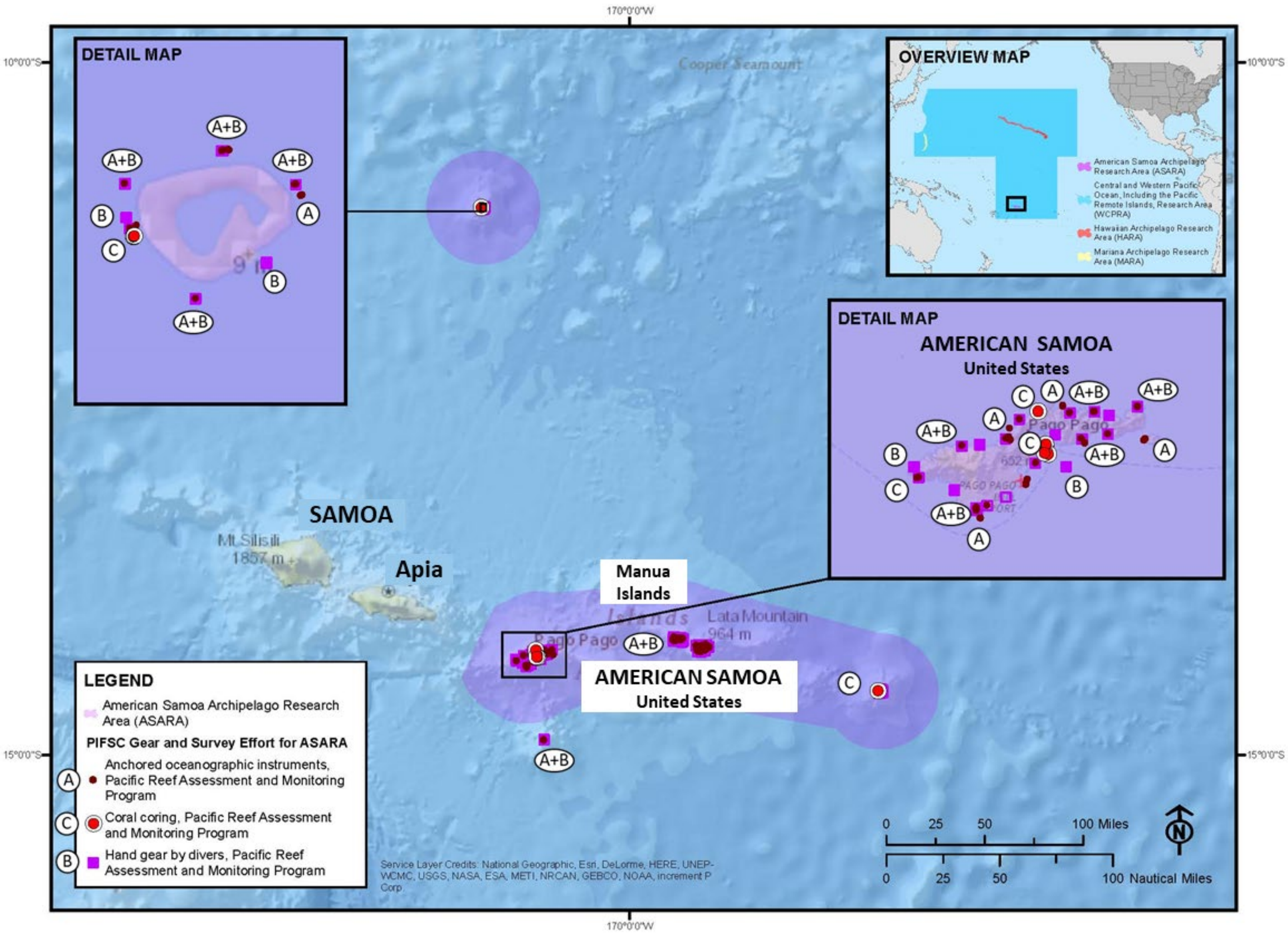

Figure B-3 **Distribution of PIFSC research effort in the ASARA for an approximate three-year survey cycle under the Status Quo Alternative**

Table B-4 PIFSC research effort by gear type in the WCPRA

Gear type	Surveys	Gear Description	Sampling Events	Effort
WESTERN AND CENTRAL PACIFIC RESEARCH AREA (WCPRA)				
Longline	Pelagic Longline Hook Trials	Pelagic longline and trolling; up to 60-mile mainline	Sum of all longline surveys total up to 130 operations per year with up to 130 trolling operations between longline operations	10-30 hr soak time
	Longline Gear Research	Pelagic longline; up to 60-mile mainline		10-30 hr soak time
	Marlin Longline	Pelagic longline and trolling; up to 60-mile mainline		10-30 hr soak time
Midwater trawling	Sampling Pelagic Stages of Insular Fish Species	Stauffer Modified Cobb Net or Isaacs-Kidd trawl	40 tows per survey per year	2.5-3.5 kts towed for 60-240 min at depths down to 250 m
	Pelagic Oceanographic Cruise	Stauffer Modified Cobb Net	20 tows per year	3 kts towed for 60-240 min
		Plankton drop net	20 drops per year	Deployed down to 100 m
Surface trawling	Sampling Pelagic Stages of Insular Fish Species	Isaacs-Kidd trawl, dip net	40 tows per survey per year	2.5-3.5 kts towed for 60 min at the surface
	Spawning Dynamics of Highly Migratory Species	Isaacs-Kidd trawl, Neuston nets, ring net	140 tows per survey per year	2.5-3.5 kts towed for 30-60 min at depths of 0-3 m
	Pelagic Oceanographic Cruise	Isaacs-Kidd trawl, Neuston nets, ring net, Bongo nets	20 tows per year	3 kts towed for 60-240 min at the surface
ROV	Deep Coral and Sponge Research	ROVs and submersibles	200 samples per year	Up to 100 specimens for DNA analysis, 60 voucher specimens, and 40 paleo specimens
Hook–and-line gear	Insular Fish Life History Survey and Studies	Hand line, electric or hydraulic reel	240 operations per year	1-30 min soak time
	Lagoon Ecosystem Characterization	Standard rod and reel	60 casts per survey	1-30 min casts

Gear type	Surveys	Gear Description	Sampling Events	Effort
Hand gear by divers	RAMP	Spear gun, slurp gun, hand net to collect reef fishes and hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, and core-punch to collect coral and algae	Up to 500 coral, algae, and invertebrate samples per year	Ad hoc fish collections and fragments to entire individuals of corals
	Lagoon Ecosystem Characterization	Hand nets	10 dives per survey	Approximately 10 fin clips per survey
Coral coring drill	RAMP	Pneumatic/hydraulic drill with masonry drill bit	30 coral cores per year	2.5 x 5-70-cm coral sample per core
Various coral monitoring units	RAMP	BMUs, ARMS, STRs, CAUs, PUCs, RAS, SEAFET	500 deployments per year	Deployed for 1-3 year
Camera drops	RAMP	BRUVS	Up to 600 deployments per year	Deployed for approximately 1 hr
Dip net	Surface Night-Light Sampling	0.5-m diameter scoop nets	30 night-light operations per year	Total catch of ≤ 1500 larval or juvenile fish per year

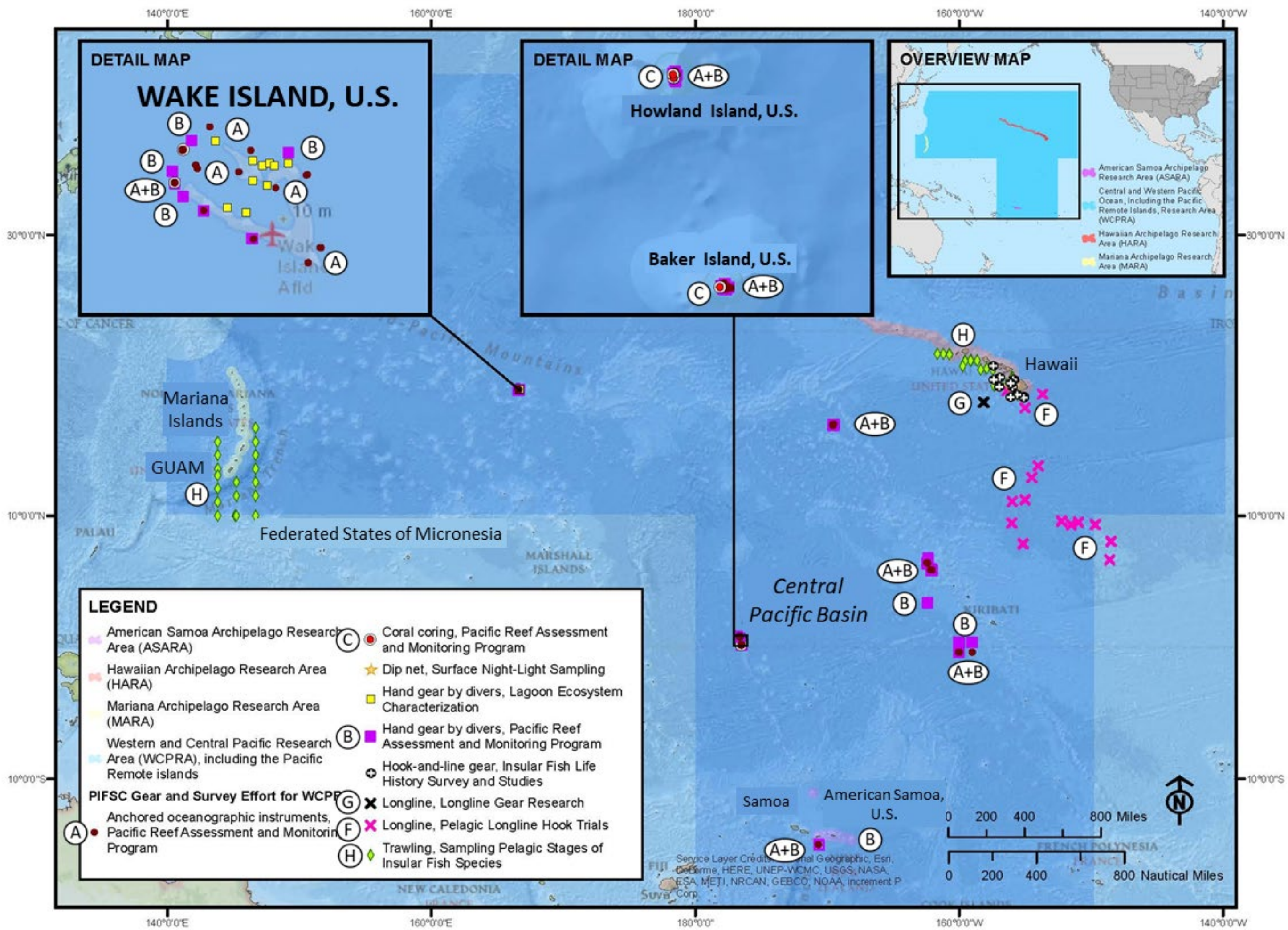

Figure B-4 Distribution of PIFSC research effort in the WCPRA for an approximate three-year survey cycle under the Status Quo Alternative

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FINAL
Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research
Conducted and Funded by the
Pacific Islands Fisheries Science Center

March 2023

Appendix C

Consultation Letters

Prepared for the National Marine Fisheries Service by:

URS Group

700 G Street, Suite 500

Anchorage, Alaska 99501

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EFH Consultation

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 • Honolulu, Hawaii 96818
(808) 725-5300

June 2, 2016

Memorandum For: Michael D. Tosatto, Regional Administrator
Pacific Islands Region

From: Michael P. Seki, Ph.D., Science Director
Pacific Islands Fisheries Science Center

Subject: Request to initiate programmatic consultation: Determination that fisheries and ecosystem research conducted by the Pacific Islands Fisheries Science Center may adversely affect Essential Fish Habitat

This letter is being submitted pursuant to the provisions of the Essential Fish Habitat (EFH) consultation requirements within section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), as amended.

The Pacific Islands Fisheries Science Center (PIFSC) is undertaking a review of its fisheries and ecosystem research program to ensure compliance with applicable environmental laws, including the National Environmental Policy Act, Marine Mammal Protection Act, Endangered Species Act (ESA), and MSFCMA. As part of this process, PIFSC is evaluating the impacts and alternatives of its current fisheries and ecosystem research program. Pursuant to 50 CFR 600.920(e), the draft programmatic Environmental Assessment (DPEA) has been transmitted to your staff electronically, and provides greater detail on these activities and their impacts to EFH. We have also prepared an EFH Assessement (enclosed), which compiles the relevant information presented in the DPEA.

In summary, PIFSC conducts research in four different research areas: 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) Western and Central Pacific including the Pacific Remote Islands Research Area (WCPRA). Research data and analyses are provided to your office, the Western Pacific Regional Fishery Management Council, and other resource management organizations. The primary fisheries and ecosystem research activities described in the DPEA include:

- Sampling and analysis of pelagic and insular fish species
- Oceanographic research and monitoring
- Reef assessment and monitoring

- Marine debris research and removal
- Active acoustic research and mapping

The area affected by the proposed action has been identified as EFH in five Fishery Management Plans developed by the Western Pacific Regional Fishery Management Council (WPRFMC) – termed Fishery Ecosystem Plans (FEPs) – including: Hawaii Archipelago FEP, Mariana Archipelago FEP American Samoa Archipelago FEP, Remote Pacific Island Areas FEP, and Pacific Pelagic FEP. However, the proposed research is expected to result in impacts that are no more than minimal and temporary in nature to EFH. Mortality of fishes, corals, and other marine organisms from captures in surveys is a potential impact, but past levels of catch in PIFSC research surveys are very small and considered negligible to their respective populations. For species that are targeted by commercial fisheries, mortality due to research surveys is much less than one percent of commercial harvest and is considered to have minor adverse effects for all species. Further, these instruments and gears are deployed infrequently over the very large geographic research area. PIFSC research instruments and gears may occasionally make bottom contact, but the area impacted and the frequency of contact would be small. PIFSC is not proposing to implement any additive conservation measures at this time.

It is important to note that some of the nearshore research proposed by PIFSC may affect ESA-listed coral species. PIFSC is consulting separately with PIRO PRD under section 7 of the ESA.

It should also be added that these PIFSC research efforts contribute to meeting U.S. scientific information obligations for marine resource management under the MSFCMA and ESA, as well as international treaties.

I have determined the proposed research actions by PIFSC will have adverse effects that are minimal and temporary in nature on any areas identified as EFH for federally managed species.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Office of Habitat Conservation
1315 East-West Highway, 14th Floor
Silver Spring, MD, 20910
(301) 427-8600

February 24, 2020

Michael Seki
Director, NMFS/PIFSC
1845 Wasp Boulevard, Building 176
Honolulu, HI 96818

Re: Magnuson-Stevens Fishery Conservation and Management Act, Essential Fish Habitat Programmatic Consultation for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center

Dear Mr. Seki:

Our staffs have been coordinating and have developed an essential fish habitat (EFH) programmatic consultation agreement for your Fisheries and Ecosystem Research Program activities. When implemented, this EFH consultation agreement will ensure that program activities continue to achieve compliance with the Magnuson-Stevens Fishery Conservation and Management Act (MSA) EFH provisions (Section 305(b)) and implementing regulations (50 CFR Part 600.920). We are providing that agreement for your consideration and response. The EFH conservation recommendations included in the agreement will ensure that adverse effects to EFH will be avoided and/or minimized to the greatest extent possible. We appreciate this opportunity to coordinate to conserve essential fish habitat to benefit federally managed species and sustainable commercial harvest.

Please be advised that regulations (Section 305(b)(4)(B)) to implement the EFH provisions of the MSA require that federal activities agencies provide a written response to this letter within 30 days of its receipt and, a preliminary response is acceptable if more time is needed. The final response must include a description of measures to be required to avoid, minimize, offset for, or otherwise mitigate the adverse effects of the proposed activities. If the response is inconsistent with our EFH conservation recommendations, an explanation of the reason for not implementing the recommendations must be provided at least 10 days prior to final approval of the activities. Please also note that a distinct and further EFH consultation must be reinitiated pursuant to 50 CRF 600.920 (j) if new information becomes available, or if the project activities are revised in such a manner that affects the basis for the EFH conservation recommendations included in this programmatic consultation.

I look forward to continuing to work together to conserve essential fish habitat. If you have any questions or need additional information please contact the PIRO's EFH Coordinator, Stuart Goldberg, by phone: (858) 334-2818; or by email: stuart.goldberg@noaa.gov.

Sincerely,

Gerry Davis
Assistant Regional Administer
PIRO, Habitat Conservation Division

CC (by email):
PIFSC: Hoku Johnson
PIRO: Malia Chow, Stuart Goldberg, Richard Hall

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Office of Habitat Conservation
1315 East-West Highway, 14th Floor
Silver Spring, MD, 20910
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Magnuson-Stevens Fishery Conservation and Management Act

Programmatic Essential Fish Habitat Consultation

Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center

Agency: NOAA Fisheries, Pacific Islands Science Center

Consultation Conducted By: National Marine Fisheries Service, Pacific Islands Regional Office

Date Issued: February 24, 2020

Issued by: ______________________________
Gerry Davis
Assistant Regional Administrator
PIRO, Habitat Conservation Division

I. CONSULTATION OVERVIEW

A. Authority

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (Section 305(b)(2)) mandates that federal agencies conduct an essential fish habitat (EFH) consultation with National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) regarding any of their actions authorized, funded, or undertaken that may adversely affect EFH. An adverse effect means any impact that reduces the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts including individual, cumulative, or synergistic consequences of actions.

Under section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to federal and state agencies for actions that will adversely affect EFH. In the Pacific Islands, NMFS', Pacific Islands Regional Office (PIRO) is responsible for providing EFH conservation recommendations to federal agencies for actions that will adversely affect EFH under section 305(b)(4)(A) of the MSA. The Pacific Islands Fisheries Science Center (PIFSC) is the research arm of NMFS in the Pacific Islands Region. PIFSC conducts individual project specific consultations in accordance with the EFH consultation regulations at 50 CFR 600.920.

B. Consultation Description

As an alternative to a consultation for each individual action, EFH consultations can apply to a program of similar and repetitive activities whose adverse effects can be adequately reduced through the application of programmatic EFH conservation recommendations (50 CFR 600.920(j)). Programmatic consultation is often appropriate for funding programs, large-scale planning efforts, and other instances where sufficient information is available to address all reasonably foreseeable adverse effects on EFH of an entire program, parts of a program, or a number of similar individual actions occurring within a given geographic area. The purpose of a programmatic consultation is to obtain and implement the EFH consultation recommendations efficiently and effectively by incorporating many individual actions that may adversely affect EFH into one consultation.

The EFH programmatic consultation (hereafter, EFH Programmatic Agreement) between PIRO and PIFSC, addresses the adverse effects from numerous marine research activities on EFH, which are fully described in their Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center (see Enclosure 1). PIFSC has taken a leading role in marine research on ecosystems in the Pacific, both in the insular and pelagic environments. PIFSC implements a multidisciplinary research strategy including scientific analysis and an ecosystem observation system to support an ecosystem-based approach to the conservation, management, and restoration of living marine resources. PIFSC conducts a wide range of activities including resource surveys and stock assessments, fisheries monitoring, oceanographic research and monitoring, critical habitat evaluation, life history and ecology studies, advanced oceanographic and ecosystem modeling and simulations, and economic and sociological studies. PIFSC research is aimed at monitoring target species stock recruitment, survival and biological rates, abundance and geographic distribution of species and stocks, and providing other scientific information needed to improve our understanding of complex marine ecological processes and promote NMFS strategic goal of ecosystem-based fisheries management.

The scope of the EFH Programmatic Agreement is limited to these activities that may adversely affect, but will not have a substantial adverse effect both individually and cumulatively on EFH. While we expect a substantial number activities to utilize the framework of the EFH Programmatic Agreement to comply with the EFH provisions of the MSA, we also anticipate the need to conduct EFH consultations independently from the EFH Programmatic Agreement when activities have the potential to result in substantial adverse effects. The EFH Programmatic Agreement will continue to be adaptive, accountable, and credible as a conservation and regulatory tool. As such, additional categories of activities may be added and/or removed in the future.

C. Implementation Process

This EFH Programmatic Agreement is designed to serve as a fundamental consultation tool between PIRO and PIFSC for activities that conform to all conditions described. This EFH Programmatic Agreement will continue to be adaptive, accountable, and credible as a conservation and regulatory tool. As such, additional categories of activities may be added and/or removed in the future.

PIRO and PIFSC consultation partners will take the following steps to implement individual proposed marine research activities using the EFH Programmatic Agreement for compliance with the MSA:

1. PIFSC will use a verification form (see Enclosure 2) to notify PIRO that proposed marine research activities that conform to all of the conditions of the EFH Programmatic Agreement, and are consistent with the activities described in PIFSC's Programmatic Environmental Assessment. The purpose of the verification form is to ensure that all conservation recommendations described in this EFH Programmatic Agreement for each activity type will be fully implementable. PIRO and/or PIFSC can propose modifications to the verification form that is implemented by written agreement (email is acceptable) by the PIFSC program representative and the PIRO Regional EFH Coordinator.

2. If the marine research activities deviate from the activities described by the PIFSC programmatic environmental assessment, but do not have the potential to result in substantial adverse effects to EFH, PIFSC can initiate a separate supplemental EFH consultation to deal with those adverse effects that are outside the scope of the EFH Programmatic Agreement.

3. PIRO will acknowledge receipt of a complete submitted verification form and provide concurrence, or may reject PIFSC verification form with justification, if PIRO believes the project does not conform to the EFH Programmatic Agreement.

4. If there is unresolved disagreement regarding conformity, and PIFSC wishes to consult on the disputed activities, PIFSC will initiate an individual EFH consultation with PIRO, either

abbreviated or expanded EFH consultation (depending upon the complexity and scale of potential adverse effects).

5. If there are unanticipated adverse effects to EFH, not included in this EFH Programmatic Agreement, PIFSC will conduct an after-the-fact EFH consultation to ensure those impacts are offset or otherwise mitigated for.

6. As part of an adaptive management approach to improving the conservation value, efficiency, and accountability of this program; this EFH Programmatic Agreement will be formally reviewed once per year. PIFSC will coordinate an annual meeting, and provide a detailed summary of all conservation recommendations implemented through application of the EFH programmatic consultation framework, and if those conservation recommendations were effective.

7. PIRO or PIFSC will terminate or modify this EFH Programmatic Agreement through official written correspondence. Termination of the EFH Programmatic Agreement would be effective 90 days from the date that written notification was received. Modifications would be effective 90 days from written agreement between the PIRO EFH Coordinator and PIFSC's program manager.

8. The determination of project eligibility of a proposal by PIFSC under this agreement, remained the authority of PIRO and this agreement will not be leverage for dispute or negotiation.

D. Essential Fish Habitat Designations

EFH is defined as those waters and substrate necessary for federally managed species to spawn, breed, feed, and/or grow to maturity. It is the legal tool that NMFS (i.e., PIRO) uses to manage marine habitat to ensure that the federally managed species identified by the fishery management councils have a healthy future. EFH has been designated for all the federally managed species referred to as the management unit species (MUS) in the Pacific Islands Region. The MUS that are managed in accordance with the MSA include bottomfish (e.g., shallow, intermediate, and deep stock complexes; and seamount groundfish), coral reef ecosystem (Pacific Remote Island Region only), pelagic species, precious corals, and crustaceans. Also included are habitat areas of particular concern (HAPC), which are a subset of EFH and defined as an area where ecological function of the habitat is important, habitat is sensitive to anthropogenic degradation, development activities are, or will stress the habitat, or the habitat type is rare. The HAPC designation is described in the implementing regulations of the EFH provisions (50 CFR § 600.815). Within the EFH consultation process, HAPCs encourage increased scrutiny and more rigorous conservation recommendations for reducing adverse impacts to fish habitat.

The EFH and HAPC designations in the Pacific Islands Region for are summarized by table in **Section VI**. In general, the MUS and life stages found within the water column in the Pacific Region include: eggs, larvae, juveniles, and adults of various MUS. EFH is described in detail in the Western Pacific Fishery Management Council's Fishery Ecosystem Plans (FEP), available on the Council's website.[1] The areas affected by the proposed action has been identified as EFH in five Fishery Management Plans developed

[1] (http://www.wpcouncil.org/fishery-ecosystem-plans-amendments/)

by the Western Pacific Regional Management Council – termed Fishery Ecosystem Plans (FEP) – including the Hawaiian Archipelago FEP, Mariana Archipelago FEP, American Samoa Archipelago FEP, Remote Pacific Remote Island Areas FEP, and Pacific Pelagic FEP.

While EFH is designated throughout a wide range of habitats that contain an extraordinary diversity of biological organisms, corals and submerged aquatic vegetation are particularly vulnerable to many types of adverse effects; and the habitats that they form (coral reefs and seagrass beds) are slow growing and hard-to-replace. In addition to being designated as EFH, these habitats were described for the Clean Water Act in 40 CFR 230 Subpart E, and both habitats have widely known critical functions in many or various life stages of multiple MUS. Uncolonized hard bottoms and hard surfaces are also important for settlement of new corals, and artificial surfaces that occur in the marine environment as a result of man-made structures often function as a proxy for where coral reefs may have once existed. Due to the ecological functions of these EFH resources and their fragile nature, avoiding and minimizing adverse effects to corals and seagrass is a priority of the EFH Programmatic Agreement. This does not preclude the importance of other resources as important EFH, but they tend to be more tolerant of disturbances and/or recover more quickly. Additionally, the water column is the medium through which marine life processes occur, and provides critical habitat functions.

II. DESCRIPTION OF PROPOSED PROGRAM ACTIVITIES

PIFSC conducts research in four different areas: 1) Hawaiian Archipelago Research Area; 2) Mariana Archipelago Research Area; 3) American Samoa Archipelago Research Area; and 4) Western and Central Pacific including the Pacific Remote Islands Research Area.

PIFSC conducts fisheries and ecosystem research activities in monuments, sanctuaries, refuges, and within designated EFH and HAPCs. The potential effects on special resource areas and EFH resulting from PIFSC research primarily involve potential adverse impacts to wildlife, and the risk of accidental spills or contamination from vessel operations. Near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment could result in temporary impacts to pelagic habitat within special resource areas and EFH. Presence of pelagic sampling equipment may result in short-term disturbance or displacement of pelagic species. PIFSC does not use bottom-contact trawl equipment or other mobile bottom-contact research equipment for any fisheries and ecosystem research programs.

A. List of Covered Activity Categories

This EFH Programmatic Agreement applies to the following activity categories, where the activities meet the defined criteria and are able to effectively mitigate environmental impacts through the implementation of the standardized BMPs. Because PIFSC research spans a wide range of activities, the activities have been divided into the following categories intended to cover a suite of closely related activity types. These include:

1. Support Vessels and Tender Boats
2. Ship Deployed Research Gear
3. Coral Research Activities and Instruments

4. Marine Debris Removal
5. Autonomous Vehicles
6. Unmanned Aerial Systems
7. Remotely Operated Vehicles
8. Traps/Baited Video Equipment/Landers
9. Pelagic Longline
10. Fishing Gear
11. Habitat Mapping
12. Sea Surface Sampling

B. EFH Determinations

PIFSC has determined that that their proposed activities, listed above, may result in an adverse effects on EFH. However, these adverse effects can be minimized such that adverse effects to EFH will be minimal, both individually and cumulatively. PIRO has determined that the effective implementation of the EFH conservation recommendations in the EFH Programmatic Agreement (**Section V**) will ensure that adverse effects to EFH will be not more than minimal, both individually and cumulatively. If an authorized activity results in a significant EFH adverse impacts, PIFSC is expected to report such a situation to PIRO. Because federal activities must be compliant with all of the EFH provisions of the MSA, if unanticipated adverse effects occur (e.g., accidents), PIFSC is expected to mitigate after-the-fact for any significant EFH adverse impacts as determined by PIRO.

III. ADVERSE EFFECTS ANALYSIS

This Section describes adverse effects to EFH that could result for marine research activities listed under the EFH Programmatic Agreement. Some information describing stressors is taken from a recent PIRO review of *Non-fishing effects that may adversely affect essential fish habitat in the Pacific Islands Region* (Minton 2017).[2] Allowable adverse effects included in this programmatic must be temporary[3] or have a net resource benefit over time. Because corals and seagrass are slow growing and hard-to-replace, the recovery time back to baseline conditions is considerably greater than other EFH organisms. Habitats may take years to recover fully from adverse effects to sensitive and hard-to-replace, these adverse effects are long-term. The following stressors are likely to occur as a result of PIFSC's proposed marine research activities.

A. Physical Impacts to Benthic Habitat (physical stressor)

Physical damage to coral or coral reefs is often associated with the breaking of colonies or in the form of abrasion. The amount of damage is dependent on many factors, but is mostly due to the nature of the physical force and the types of corals being impacted (Storlazzi *et al.* 2005, Shimabukuro 2014). In general, lobate, encrusting, and other massive colony morphologies tend to withstand breakage better than foliose, table, plating, and branching morphologies. However, these more fragile forms tend to have higher growth rates (Minton 2013), which would facilitate more rapid recovery following damage,

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[2] Available upon request.
[3] Adverse effects completely return to baseline conditions in from minutes to hours.

provided the colony did not experience total mortality. Because of the way that seagrasses establish themselves in an area, an area where they have been removed may take years to recover (Williams 1990; van Tussenbroek 1994, Creed and Amado Filho 1999).

The abundance of fish and other coral-associated organisms are defined by the quantity and quality on a reef's structure and complexity, and any alterations can lead to declines in biodiversity (Alvarez-Filip *et al.* 2009). For example, Jameson *et al.* (2007) found that sites suffering from anchor and scuba diver damage had a lower frequency of hard coral (especially *Acropora* coral), and higher percentage of algae, suggesting physical damage can contribute to a shift from coral- to algal-dominated assemblages.

B. Increase in Invasive Species (biological stressor)

Introduced species are organisms that have been moved, intentionally or unintentionally, into areas where they do not naturally occur. Species can be introduced to new biogeographies, typically via transport on vessel hulls or in ballast water, such as those that may be used in the applicant's proposed activities. Invasive species rapidly increase in abundance to the point that they come to dominate their new environment, creating adverse ecological effects to other species of the ecosystem and the functions and services it may provide (Goldberg and Wilkinson 2004). Invasive species can decrease species diversity, change trophic structure, and diminish physical structure, but adverse effects are highly variable and species-specific.

C. Increase in Sedimentation/Turbidity, and/or Chemicals (pollution stressor)

Increased sedimentation and turbidity can cause smothering of benthic species and block sunlight necessary for those species that rely on photosynthesis. Increases in suspended sediments and turbidity will reduce the depth that sunlight can penetrate to, which changes the wavelengths of light reaching benthic species. Many photosynthetic marine species are dependent on sunlight and often have a narrow band of wavelengths of light that they are able to use.

An increase in contaminants can reduce fitness and cause mortality of exposed organisms. Often, contaminants entering the marine environment are lighter that water, and thus float on the surface where much of it evaporates within a few days (Neff et al. 2000). Unfortunately, this property of some contaminants may lead to greater exposure for seagrass ecosystems which could cause extensive mortality of the seabed, with the associated loss of juvenile fish and invertebrates due to the loss of habitat (Zieman et al. 1984). For those contaminants that sink, the effects on coral colonies may include mortality, tissue death, reduced growth, impaired reproduction, bleaching, and reduced photosynthetic rates (Fucik et al. 1984, Cook and Knap 1983, Neff and Anderson 1981, Burns and Knap 1989, Ballou et al. 1989, Guzman et al. 1993). Few studies have been conducted on the adverse effects of oil on tropical fish, but decreased growth, altered behavioral responses, and changes in metabolic rate have been observed (Johnson et al. 1979, Kloth and Wohlschlag 1972).

D. Increase in Noise (acoustic stressor)

Vessel movement will generate sound and vibratory stress to individual animals. Behavioral changes can occur, resulting in animals leaving feeding or reproduction grounds (Slabbekoorn et al. 2010) or becoming more susceptible to mortality through decrease predator-avoidance responses (Simpson et al. 2016). Less intense but chronic noise, such as that produced by continuous boating, can cause a general increase in background noise over a large area. Although not likely to kill organisms, chronic noise can mask biologically important sounds and alter the natural soundscape, cause hearing loss, and/or have an adverse effect on an organism's stress levels and immune system.

In addition, a wide range of active acoustic sources are used in PIFSC fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus on and resolution of specific objects. Instruments on board the NOAA vessels that fall into this category include: Multibeam Simrad EM3002 D and EM300, Multibeam Reson 8101 ER, Imagenex 837 DeltaT, Split-beam Simrad EK60, Ship-based multibeam (SeaBeam 3012 multibeam, Kongsberg EM-302 30 kHz, EK-60 18 kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz).

All of these instruments involve the production of an acoustic signal, but these instruments are usually only operated while the ship is in motion, so any area would be exposed to acoustic energy of a very short duration. Also, the energy of the signal drops off rapidly with distance from the source, and habitat mapping is most often conducted in deeper water (> 100 m), so the acoustic energy that would reach the seafloor would be minimal.

E. Physical Impacts to Water Column (physical stressor)

Vessels and/or gear moving through the water column. Vessel movement through the water column can disrupt and cause mortality to floating eggs and larvae by physically damaging them with the hull or other ship parts, including the ballast and propulsion systems. Instruments and gear that interact with the upper water column include: dip net (surface), sieves, plankton drop net (stationary surface sampling), and water samplers (PUCs, RAS, and hand collecting devices). A dip net is a bag net attached to a long rod that is used by hand to scoop fish or other organisms of interest from the water. Dip nets come in various sizes, including a commonly utilized dip net with a diameter of 19 in and 1/4 in mesh size. All of these activities occur at, or near, the ocean's surface, or involve the collection of water samples, with no contact with the seafloor or benthic organisms.

IV. ACTIVITIES AND ASSOCIATED ADVERSE EFFECTS TO EFH

The following section describes activity categories included in the EFH Programmatic Agreement, and their associated potential adverse effects to EFH are described in **Section III**. Applicable conservation recommendations are identified for each activity category, and are described in **Section IV**.

A. Support Vessels and Tender Boats

This category covers the large vessels used to access the areas under NMFS jurisdiction in the Pacific, along with the smaller boats deployed from the main support ship used to shuttle staff and supplies to various locations in shallower waters or on land that are inaccessible to the larger vessels. The main vessels covered in this category are the NOAA ships *Oscar Elton Sette* and *Hi'ialakai*.

RV/ Oscar Elton Sette - operates throughout the central and western Pacific, and conducts fisheries assessment surveys, physical and chemical oceanography, marine mammal projects and coral reef research. It collects fish and crustacean specimens using midwater trawls, longlines, and fish traps. Plankton, fish larvae, and eggs are also collected with plankton nets and surface and midwater larval nets. The ship is also actively involved in PIFSC marine debris cruises, which concentrate scientific efforts on the removal, classification, and density of derelict fishing gear across the Pacific Islands Region.

RV/ Hiʻialakai - operates across the Pacific Islands Region, including the Hawaiian Islands, American Samoa, the Commonwealth of the Northern Mariana Islands, and Guam. The *Hiʻialakai* is the primary platform for coral reef ecosystem mapping, bio-analysis assessments, and coral reef health and fish stock studies. Scuba diving operations are essential to scientific operations, and *Hiʻialakai* is well suited to support both shallow and deep-water dive projects.

Tender Vessels (aka "small boats") are used daily to support research activities ranging from dive operations to small-scale plankton collection. There are between 3-5 small boats that work off of each NOAA ship and are typically put into the water for field work via ship crane in the morning and loaded back on the ship in the evening.

Boat operations are transient, and will not generate adverse effects to the same EFH for long durations. Because these activities occur at the ocean's surface, are transient, and will generate a narrow extent of adverse effects; NMFS has determined that there would be only minimal and temporary effects to EFH from noise generate by vessels operating. All vessel discharges are regulated by the U.S. Environmental Protection Administration under their National Pollutant Discharge Elimination System.

The likelihood of adverse effects to EFH from a vessels grounding is low based on accidents from routine operations, although the potential for substantial adverse effects from a single vessel grounding is high. Total adverse effects to EFH would somewhat be dictated by circumstance and response tactics. These activities and mitigation for impacts are often covered under state or other federal statutes and/or processes (e.g., Oil Pollution Act, Natural Resource Damage Assessment).

Adverse Effects from Support Vessels and Tender Boats

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.D) Increase in noise
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.1, 2
2. Increase in invasive species: V.B.2
3. Increase in sedimentation/turbidity, and/or chemicals: V.C.1, 2, 3, 4

B. Ship Deployed Research Gear

Activities under this category involve biological and oceanographic sampling using various trawls, nets, and instruments deployed from the main support vessel or smaller tender vessels. Sampling generally occurs anywhere in the water column below the surface, with no contact with the seafloor.

A trawl is a funnel-shaped net towed behind a boat to capture fish. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh to enable estimates of the size and age distributions of fish in a particular area. Most PIFSC research survey activities utilize ‘pelagic’ trawls, which are designed to operate at various depths within the water column. The types of trawls utilized by PIFSC include the following: Cobb-Stauffer midwater trawl (n=240-280); Isaacs Kidd 10 foot (ft) midwater trawl (n=0-100); and Isaacs-Kidd 6-ft midwater trawl (n=180-280).

PIFSC research surveys also utilize plankton sampling nets that employ very fine mesh to sample plankton and fish eggs. Plankton net mesh sizes generally range from 20 to 500 micrometers. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Nets that PIFSC use includes - small-mesh towed net (surface trawl), neuston tows (surface), 1-m ring net (surface), and small-mesh surface trawl nets (Isaacs-Kidd, neuston, ring, bongo nets). Neuston tows and the 1-m ring net are deployed up to 430 times per year; the small-mesh towed net may be used up to 180 times per year.

An Acoustic Doppler Current Profiler (ADCP) is a type of sonar used for measuring water current velocities simultaneously at a range of depths. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument. Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return and particles moving toward the instrument send back higher frequency waves. The ADCP is deployed continuously during each cruise or temporarily (before sonar calibration operations) and secured during actual calibration.

A conductivity, temperature, depth (CTD) profiler is the primary research tool for determining chemical and physical properties of seawater. A shipboard CTD is made up of a set of small probes attached to a large (1 to 2 m in diameter) metal rosette wheel. The rosette is lowered through the water column on a cable, and CTD data are observed in real time via a conducting cable connecting the CTD to a computer on the ship. The rosette also holds a series of sampling bottles that can be triggered to close at different depths in order to collect a suite of water samples that can be used to determine additional properties of the water over the depth of the CTD cast. Additionally, a Didson sonar may be mounted on the CTD to collect high resolution information on the density of sound scattering layers. The Didson sonar operates on a low frequency of 1.8 megahertz and is capable of imaging targets up to 30 m away. The CTD profiler would be utilized on both NOAA *Ship Oscar Elton Sette* and NOAA Ship *Hi'ialakai* and may be cast hundreds of times per year.

The Towed Optical Assessment Device (TOAD) is a camera sled built around a stainless steel tubing frame. It is equipped with a low-light color video camera angled downwards to provide imagery of the seabed, and a downward-facing digital still camera. Illumination is provided by two forward-facing lights for the video camera and a downward-facing strobe for the still camera. The sled also has an altimeter to detect the height of the camera sled above the seafloor, and a pressure (depth) sensor and fluxgate compass, all installed inside an electronics bottle. The sled is attached to a control console via umbilical cable that provides a real time feed from the video camera to an electronics console installed on the towing vessel. Dives typically last from 5 to 20 minutes in duration but can run for several hours depending on the mission. Dive depths are most commonly between 20 – 100 m but have exceeded 200 m in depth in a few instances. The TOAD may be deployed up to 600 times per year.

The types of scientific sampling gear that will be deployed will have adverse effects from physical disturbance that are transient, and will generate a narrow extent of adverse effects. In addition to removing scientific samples of seawater and marine organisms, brief changes to ambient conditions (e.g., camera flash, minor sonar noise) will occur. NMFS has determined that these adverse effects would be only minimal and temporary effects to EFH from vessels operating.

Adverse Effects from Ship Deployed Research Gear

(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.D) Increase in noise
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Increase in invasive species: V.B.2
2. Increase in sedimentation/turbidity, and/or chemicals: V.C.4

C. Coral Research Activities and Instruments

This category includes research, gear and personnel used to study corals. Research may include physical contact and/or loss of coral through sampling and measuring, or through the use of settlement plates. Rates of net calcium carbonate accretion are monitored with Calcium Accretion Units (CAUs), which allow for recruitment and colonization of crustose coralline algae and hard corals. Each CAU consists of 2 gray PVC plates (10 x 10 cm) separated by a 1 cm spacer and mounted on a stainless steel rod which is installed by divers into the bottom. Up to 500 CAUs are deployed per year (deployed for 1 – 3 years).

Bioerosion Monitoring Units (BMUs) are small blocks made up layers of calcium carbonate. These units are frequently attached to CAUs for the measurement of coral erosion due to ocean acidification. The PIFSC uses 1 x 2 x 5 cm pieces of relic calcium carbonate and deploys them near reef structures for a period of 1-3 years. Up to 500 BMUs may be deployed a year (deployed for 1 – 3 years before recovery).

Autonomous Reef Monitoring Structures (ARMS) are used to examine the biodiversity and community structure of the cryptobiota community. The ARMS used by the PIFSC are 36 x 46 x 20 cm structures placed on pavement or rubble, secured to the bottom by stainless steel stakes and weights in proximity to coral reef structures. Up to 150 ARMs may be deployed per year (deployed for 1 – 3 years).

High-frequency Acoustic Recorder Packages (HARPs) consist of three parts: hydrophones to convert sound pressure into a voltage signal that is amplified and filtered, a data acquisition system that records and stores sound, and digital disk drives for recording onto disk. The seafloor instrument frames are compact arrangements of flotation, data recording electronics, batteries, ballast and release systems which free-fall to the seafloor, record sound for a specified period, and are recalled back to the sea surface for data retrieval and battery replenishment. Passive acoustic data is collected using an Ecological Acoustic Recorder (EAR). The EAR is a microprocessor-based autonomous recorder that samples the ambient sound field on a programmable duty cycle. EARs are generally programmed to record for periods of 30 seconds every 15 minutes at a sampling rate of 25-40 kHz. A combination of HARPs or EARs are deployed up to 30 times per year.

The PIFSC uses two different types of drills to obtain coral core samples: pneumatic and hydraulic drills. The pneumatic drill is powered by air and is smaller and hand held. The hydraulic drill is considerably larger, requiring two people to operate. The core samples collected by the PIFSC are approximately 4 cm in diameter and no more than 100 cm long. Up to 30 coral cores may be taken in a year. SCUBA divers and free divers may collect up to 500 samples of corals, algae, and sessile invertebrates, and perform up to 3000 transects per year.

The types of scientific sampling gear that will be deployed will have adverse effects from physical disturbance that are transient, and will generate a narrow extent of adverse effects (i.e., displacement). In addition, removing scientific samples of benthic organisms (e.g., coral cores), brief changes to ambient conditions (e.g., camera flash, minor sonar noise) will occur. NMFS has determined that these adverse effects would be only minimal and temporary.

Adverse effects to EFH from Coral Research Activities and Instruments

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.D) Increase in noise
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.1, 2, 3, 4, 9
2. Increase in invasive species: V.B.2, 3, 4, 5, 6
3. Increase in sedimentation/turbidity, and/or chemicals: V. C. 1, 2, 4

D. Marine Debris Removal

Marine debris surveys: (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. Team members systematically survey reefs using shoreline walks, swim surveys, and towed-diver surveys to locate submerged derelict fishing gear in shallow water. Debris type, size, fouling level, water depth, GPS coordinates, and substrate of the adjacent habitat are recorded.

Removal of marine debris will have adverse effects from physical disturbance that may be more than minimal. However, the removal will replace lost functionality of habitat and result in an overall benefit to MUS.

Adverse effects to EFH from Marine Debris Removal

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.D) Increase in noise
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.1, 2, 5
2. Increase in invasive species: V.B.2, 3, 5
3. Increase in sedimentation/turbidity, and/or chemicals: V.C.1, 2, 4

E. Autonomous Vehicles

Autonomous vehicles (AUVs) are unpiloted systems that can contain a myriad of instruments to collect a variety of oceanographic, meteorological, and anthropogenic data. Also known as Acoustic or Oceanographic Gliders, these vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic devices integrated into the vehicle provide measure of cetacean occurrence and background noise, CTD, pH, fluorometer, and other sensors provide semi-continuous measurements for up to several months. This category includes such instruments as Seaglider; WaveGlider; and Emily Unmanned Surface Vehicles (USV). Deployment for these platforms is continuous.

The likelihood of adverse effects to EFH from a AUVs grounding is low based on accidents from routine operations. AUVs will have similar adverse effects as vessels as they move through the water, however to a lesser extent due to less kinetic propulsion systems (e.g., glider instead of prop-driven engine), and much smaller mass. These adverse effects are expected to be temporary and minimal.

Adverse effects to EFH from Autonomous Vehicles

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.D) Increase in noise
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.6, 7

2. Increase in invasive species: V.B.1
3. Increase in sedimentation/turbidity, and/or chemicals: V.C.4, 5

F. Unmanned Aerial System Operations

Unmanned Aerial Systems (UAS) are small to medium sized piloted airborne systems used by PIFSC to access areas that are difficult or unsafe for PIFSC staff to reach, to cover larger areas in a shorter amount of time, or to allow the collection of data (population studies) with minimal anthropogenic impacts. These systems are used to collect coral reef ecosystem mapping and monitoring data. Systems used by the PIFSC include PUMA or NASA Ikhana systems, and APH-22 hexacopter. They are operated from shore, small boat or ship and operate along the shoreline or over water around an atoll. There are up to 20 UAS operations per atoll per year.

Possible adverse effects from UAS are limited to situations where the UAS crashes into the ocean, becoming marine debris (i.e., pollution) and causing very localized chemical contamination. Given the small mass and size of these devices, and rarity of crashing. Adverse effects from UAS are expected not to occur, but are possible.

Adverse effects to EFH from Unmanned Aerial System Operations

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.6, 8
2. Increase in invasive species V.B.1
3. Increase in sedimentation/turbidity, and/or chemicals V.C.4, 6

G. Remotely Operated Vehicle (ROV) and Submersibles

An ROV is a piloted vehicle that allows for the exploration of areas of the marine environment inaccessible directly by people. Equipment under this category includes ROVs such as the Super Phantom S2 and Submersibles like the Pices IV. The Super Phantom S2 is a powerful, versatile, remotely operated vehicle with high reliability and mobility. This light weight system can be deployed by two operators and is designed as an underwater platform which provides support services including color video, digital still photography, navigation instruments, lights, and a powered tilt platform. The Pisces IV and Pisces V are three-person, battery-powered, submersibles with a maximum operating depth of 2000 m (6,500 ft). The submersibles are equipped with HD and SD video cameras that allow the science observer to record detailed images of bottom terrain, sea life, and sample collecting. Each of the submersibles is equipped with two mechanical arms that give the submersibles the ability perform very fine sampling of fragile marine organisms or operating samplers or scientific instruments. Up to 400 deployments of these vehicles are made per year.

The likelihood of adverse effects to EFH from a ROVs grounding is low based on accidents from routine operations. AUVs will have similar adverse effects as vessels as they move through the water as vessels, however, like AUVs, to a lesser extent due to less kinetic propulsion systems (e.g., battery instead of combustion-driven engine), and much smaller mass. These adverse effects are expected to be temporary and minimal.

Adverse effects to EFH from Remotely Operated Vehicle (ROV) and Submersibles

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.D) Increase in noise
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.7, 9
2. Increase in invasive species: V.B.1
3. Increase in sedimentation/turbidity, and/or chemicals: V.C.4, 5

H. Traps, Baited Video Equipment, and Landers

This category includes gear and equipment designed to collect biological data on the various marine species of interest through the physical collection of samples, or through video taken of the species attracted to equipment using bait or some other attractant. These types of gear and equipment are deployed on the seafloor with deployment times ranging up to several hours.

The Bottom Camera or ("BotCam") system includes programmable control functions which allow for the activation of imaging systems, bait release mechanisms, image scaling indicators, and acoustic release to enable recovery of the camera. The camera bait station can be deployed repetitively during a survey of a site or can sit dormant on the seafloor ready for activation at a preset time. Further, the stereo-video configuration of the camera system allows for the sizing and ranging of both fish and benthic features. Development of a field-tested deep-water camera bait station, coupled with a standard method to analyze the collected image data, will provide a cost-effective and non-extractive alternative method to assess the abundance and size composition of bottomfish populations in deepwater habitats.

BRUVS are similar to the existing BotCam technology but are more suitable for deployment on coral reef systems because they are smaller, lighter, and can be deployed closer to a substrate. BRUVS are used for reef surveys to depths of approximately 100 m. Each BRUVS uses high-definition video cameras which allows for identification of fish species and to accurately determine fish sizes and their distances from the camera when the video images from these cameras are subsequently analyzed.

The MOUSS, or Modular Underwater Survey System, is a next generation BotCam that is currently under development. MOUSS is rated to 500 m and uses highly light sensitive stereo-vision cameras that allow for the identification, enumeration, and sizing of individual fish at a range of 0-10 m from the system. In

Hawaiian waters, the system can effectively identify individuals to a depth of 250 m using only ambient light. MOUSS is an improvement over the older analogue because it is three times lighter (92 lbs versus 310 lbs), able to attach to different deployment platforms, and captures high-resolution digital footage. A combination of BRUVs, BotCam, and MOUSS may be deployed up to 9600 times per year.

Strings of Fathoms Plus traps are deployed in approximately 200 – 500 m of water targeting offshore seamounts. These traps are deployed off the stern of NOAA Ship Oscar Elton Sette and retrieved using the Sette's pot hauler. The traps target invertebrates and are set in the late afternoon/evening, soak for approximately 16-24 hours and retrieved the following day. The traps are dome shaped, single-chambered, two entrance cones (with dimensions of 980 millimeter (mm) x 770 mm x 295 mm, with inside mesh dimensions 45 mm x 45 mm), made of high density, high impact polyethylene plastic. Each trap contains two bait containers measuring 100 x 305 mm that would hold squid bait or the remains of life history samples from bottomfishing operations. To prevent 'ghost fishing' in the unlikely event traps are lost; the traps have 'rot-out' escape panels sewn into each trap. Natural fiber cord (hemp) is used to hold the panels in place and if the trap is lost, the cord rots and the panel opens. Three strings of twenty traps each are typically deployed on sandy and rocky substrate away from coals and weighted to the seafloor utilizing approximately 10-15 kilograms (kg) of lead weight secured inside each trap.

The types of scientific sampling gear that will be deployed will have adverse effects from physical disturbance that are transient, and will generate a narrow extent of adverse effects (i.e., displacement). In addition, removing scientific samples of marine organism with traps may result in very limited bycatch to MUS' prey bases (due to small size and rot-out panels). Brief changes to ambient conditions (e.g., camera flash) will occur. Traps have the potential to become derelict and become marine debris (pollution). NMFS has determined that these adverse effects would be only minimal and temporary.

Adverse effects to EFH from Traps, Baited Video Equipment, and Landers

(III.A) Physical impacts to benthic habitat
(III.B) Increase in invasive species
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.3, 4, 9
2. Increase in invasive species: V.B.6
3. Increase in sedimentation/turbidity, and/or chemicals: V.C.4

I. Pelagic Longline

Pelagic longline gear is deployed at various depths to target different species and to avoid non-target species. Deep-set gear is deployed at depths greater than 100 m and is used to target tunas, e.g., bigeye tuna. Shallow-set gear is deployed at depths less than 100 m and is used to target swordfish. Both types of gear are used to test bycatch mitigation technology to reduce interaction and mortality of marine mammals, seabirds, and sea turtles in pelagic longline fisheries.

Longline gear used by the PIFSC typically has 600 to 2000 hooks attached to a mainline of up to 60 miles in length. Buoys are used to keep pelagic longline gear suspended near the surface of the water, and flag buoys (or 'high flyers') equipped with radar reflectors, radio transmitters, and/or flashing lights are attached to each end of the mainline to enable the crew to find the line for retrieval. Longline gear is deployed for 10 – 30 hours, and up to 21 sets would be deployed per year.

Pelagic longline activities have the potential to become derelict and become marine debris (pollution). In addition, removing scientific samples of marine organism with traps may result in bycatch to MUS' prey bases. NMFS has determined that these adverse effects would be only minimal and temporary, based on the frequency of lost gear and bycatch rates.

Adverse effects to EFH from Pelagic Longline

(III.A) Physical impacts to benthic habitat
(III.C) Increase in sedimentation/turbidity, and/or chemicals
(III.E) Physical impacts to water column

Applicable Conservation Recommendations

1. Physical impacts to benthic habitat: V.A.9, 10
2. Increase in sedimentation/turbidity, and/or chemicals: V.C.4

J. Fishing Gear

This is gear used or operated by PIFSC staff used to collect biological data used to develop fishery-independent assessments of economically important insular fish stocks, species life history, age/growth studies, and various other topics related to commercially and recreationally important fish species.

Trolling is a type of hook-and-line fishing method where multiple lines are towed behind a boat to catch species such as mahi mahi and albacore tuna. Gear used by the PIFSC consist of four troll lines each with 1-2 baited hooks towed at 4-6 knots. Up to 23 tolling operations would occur per day at sea per survey year across all four research areas.

The PIFSC uses various types of hook-and-line gear that include standard handlines, rods and reels with lures or bait, as well as electric or hydraulic reels with multiple lines and hooks. These set-ups may be used while stationary or mobile. The gear used in PIFSC bottomfish surveys consists of a main line constructed of dacron or monofilament with a 2–4 kg weight attached to the end. Hook-and-line operations involve 1 – 3 lines with 4 – 6 hooks per line that are soaked for up to 30 minutes. Up to 12000 hook-and-line operations would occur per survey year across all four research areas.

Fishing gear, like pelagic longline activities, has the potential to become derelict and become marine debris (pollution). In addition, removing scientific samples of marine organism with traps may result in bycatch to MUS' prey bases. NMFS has determined that these adverse effects would be only minimal and temporary, based on the frequency of lost gear and bycatch rates.

Adverse effects to EFH from Fishing Gear

(IIIA) Physical impacts to benthic habitat

Applicable Conservation Recommendations y

1. Physical impacts to benthic habitat: V.A.9, 10

V. EFH CONSERVATION RECOMMENDATIONS (CRs)

During the EFH programmatic consultation process, PIFSC requested EFH conservation recommendations by stressor type. PIFSC can propose additional measures where they can result in reduced adverse effects to EFH, but may not substitute new measures for the conservation recommendations linked to each activity as described in the EFH Programmatic Agreement. If a project activity cannot comply with the conservation recommendations, PIFSC will complete an individual EFH consultation with PIRO.

A. CRs for Physical Impacts to Benthic Habitat

1. Slower vessel speeds reduce the risk of vessel groundings and damage to EFH habitat such as coral reefs. Transit from the open ocean to shallow-reef survey regions (depths of < 35 m) of atolls and islands should be no more than 3 nm, dependent upon prevailing weather conditions and regulations.
2. All care will be taken during anchoring small boats, with sand or rubble substrate targeted for anchorage to minimize benthic disturbance or coral damage. The anchor will be lowered rather than thrown, and a diver will check the anchor to make sure it does not drag or entangle any benthos.
3. All instruments, gear, and structures that will contact the seafloor should be installed on sandy bottom devoid of seagrass, corals, and/or on un-colonized hard bottom where possible. Whenever possible, habitat mapping data, and the ships sonar and ADCP should be used during deployment.
4. All instruments, gear, and structures should be properly weighted in place to avoid dragging or rolling on the seafloor. All oceanographic monitoring instruments will be secured to non-coral areas near reefs with stainless steel stakes, zip ties, or sand screws to ensure instruments do not break loose and damage corals. Installations immediately adjacent to high coral cover reef should be avoided. Whenever possible, retrieve all gear including anchoring mechanisms (concrete blocks and weights).
5. In order to prevent damage to coral reefs, all marine debris including Derelict Fishing Gear (DFG) will be removed following the decision tree in Figure 1.
6. In order to minimize malfunction, prior to operations employing AUVs, UASs, and submersibles, a pre-deployment test of all operating systems will be run to ensure that equipment is operating

correctly, there are no visually apparent physical defects, and conditions are conducive to operations.

7. All AUV and submersible missions will have a plan that details the mission, geographic locations, and deployment and retrieval plans to minimize the potential for collisions and groundings and ensure proper retrieval.
8. All UAS operations will be conducted with a pilot and a spotter to ensure that the UAS is monitored at all times. Vehicles should be operated within visual distance at all times.
9. Samples collected should be the minimum size necessary for the research purpose and the number necessary to meet the scientific statistical requirements. When the research design calls for the collection of whole samples, those samples should only be taken from areas where the removal would not significantly (< 10 %) reduce the population of that species in the given area.
10. Researchers and contracted fishers will use pre-existing mapping data to avoid sensitive areas (areas of high coral cover) when conducting bottomfishing operations. Fishing should be conducted on the edges of reefs, or above a reef without contact. All longline gear should have a GPS locator attached to ensure the gear can be located and recovered after deployment.

B. CRs for Invasive Species

1. All vessels (small boats, AUSs, UAVs, submersibles) will be inspected and cleaned of any organic material, including algae and other organisms, prior to deployment, in order to minimize the spread of invasive species.
2. Small boats that have been deployed in the field should be cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, should be physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external surfaces of vessels will be rinsed daily with freshwater and always rinsed between islands before transits. Vessels will be allowed to dry before redeployment the following day.
3. Equipment (e.g., gloves, forceps, shears, transect lines, photographic spacer poles, surface marker buoys) in direct contact with potential invasive species, diseased coral tissues, or diseased organisms will be soaked in a freshwater 1:32 dilution with commercial bleach for at least 10 min and only a disinfected set of equipment is used at each dive site.
4. All samples of potentially invasive species, diseased coral tissues, or diseased organisms are collected and sealed in at least 2 of a combination of bags or jars underwater on-site and secured into a holding container until processing.
5. Dive gear (e.g., wetsuit, mask, fins, snorkel, BC, regulator, weight belt, booties) is disinfected by one of the following ways: a 1:52 dilution of commercial bleach in freshwater, a 3 percent free chlorine solution, or a manufacturer's recommended disinfectant-strength dilution of a quaternary ammonium compound in "soft" (low concentration of calcium or magnesium ions) freshwater.
6. In order to prevent the spread of invasive species, ensure all traps, baited cameras, and anchoring mechanisms (e.g. concrete blocks and metal weights) are thoroughly washed in fresh water and air dried.

C. CRs for Sedimentation/Turbidity, and/or Chemicals

1. As possible, a spill response kit should be kept on all boats while in operation in order to be able to respond rapidly in the event of a spill (gas, oil, etc.).
2. With regards to waste and garbage discharges, vessels must adhere to MARPOL 73/78 protocols to prevent damage to nearby coral reefs and marine life.
3. Debris from ship maintenance and chemicals used aboard the ship should not be allowed to enter the marine environment where they might be a risk of exposure, entanglement, or ingestion.
4. Vessels, equipment, and instruments should be clean and contaminant free, and no chemicals, oils or other pollutants associated with the equipment and/or sampling activity should be released into the ocean.
5. When piloting AUVs and submersibles, attention should be paid to the proximity to the seafloor to minimize the resuspension of sand and/or silt.
6. Should any UAS make an emergency landing in the water, small boats will be deployed immediately to retrieve the equipment to minimize potential for pollution (e.g. loss of gas or batteries into the marine environment).

VI. TABLES AND FIGURES

Table 1. EFH and Designations for the Pacific Islands Region.

FEP	Fishery	Stock or Stock Complex	Life Stage(s)	EFH Designation
American Samoa	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 (200 fm)
			Juvenile/adult	The water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fm)
Hawaiʻi	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 (75 fm)
			Juvenile/adult	All of the bottom habitat from the shoreline to a depth of 100 m (50 fm)
		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 300-700 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
		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
		Deep stocks: *Etelis carbunculus, Etelis coruscans, Pristipomoides seiboldii, 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

FEP	Fishery	Stock or Stock Complex	Life Stage(s)	EFH Designation
			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. coruscansi*) zones, including all bottom habitats, in depths from 80 to 400 m bounded by the official US baseline and 400 m isobaths
		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
			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
		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
Pacific Remote	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 (200 fm)

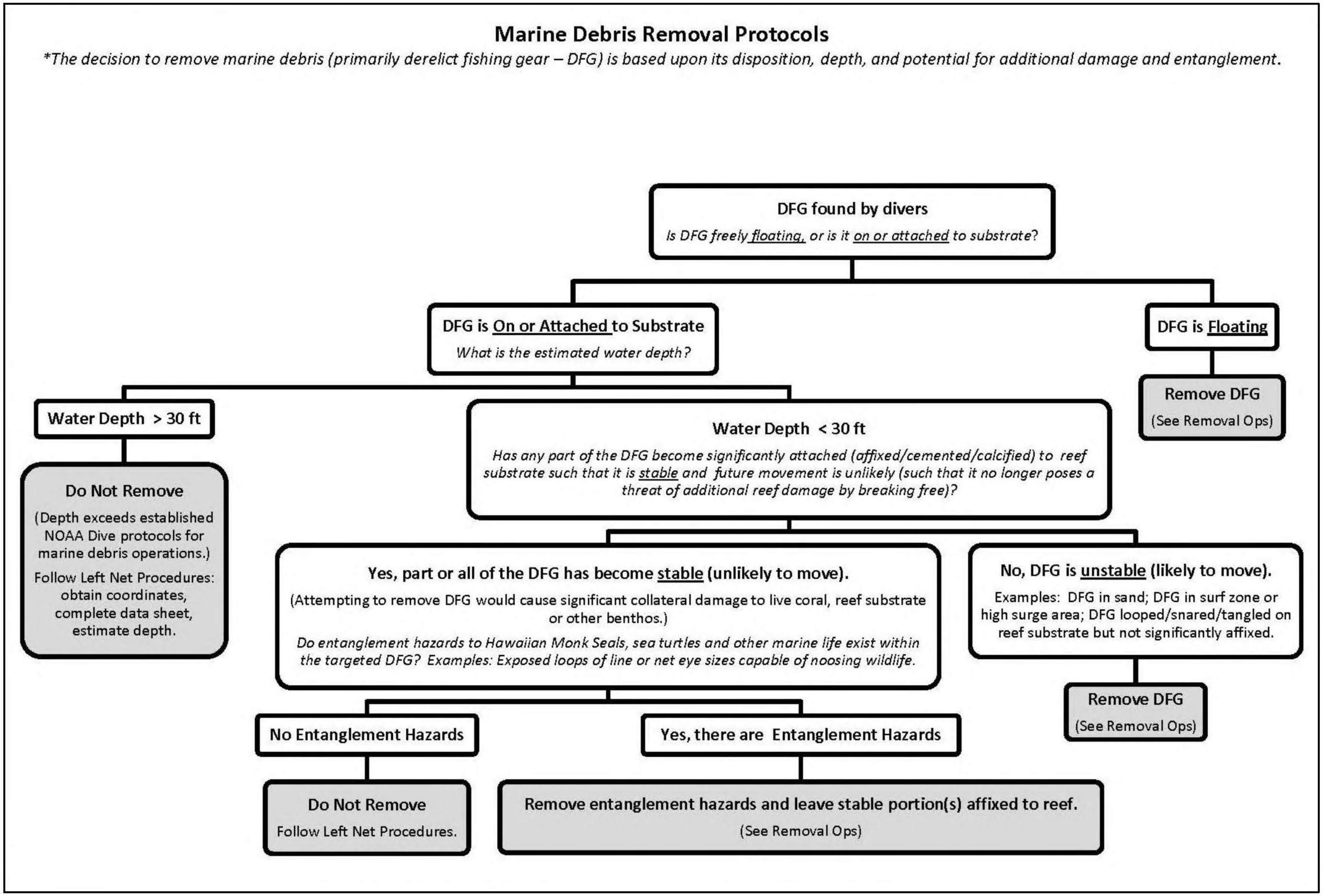
FEP	Fishery	Stock or Stock Complex	Life Stage(s)	EFH Designation
Island Area (PRIA)	Coral Reef Ecosystem	Currently harvested coral reef taxa, Labridae	Egg/larval	The water column and all bottom habitat from the shoreline to the outer boundary of the EEZ to a depth of 100 m (50 fm)
		Currently harvested coral reef taxa, Octopodidae	Egg	All coral, rocky, and sand-bottom areas from 0 to 100 m (50 fm)
		Currently harvested coral reef taxa , Carcharhinidae	Egg/larval	No designation
		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 (50 fm)
		Currently harvested coral reef taxa, Carcharhinidae, Labridae	Juvenile/adult	All bottom habitat and the adjacent water column from 0 to 100 m (50 fm) to the outer extent of the EEZ.
		Currently harvested coral reef taxa, Holocentridae and Muraenidae	Juvenile/adult	All rocky and coral areas and the adjacent water column from 0 to 100 m (50 fm)
		Currently harvested coral reef taxa, Kuhliidae	Juvenile/adult	All bottom habitat and the adjacent water column from 0 to 50 m (25 fm)
		Currently harvested coral reef taxa, Kyphosidae	Adult	All rocky and coral bottom habitat and the adjacent water column from 0 to 30 m (15 fm)
		Currently harvested coral reef taxa, Mullidae, Octopodidae, Polynemidae, Priacanthidae	Juvenile/adult	All rocky/coral bottom and sand bottom habitat and the adjacent water column from 0 to 100 m (50 fm)
		Currently harvested coral reef taxa, Mugilidae	Juvenile/adult	All sand and mud bottom and the adjacent water column from 0 to 50 m (25 fm)
		Currently harvested coral reef taxa, Scombridae	Juvenile/adult	Only the water column from the shoreline to the outer boundary of the EEZ to a depth of 100 m (50 fm)

FEP	Fishery	Stock or Stock Complex	Life Stage(s)	EFH Designation
		(dogtooth tuna), Sphyraenidae		
		Currently harvested coral reef taxa, Aquarium Species/Taxa	Juvenile/adult	Coral, rubble, and other hard-bottom features and the adjacent water column from 0 to 100 m (50 fm)
		All other currently harvested coral reef taxa	Juvenile/adult	All bottom habitat and the adjacent water column from 0 to 100 m (50 fm)
		Potentially harvested coral reef taxa	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 (50 fm)
	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 (75 fm)
			Juvenile/adult	All of the bottom habitat from the shoreline to a depth of 100 m (50 fm)
		Lobster complex: *Panulirus marginatus, P. penicillatus, P. spp., Scyllarides haanii, Parribacus antarticus*	Egg/larval	The water column from the shoreline to the outer limit of the EEZ down to a depth of 150 m (75 fm)
			Juvenile/adult	All of the bottom habitat from the shoreline to a depth of 100 m (50 fm)
Marianas	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 (200 fm)
			Juvenile/adult	The water column and all bottom habitat extending from the shoreline to a depth of 400 m (200 fm)
Pelagic	All pelagic fisheries	Tropical and temperate	Egg/larval	The water column down to a depth of 200 m (100 fm) from the shoreline to the outer limit of the EEZ
			Juvenile/adult	The water column down to a depth of 1,000 m (500 fm)

Table 2. Habitat Areas of Particular Concern (HAPC) for Managed Commercial Fisheries in the Pacific Islands

FEP	Fishery	Stock or Stock Complex	HAPC
American Samoa	Bottomfish	Shallow- and deep-water	All slopes and escarpments between 40 m and 280 m (20 and 140 fm)
Hawaiʻi	Crustaceans	Kona crab	All banks in the NWHI with summits less than or equal to 30 m (15 fm) from the surface
	Precious Coral	Deep-water	Makapuu, Wespac, and Brooks Bank bed
		Shallow-water	Auau Channel bed
	Bottomfish	All bottomfish stocks	Discrete areas at Kaena Point, Kaneohe Bay, Makapuu Point, Penguin Bank, Pailolo Channel, North Kahoolawe, and Hilo (please see Amendment 4 to the Hawaiʻi Archipelago FEP, Section 3.3.3 for GPS coordinates of the locations and Appendix 2 for maps)
		Seamount groundfish	Congruent with EFH (See **Error! Reference source not found.**).
Marianas	Bottomfish	Shallow- and deep-water	All slopes and escarpments between 40 m and 280 m (20 and 140 fm)
Pacific Remote Island Areas (PRIA)	Bottomfish	Shallow- and deep-water	All slopes and escarpments between 40 m and 280 m (20 and 140 fm)
	Coral Reef Ecosystem	Currently and potentially harvested coral reef taxa	All coral reef habitat in the Pacific Remote Island Areas
Pelagic	All pelagic fisheries	Temperate and tropical species	Water column from the surface down to a depth of 1,000 m (500 fm) above all seamounts and banks with summits shallower that 2,000 m (1,000 fm) within the EEZ

Figure 1. Diagram of Marine Debris Removal Protocol



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ESA Section 7 Consultation

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
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September 11, 2018

Ann Garrett, Protected Resources
NMFS Pacific Islands Regional Office
1845 Wasp Blvd., Bldg. 176
Honolulu, Hawai'i 96818

Re: Request for Concurrence of a 'May Affect, Not Likely to Adversely Affect' Determination under Section 7 of the Endangered Species Act

Dear Ms. Garrett:

The Pacific Islands Fisheries Science Center (PIFSC) proposes to conduct and fund fisheries and ecosystem research activities annually as part of our mission. This research promotes both the recovery of protected species and the long-term sustainability of fish stocks and other marine resources. The proposed activities would occur in the Pacific Islands Region in four geographic areas that include: (1) the Hawaiian Archipelago Research Area, (2) the Mariana Archipelago Research Area, (3) the American Samoa Archipelago Research Area, and (4) the Western and Central Pacific Research Area, including the Pacific Remote Islands.

Two federal actions are associated with these activities: (1) Obtaining scientific research permits for our activities; and (2) Obtaining a Letter of Authorization (LOA) for our research which may result in the incidental take of marine mammals protected under the Marine Mammal Protection Act. Per the requirements of the National Environmental Policy Act, and as part of the LOA application process, we completed a draft Environmental Assessment (DPEA). With this letter and the enclosed DPEA, we request to initiate informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA) for listed species and critical habitat in the Pacific Islands Region. This request excludes all marine mammals which will be addressed as part of our LOA application. We request that PIRO review the attached DPEA, verify that it contains the necessary information and analysis required, and concur with our 'may affect, not likely to adversely affect' determination.

As described in the enclosed DPEA, we have determined that the proposed action may affect, but is not likely to adversely affect the following ESA-listed species: sea turtles (green sea turtle – Central North Pacific Distinct Population Segment (DPS), Central West Pacific DPS, and Central South Pacific DPS; hawksbill sea turtle, leatherback sea turtle, loggerhead sea turtle – North Pacific Ocean DPS and South Pacific Ocean DPS; and olive ridley sea turtle), the scalloped hammerhead shark – Indo-West Pacific DPS, the oceanic white tip shark, the giant manta ray, false killer whale critical habitat, Hawaiian monk seal critical habitat, and the following species that are proposed for listing: the chambered nautilus (82 FR 48948) and seven species of the giant clam (82 FR 28946).

We look forward to working with PIRO to complete the ESA consultation process for PIFSC fisheries and ecosystem research activities. Please contact Hoku Johnson of my staff at hoku.johnson@noaa.gov or (808) 725-5323 regarding this consultation and for any additional information needs.

Sincerely,

Michael P. Seki, Ph.D.
Director

Enclosure:
(Electronic) Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center and Addendum

U.S. DEPARTMENT OF COMMERCE
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Michael P. Seki, Director
NMFS Pacific Islands Fisheries Science Center
1845 Wasp Boulevard, Building 176
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SEP 13 2018

RE: Request for ESA Consultation on the Pacific Islands Fisheries Science Center Fisheries and Ecosystem Research (I-PI-18-1653-AG, PIR-2018-10420)

Dear Dr. Seki:

On August 1, 2016, the Pacific Island Regional Office (PIRO) received a request for consultation on the effects of the Fisheries and Ecosystem Research (FER) program and its effects on listed species and their designated critical habitat. PIRO's Protected Resources Division and PIFSC worked under the guise of technical assistance (informal consultation) to May 2, 2018. On September 11, 2018, NOAA's National Marine Fisheries Service (NMFS) received your electronic request for concurrence that the Pacific Islands Fisheries Science Center's proposed action to conduct a program of fisheries and ecosystem research throughout the Pacific Islands Region is not likely to adversely affect (NLAA) the following endangered or threatened species or designated critical habitat under NMFS' jurisdiction: threatened Central North Pacific, Central West Pacific and Central South Pacific DPSs of green sea turtles; endangered hawksbill sea turtles; endangered leatherback sea turtle; endangered North Pacific and South Pacific loggerhead sea turtle DPSs; threatened olive ridley sea turtles; threatened Indo-West Pacific DPS scalloped hammerhead sharks; threatened oceanic whitetip sharks; threatened giant manta rays; seven threatened corals species *Acropora globiceps*, *A. jacquelineae*, *A. retusa*, *A speciosa*, *Euphyllia paradivisa*, *Isopora crateriformis* and *Seriatopora aculeata*; designated critical habitat for the Hawaiian monk seal and the Hawaiian Islands insular false killer whale. Also considered in this consultation are the proposed chambered nautilus and the candidate giant clam species *Hippopus hippopus*, *H. porcellanus*, *Tridacna costata*, *T. derasa*, *T. gigas*, *T. squamosal*, and *T. tevoroa*.

This response to your request was prepared by NMFS pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. §1531 *et seq.*), implementing regulations at 50 CFR 402, and agency guidance for the preparation of letters of concurrence.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The concurrence letter will be available through NMFS' Public Consultation

Tracking System [https://pcts.nmfs.noaa.gov]. A complete record of this consultation is on file at the Pacific Island Regional Office, Honolulu, Hawaii.

Background

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1539(a)(2)) requires each Federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. To "jeopardize the continued existence" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). A Federal agency is required to consult formally with the National Marine Fisheries Service (NMFS) for marine species or their designated critical habitat or with the United States Fish and Wildlife Service (USFWS) for terrestrial and freshwater species or their designated critical habitat when that agency's action "may affect" an ESA-listed species. Federal agencies are exempt from the requirement for formal consultation if they have received from NMFS or USFWS written concurrence with a determination that an action "may affect, but is not likely to adversely affect" (NLAA) ESA-listed species or their designated critical habitat (see ESA Section 7 Implementing Regulations; 50 CFR 402).

This document represents NMFS' effects analyses and determinations regarding effects on marine resources protected under the ESA that may result from carrying out the proposed Pacific Islands Fisheries Science Center (PIFSC) Fisheries and Ecosystem Research (FER) program. The FER program, and this consultation, covers fisheries and ecosystem research activities conducted and funded by the PIFSC throughout the Pacific Islands Region (PIR). The effects section also incorporates effects analyses described in the Programmatic Environmental Assessment (PEA), the draft Biological Evaluation (BE), and analyses conducted in recent consultations with NMFS Pacific Islands Regional Office (PIRO), Protected Resources Division (PRD) for PIFSC research activities throughout the Pacific Islands region. Additionally, we also consider information provided in recovery plans and status reviews for ESA-listed marine species known or believed to occur within the action area, current scientific data, gray literature and anecdotal information (see Literature Cited). This programmatic Letter of Concurrence is transmitted in accordance with section 7 of the ESA of 1973, and is based in part on the November 2015 Programmatic Environmental Assessment for Fisheries and Ecosystem Research conducted and funded by the Pacific Islands Fisheries Science Center.

In order to direct and coordinate the collection of scientific information needed to make informed fishery conservation and management decisions, NMFS established six regional Fisheries Science Centers[1], each a distinct organizational entity and the scientific focal point within NMFS for region-based federal fisheries-related research in the United States. The Fisheries Science

[1] The six regional Fisheries Science Centers are: Northeast FSC, Southeast FSC, Southwest FSC, Northwest FSC, Alaska FSC, and Pacific Islands FSC.

Centers conduct primarily fisheries-independent research studies[2] but may also participate in fisheries-dependent and cooperative research studies. This research is aimed at monitoring target species' stock recruitment, survival and biological rates, abundance and geographic distribution of species and stocks, and providing other scientific information needed to improve our understanding of complex marine ecological processes and promote NMFS strategic goal of ecosystem-based fisheries management.

The PIFSC conducts research and provides scientific advice to managers of fisheries and protected resources for the State of Hawaii, Territory of American Samoa (Samoa), Territory of Guam (Guam), the Commonwealth of the Northern Mariana Islands (CNMI) and the Pacific Remote Island Areas (PRIAs).

As identified in their draft PEA, draft BE and BE Addendum, the PIFSC proposes to continue their ongoing research programs as described.

Consultation History

NMFS has historically conducted separate ESA Section 7 consultations on each PIFSC research action as it has come up during the year, resulting in eight informal consultations in 2015, ten in 2016, and seven in 2017. Copies of these consultations are available at the Pacific Island Regional Office, Honolulu, Hawaii, and through the NOAA Public Consultation Tracking System (PCTS) at: https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts.

Early coordination and pre-consultation with the PIFSC was conducted via a series of meetings and teleconferences beginning in August, 2015. On February 19, 2016, the PIFSC requested technical assistance from PIRO PRD with its development of the Fisheries and Ecosystem Research Section 7 Programmatic Environmental Assessment (PEA). This request was part of a large national effort to complete similar FER consultations for each NMFS Region. Regular meetings were held during the technical assistance portion of the consultation through August 2, 2017 when a request for formal consultation was received from the PIFSC. Formal consultation was not initiated at this time because the PEA was in draft form, as was a Biological Evaluation. It was subsequently decided the PEA would suffice as the BE.

When staffing and assignment changes occurred within PRD during this same period, we mutually agreed to place the consultation on hold until we resolved issues with the draft PEA and low staffing. Additionally, two new species were proposed and subsequently listed under the ESA (the giant manta ray and the oceanic whitetip shark), critical habitat was proposed for the Main Hawaiian Islands insular false killer whale (it has since been finalized). One additional species was proposed for listing (Pacific nautilus) and seven candidate species were petitioned for listing with a positive 90-day finding (giant clams). Potential additional research actions were discussed for possible inclusion and some existing actions for deletion from consultation. These issues were finalized and included in an amendment to the PEA. This new addendum was

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[2] Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals, and includes research directed by PIFSC scientists and conducted on board NOAA-owned and operated vessels or NOAA-chartered vessels. Fisheries-dependent research is dependent on commercial fishing activity (e.g. collection and sampling by observers in commercial fishing vessels).

delivered on May 2, 2018, which included all newly ESA-listed, proposed and candidate species, and critical habitats, and formal consultation was initiated on that date.

PIFSC has a permit (No. 20311) for directed take of marine mammals under Marine Mammal Protection Act (MMPA) the associated with the proposed activities. The permit was issued by NMFS' Office of Protected Resources (OPR) on June 30, 2017. On August 29, 2018, we were made aware that PIFSC had also applied for a MMPA Letter of Authorization (LOA) for incidental takes of marine mammal species associated with the proposed action and that ESA consultation on the LOA is still in process. No marine mammal take had been yet authorized under the MMPA. The issuance of a LOA for the Center's marine mammal research and the associated section 7 consultation will be conducted separately by the Office of Protected Species (OPR) at headquarters in Silver Spring MD, and is not addressed herein. In this consultation we evaluate the effects of proposed fisheries and ecosystem research activities conducted and funded by the PIFSC on all protected species not covered by the above LOA application and associated formal ESA consultation.

On September 11, 2018, we received a request for informal consultation from the PIFSC for the proposed FER program. It was decided that we would proceed with an informal consultation for all ESA- listed species with the exception of marine mammals covered under the MMPA LOA process. When an LOA and incidental take authorization (ITA) has been issued, that permit will be incorporated by reference into this consultation. We will review this consultation at that time to determine if any modifications to the proposed FER action or additional terms and conditions require reinitiation under 50 CFR 402.16.

Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02).

The primary action subject to this consultation is the proposed implementation of PIFSC fisheries and ecosystem research activities as long as the activities continue to be implemented as described in the document, and the analysis of the environmental effects remains consistent and applicable with those activities and ESA-listed species. A secondary, related action is the issuance of regulations and Letters of Authorization (LOA) under Section 101(a)(5)(A) of the MMPA of 1972, as amended (MMPA; 16 United States Code [U.S.C.] 1361 et seq.) that will govern the unintentional taking of small numbers of marine mammals incidental to PIFSC's research activities. Under the MMPA, any activities resulting in the taking of marine mammals must be authorized by NMFS; this includes research programs conducted by the NMFS science centers. Because PIFSC's research activities have the potential to take marine mammals by Level A and B harassment[3], serious injury or mortality, PIFSC has applied for an LOA and an ITA for its research programs. The LOA for these activities will be subject to a separate ESA

[3] Under the 1994 Amendments to the Marine Mammal Protection Act, harassment is statutorily defined as, any act of pursuit, torment, or annoyance which: Has the potential to injure a marine mammal or marine mammal stock in the wild (known as Level A harassment); or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild (known as Level B harassment).

section 7 consultation, and any incidental takes under the ESA will be subjected to a jeopardy analysis as part of that consultation, and an incidental take statement will be issued in the accompanying biological opinion for that consultation. Therefore, marine mammals covered under the MMPA will not be part of this informal consultation but will be addressed under the ESA section 7 consultation on the MMPA LOA process.

The proposed action under ESA Section 7 consultation is implementation of the PIFSC fisheries and ecosystem research activities throughout the Pacific Islands Region. The purpose of the proposed action is to produce scientific information necessary for the management and conservation of domestic and international living marine resource in a manner that promotes both the recovery and long-term sustainability of certain species and generates social and economic benefits from their use. The information derived from these research activities is necessary for the development of a broad array of management actions for fisheries, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities.

The proposed action, as described in the PEA and other associated documents, covers research activities conducted by PIFSC or its partners throughout the Pacific Islands Region that:

- Contribute to fishery management and ecosystem management responsibilities of NMFS under U.S. law and international agreements.
- Take place in marine waters in the Hawaiian Archipelago Research Area, the Mariana Archipelago Research Area, the American Samoa Archipelago Research Area, and the Western and Central Pacific including the Pacific Remote Islands Research Area (see action area).
- Involve the transiting of these waters in research vessels, observational surveys made from the deck of those vessels (e.g., marine mammal and seabird transects), the deployment of fishing gear and scientific instruments into the water in order to sample, collect specimens, and monitor living marine resources and their environmental conditions, or use active acoustic devices for navigation or remote sensing purposes.
- Have the potential to interact with protected species. However, the research activities covered under this PEA involve only *incidental* or *indirect* interactions with protected species, not *intentional*, *targeted* or *direct* interactions with those species.
- The primary focus of this consultation is fisheries research but also includes fisheries-related ecosystem research (i.e., collection of data necessary to understand the habitats and ecosystem processes that affect fisheries). These other types of surveys are also included because they deploy gear and instruments similar to those used in fisheries research, from similar research platforms (e.g., vessels), and in the same areas.

The consultation does NOT cover:

- Directed research on protected species which includes capture or physical interaction with individuals, such as studies involving intentional capture of marine mammals for tagging and tissue sampling, which require directed scientific research permits. Directed research on protected species is covered by other environmental review processes and consultations under applicable regulations.

- The incidental taking of marine mammals as a result of the proposed action. Those takes are part of a separate LOA application under MMPA section 101(a)(5)(A), which is subject to a separate ESA section 7 consultation, and any incidental takes under the ESA will be subjected to a jeopardy analysis as part of that consultation, and an incidental take statement will be issued in the accompanying biological opinion for that consultation.
- The potential effects of research conducted by scientists in other NMFS Science Centers.
- Other activities of PIFSC that do not involve the deployment of vessels or gear in marine waters, such as evaluations of socioeconomic impacts related to fisheries management decisions, taxonomic research in laboratories, fisheries enhancements such as hatchery programs, and educational outreach programs.
- Other fisheries research programs conducted and funded by other agencies, academic institutions, non-governmental organizations, and commercial fishing industry research groups without material support from PIFSC.

The proposed action involves fisheries and ecosystem research activities in four distinct research areas (Figure 2): 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) Western and Central Pacific including the Pacific Remote Islands Research Area (WCPRA).

The bulk of the proposed actions would take place on, or from, the two NOAA ships operated by the PIFSC out of Pearl Harbor, Oahu, HI. These are the *Oscar Elton Sette* and the *Hiialakai*. The 224 foot *Oscar Elton Sette* is a multipurpose oceanographic research vessel that conducts fisheries assessments, physical and chemical oceanographic research, marine mammal and marine debris surveys throughout the central and western Pacific Ocean. The *Hiialakai* is a 224 foot multipurpose oceanographic research vessel whose primary missions include coral reef ecosystem mapping, coral reef health and fish stock studies, and maritime heritage surveys in the western Pacific.

Figure 1. The NOAA research vessel Sette

PIFSC fisheries-dependent research includes research conducted on-board commercial or contracted fishing vessels during their fishing operations (e.g., cooperative research with the bottomfish fishery). Fishery-independent research activities by PIFSC on commercial or contracted fishing vessels, which are not part of a Fishery Management Plan, Fishery Ecosystem Plan, or Exempted Fishing Permit whereby marine mammal and ESA-listed species take has been exempted or that complies with MMPA section 118 or an ESA incidental take statement, are evaluated in this consultation.

PIFSC Fisheries Research Activities

Following are summary descriptions of proposed PIFSC survey actions in the Pacific Islands Region. As noted earlier, the PIFSC requested Federal rulemaking and subsequent Letters of Authorization (LOAs) under the MMPA for proposed actions that have the potential to take marine mammals incidentally to research activities. Therefore, marine mammals will not be addressed in this informal consultation, but will be subsequently addressed through the MMPA process.

Sampling Pelagic Stages of Insular Fish Species

Results of sampling inform life history and stock structure studies for pelagic larval and juvenile stage specimens of insular fish. Additional habitat information is also collected. Target species are snapper, grouper, and coral reef fish species within the 0-175 m depth range. Pelagic stages sampling is conducted both at midwater depths using a "Stauffer" modified Cobb trawl (Cobb trawl) or a 10-foot Isaacs-Kidd trawl, and at the surface using a 6-foot Isaacs-Kidd trawl. Surveys may occur every year in the HARA, but approximately once every three years in the MARA, ASARA, and WCPRA.

Spawning Dynamics of Highly Migratory Species

Early life history studies provide larval stages for population genetic studies and include the characterization of habitat for early life stages of pelagic species. Egg and larval collections are taken in surface waters using a variety of plankton gear, primarily Isaacs-Kidd 6-foot surface trawl, but also sometimes including 1-meter ring net and surface neuston net.

Cetacean Ecology Assessment

Survey transects conducted in conjunction with cetacean visual and acoustic surveys within the Hawaii Exclusive Economic Zone (EEZ) to develop ecosystem models for cetaceans. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.

<u>Passive Acoustics Calibration</u> - Transmit sound (synthetic pings, dolphin whistles or echolocation clicks, etc.) to passive acoustic recording devices for purposes of in-situ calibration, needed to understand detection distances and received level or frequency-dependent variation in the device performance.

<u>Stationary Passive Acoustic Recording</u> - Placement of long-term acoustic listening devices for the purposes of recording cetacean occurrence and distribution, ambient and anthropogenic noise

levels, and presence of other natural sounds. Recorders are typically deployed and retrieved once or twice per year at each monitoring location.

Passive Acoustic Monitoring - Deployment of passive acoustic monitoring devices in conjunction with other sampling measures, such as on fishing gear or free-floating.
Passive Acoustic or Oceanographic Gliders - Autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle provide measure of cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide oceanographic measures over several months duration.

Marine Debris Research and Removal - These surveys: (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. Team members systematically survey reefs using shoreline walks, swim surveys, and towed-diver surveys to locate submerged derelict fishing gear in shallow water. Debris type, size, fouling level, water depth, GPS coordinates, and substrate of the adjacent habitat are recorded. Nets are evaluated before removal actions to determine appropriate removal strategies. Attempts to remove marine debris encountered at sea are variable and can be unfeasible because of operational, vessel, or safety constraints. However, by attaching a satellite-tracked marker to debris, it will be possible to locate that debris in the future and to track and analyze its drifting patterns. Additional activities include: Surface and midwater plankton tows to quantify floating microplastics in seawater; the use of Unmanned Aerial Systems (UAS) platforms to aid in efficiency during removal operations by directing efforts to high density areas; adding more frequent marine debris research and removal activities to other research areas; and collection and sieving of mesoplastics from beach sand located between the low and high tide lines. Plastics may be removed for sampling and further study.

Coral Reef Benthic Habitat Mapping
Coral reef benthic habitat mapping activities produce comprehensive digital maps of coral reef ecosystems using multibeam sonar surveys and optical validation data collected using towed vehicles and AUVs.

Deep Coral and Sponge Research
Research includes opportunistic surveys on distribution, life history, ecology, abundance, and size structure of deep corals and sponges using ROVs, divers, and submersibles. Besides visual surveys, sampling protocols include collection of coral and sponges for genetic, growth and reproductive work and an array of data loggers (temperature, currents, particulate load) placed on the bottom for recovery in future years.

Insular Fish Life History Survey and Studies
Research activities include providing deepwater eteline snappers, groupers, and large carangids to determine sex-specific length-at-age growth curves, longevity estimates, length and age at 50% reproductive maturity within the Bottomfish Management Unit Species (BMUS) in Hawaii and the other Pacific Islands Regions. Specimens are collected in the field and sampled at markets.

Pacific Reef Assessment and Monitoring Program (RAMP)
Ecosystem surveys that include rapid ecological assessments; towed-diver surveys; coral disease, invertebrates, fish, and algae surveys; and oceanographic characterization of coral reef ecosystems. Surveys also include training to conduct surveys which occur between 0-3nm from shore, year-round, using small boats, SCUBA or closed circuit rebreathers (CCR) diver surveys, sampling, and deployment of various equipment. Samples and specimens collected in the field would be analyzed in the laboratory.

Insular fish Abundance Estimation Comparison Surveys
The insular fish abundance estimation comparison surveys include a comparison of fishery-independent methods to survey bottomfish assemblages in the Main Hawaiian Islands which involves coordinated research between the PIFSC Ecosystem Sciences Division and Fishery Research and Monitoring Division, State of Hawaii Department of Land and Natural Resources, University of Hawaii at Manoa, and University of Miami. Day and night surveys are used to develop fishery-independent methods to assess stocks of economically important insular fish. Methods include: active acoustics, stereo baited underwater video camera systems (BotCam, Modular Optical Underwater Survey System [MOUSS], BRUVS), autonomous underwater vehicle (AUV) equipped with stereo video cameras, towed optical assessment device (TOAD), and hook-and-line fishing.

Gear and Instrument Development and Field Trials
Field trials to test the functionality of the gear prior to the field season or to test new gear or instruments utilized in research activities (e.g., sonar systems, net mensuration systems, UAS, etc.), but outside the geographic scope specified for other surveys.

Mariana Resource Survey
The Mariana Resource Survey is a sampling activity to quantify baseline bottomfish and reef fish resources in the Mariana Archipelago Research Area. Various artificial habitat designs, Cobb trawl and IK trawls will be developed, enclosed in mesh used to retain captures, and evaluated for collection of pelagic-stage specimens of reef fish and bottomfish species. Large fish traps (1m x 1m x 2m) deployed along or perpendicular to determine bottom contour overnight to access adult reef and bottomfish composition relative to hook-and-line fishing. Traps will be primarily set in mesophotic habitats (50-200 m depths) and in the quality of each habitat for recent recruits.

Pelagic Oceanographic Cruise
The Pelagic Oceanographic Cruise integrates physical (e.g., fronts) and biological features that define the habitats for important commercial and protected species of the North Pacific Ocean, especially tuna and billfishes, which are targeted by longline fishers. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; surface and water column oceanographic measurements and water sample collection.

Pelagic Troll and Handline Sampling
Surveys would be conducted to collect life history and molecular samples from pelagic species. Other target species would be tagged-and-released. Different tags would be used depending

upon the species and study, but could include: passive, archival, ultrasonic, and satellite tags. Fishery observers or NOAA scientists conduct on-board documentation of catch and survival.

Sampling of Juvenile-stage Bottomfish via Settlement Traps
This survey includes sampling activities to capture juvenile recruits of eteline snappers and grouper that have recently transitioned from the pelagic to demersal habitat. The specimens will provide estimates of birthdate, pelagic duration, settlement date, and pre-and post-recruitment growth rates derived from the analysis of otoliths. The target species include Deep-7 bottomfish[4] and the settlement habitats these stages are associated with.

Pelagic Longline, Troll, and Handline Gear Trials
Researchers will investigate effectiveness of various types of hooks, hook guards, gear configurations, or other modified fishing practices for reducing the bycatch of non-target species and retaining or increasing target catch. Data collected on catch efficacy, fish size, species selectivity, and survival upon haul-back. Investigate the vertical distribution of pelagic species catch and capture time with time-depth recorders (TDRs) and hook-timers. Investigate behavior of catch and bycatch in relation to fishing operations using cameras, hydrophones, or other sensors. Catch may be tagged and released and specimens may be kept for genetic, physiological, and ecological studies. Troll and handline fishing for pelagic species may also be investigated, with tag and release of catch and collection of specimens.

Lagoon Ecosystem Characterization
Measures of abundance of juvenile bumphead parrotfish in any of the lagoons in the WCPRA will be taken over a two-week-long period by employing standardized transect and photo-quadrant techniques using SCUBA and snorkeling gear. A collection net may also be used to non-lethally sample fish species inhabiting the lagoon to determine genetic identity. Hook-and–line and spear may also be used to lethally collect specimens.

West Hawaii Integrated Ecosystem Assessment (IEA) Cruise
The West Hawaii IEA includes survey transects conducted off the Kona coast and Kohala Shelf area to develop ecosystem models for coral reefs, socioeconomic indicators, circulation patterns, larval fish transport and settlement. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection. This survey is usually performed along with passive acoustic surveys as described under the Cetacean Ecological Surveys.

Surface Night Light Sampling
Surface night light sampling is conducted opportunistically for decades aboard PIFSC research vessels. Sampling goals: collect larval or juvenile stages of pelagic or reef fish species that accumulate within surface slicks during daylight hours and those attracted to surface and submerged lights from research vessels at night.

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[4] See http://www.fpir.noaa.gov/SFD/SFD_regs_5.html for more information on Deep 7 Bottomfish.

Action Area
"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area includes a vast area of marine waters throughout the Pacific Islands Region, which has been divided into four discreet areas: 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) Western and Central Pacific including the Pacific Remote Islands Research Area (WCPRA) (Figure 2). The HARA, MARA, and ASARA extend approximately 24 nm from the baseline of the respective archipelagos (i.e., to approximately the outer limit of the contiguous zone). The fourth research area, the WCPRA, includes the remainder of the archipelagic U.S. EEZs, the Central and Western Pacific Ocean between the archipelagos, and the waters around the Pacific remote islands.

Research activities typically occur from ship-based platforms that may transit anywhere through this area, and we assume for purposes of analyzing effects to BSA-listed species and designated critical habitats that research activities could occur anywhere throughout this area.

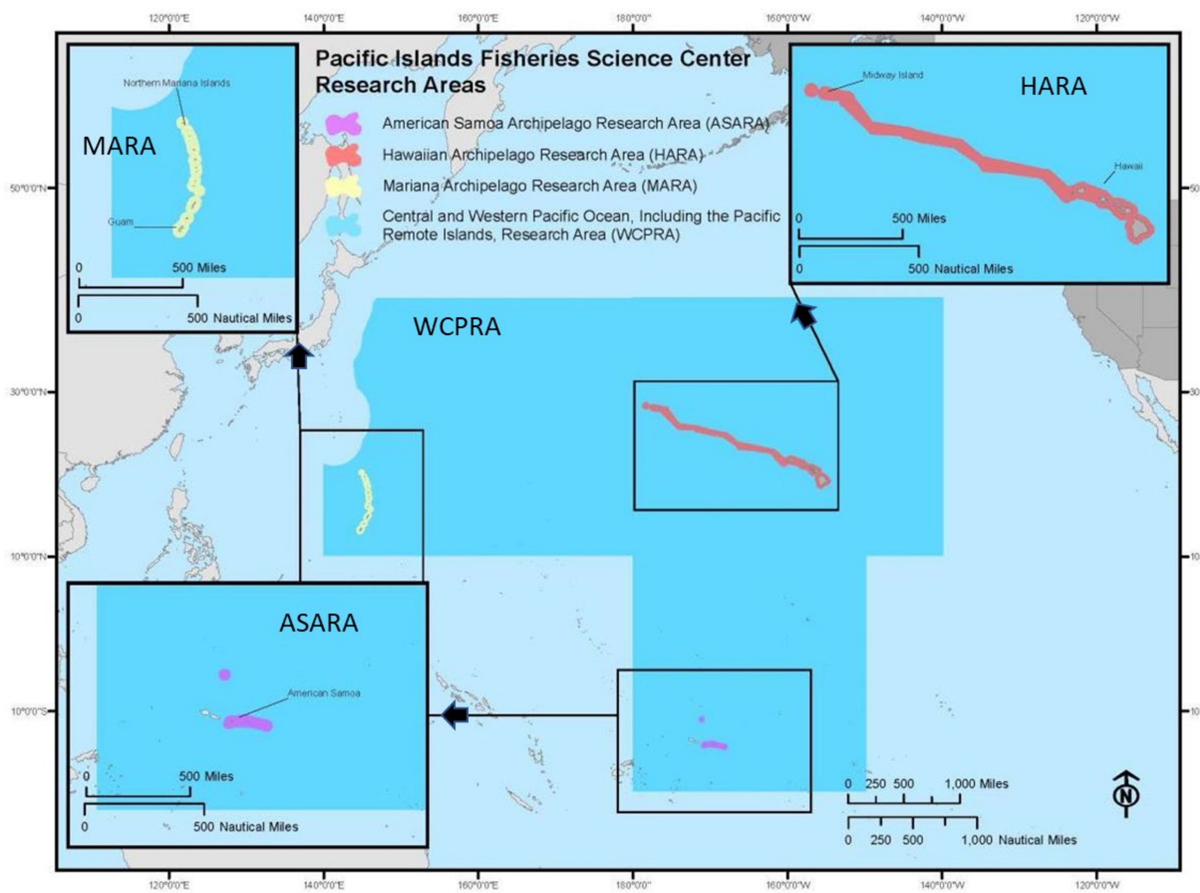

Figure 2. Map of distinct research areas of the Pacific Islands Region.

Hawaiian Archipelago Research Area (HARA)

The HARA includes waters surrounding the Hawaiian Islands to a seaward extent of approximately 24 nautical miles. PIFSC conducts research surveys in the HARA, primarily inside the Insular Pacific-Hawaiian Large Marine Ecosystem (LME) boundary. The Insular Pacific-Hawaiian LME has a surface area of approximately one million km^2, extending 1,500 miles from the main Hawaiian Islands to the outer northwest islands, including a range of islands, atolls, islets, reefs and banks (WPRFMC 2009a). Within the Pacific basin are underwater plate boundaries that define long mountainous chains, submerged volcanoes, islands and archipelagos as well as various other bathymetric features that influence the movement of water and the distribution of marine organisms. The Hawaiian Islands were created during successive periods of volcanic activity and are surrounded by coral reefs. This area contains about 1 percent of the coral reefs and sea mounts in the world and four major estuaries (Aquarone and Adams 2008).

Mariana Archipelago Research Area (MARA)

The MARA includes waters surrounding the Commonwealth of the Northern Mariana Islands (CNMI) and the Territory of Guam to a seaward extent of approximately 24 nautical miles. The Mariana Islands cover approximately 396 square miles. They are composed of 15 volcanic islands that are part of a submerged mountain chain that spans from Guam to Japan. Politically, the islands are split into the Territory of Guam and the CNMI, but are combined for the purposes of defining the MARA. The islands are oriented along a north-south axis, with Guam being the southernmost island in the archipelago. Additionally, there is a chain of submerged seamounts located approximately 120 nautical miles west of the Mariana Islands, also in a north-south pattern, reaching southwest of Guam. Seamounts are mountains rising from the ocean seafloor that do not reach the water's surface. Species richness is greater near seamounts than nearshore or oceanic areas, creating hotspots of pelagic biodiversity (Morato et al. 2010). The islands and seamounts were formed approximately 43 million years ago by the subduction of the Pacific tectonic plate under the Philippine plate. The Mariana Trench is a unique feature created at this subduction zone. Also running in a north-south pattern located east of the island chain, the Mariana Trench is the deepest location on earth with its deepest point, the Challenger Deep, at 11,000 meters (m), which is located just outside of the U.S. EEZ.

American Samoa Archipelago Research Area (ASARA)

The ASARA includes waters surrounding the American Samoa archipelago to a seaward extent of approximately 24 nautical miles. The Samoa archipelago is located northeast of Tonga and consists of seven major volcanic islands, several small islets, and two coral atolls. The two largest islands in this chain, Upolu and Savaii are governed by the Independent State of Samoa and are not included in the ASARA. The five major inhabited islands of American Samoa are Tutuila, Aunuu, Ofu, Olosega, and Tau. The total land mass of American Samoa is about 200 km^2 and surrounded by an EEZ of approximately 390,000 km^2. The largest island, Tutuila, is nearly bisected by Pago Pago Harbor, the deepest and one of the most sheltered embayments in the South Pacific.

Western Central Pacific Including the Pacific Remote Islands Research Area (WCPRA)

The WCPRA includes part of the high seas (i.e., international ocean waters) considered under the jurisdiction of the Western and Central Pacific Fisheries Commission. The WCPRA also includes the Pacific Remote Islands Area comprised of Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Atoll, and Palmyra Atoll. This large area essentially captures all past, present, and future PIFSC high seas research surveys (e.g. oceanography, longline gear research) that occur outside of the HARA, MARA, and ASARA, while also approximately aligning with various RFMOs and other geopolitical boundaries.

Listed Species

The following ESA-listed species may be found in all or portions of the described action area as noted in Table 1.

Sea Turtles

Common Name	Scientific Name	Status	HARA	MARA	ASARA	WCPRA
Green sea turtle[1]	*Chelonia mydas*	Threatened/ Endangered[1] 81 FR 20058	N	N	N	N
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered 43 FR 32800	N	N	N	X
Leatherback sea turtle	*Dermochelys coriacea*	Endangered 35 FR 8491	X	X	X	
Loggerhead sea turtle	*Caretta caretta*	Endangered[2] 76 FR 58868	X			
Olive ridley sea turtle	*Lepidochelys olivacea*	Threatened 43 FR 32800	X		X	

N - Nesting occurs within this research area.

Notes:

1. Central North Pacific DPS in the HARA (Threatened), Central West Pacific DPS in the MARA (Endangered), and Central South Pacific DPS in the ASARA (Endangered)
2. North Pacific Ocean DPS (north of the equator and south of 60° north latitude) and South Pacific Ocean DPS (south of the equator, north of 60° south latitude, west of 67° west longitude, and east of 141° east longitude)

Fish

Common Name	Scientific Name	Status	HARA	MARA	ASARA	WCPRA
Scalloped hammerhead Indo-West Pacific DPS, Central Pacific DPS	*Sphyrna lewini*	Threatened[1] 79 FR 38213		X	X	X
Oceanic white tip shark	*Carcharhinus longimanus*	Threatened 83 FR4153	X	X	X	X
Giant manta ray	*Manta birostris*	Threatened 83 FR 2916	X	X	X	X

Corals

Scientific Name	Status	HARA	MARA	ASARA	WCPRA
Acropora globiceps	Threatened 79 FR 53851		X	X	X
Acropora jacquelineae	Threatened 79 FR 53851			X	
Acropora retusa	Threatened 79 FR 53851		X	X	X
Acropora speciosa	Threatened 79 FR 53851			X	X
Euphyllia paradivisa	Threatened 79 FR 53851			X	
Isopora crateriformis	Threatened 79 FR 53851			X	
Seriatopora aculeata	Threatened 79 FR 53851		X		

There is one proposed and seven candidate species for ESA listing that occur in the action area:

Common Name	Scientific Name	Proposed Status	HARA	MARA	ASARA	WCPRA
Chambered Nautilus (Proposed)	*Nautilus pompilius*	Threatened 82 FR 48948			X	
Giant Clam (Candidate)	*Hippopus hippopus, H. porcellanus, Tridacna costata, T. derasa, T. gigas, T. squamosa,* and *T. tevoroa*	ESA Listing May be Warranted 82 FR 28946		X	X	X

Table 1. ESA-listed species considered in this consultation.

NMFS is drafting a final rule on a petition to list the chambered nautilus (*Nautilus pompilius*) under the ESA. We anticipate publishing this final rule in the fall of 2018. On October 23, 2017, NMFS published a 12-month finding/proposed rule to list the species as threatened (82 FR 48948). A 60-day public comment period was open until December 22, 2017. This follows an August 26, 2016, positive 90-day finding to list the species under the ESA (81 FR 58895), which initiated a comprehensive status review of the species. Public comments and information on the species were accepted until October 25, 2016. This is in response to a May 31, 2016, petition from Center for Biological Diversity to list the chambered nautilus as endangered or threatened under the ESA. The species' range includes American Samoa.

NMFS is conducting a comprehensive status review of seven species of giant clams to determine if listing any of them is warranted under the ESA. This follows a June 26, 2017, positive 90-day finding, determining that the petitioned action may be warranted seven of the species included in the petition (82 FR 28946). These species are as follows: *Hippopus hippopus, H. porcellanus, Tridacna squamosa, T. costata, T. gigas, T. derasa,* and *T. tevoroa*. Public comments and information on these seven species were accepted until August 25, 2017. We also made a negative 90-day finding, determining that the petition did not present substantial scientific or commercial information indicating that the petitioned action was warranted for the remaining three giant clam species in the petition: *Tridacna maxima, T. crocea*, and *T. noae*. This follows an August 8, 2016, petition to list 10 species of Tridacninae giant clams (excluding *Tridacna rosewateri*) as threatened or endangered species under the ESA, and designate critical habitat concurrent with their listing. The U.S. Pacific territories and possessions are in the range of (or historically contained) at least *H. hippopus, T. derasa, T. gigas, T. maxima*, and *T. squamosa*.

Critical Habitat

Critical Habitat Within PIFSC Research Areas (HARA only)	
Hawaiian monk seal *(Neomonachus schauinslandi)* 80 FR 50926	Sixteen occupied areas within the range of the species: ten areas in the Northwestern Hawaiian Islands (NWHI) and six in the main Hawaiian Islands (MHI). These areas contain one or a combination of habitat types: preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas, that will support conservation for the species. Specific areas in the NWHI include all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and including marine habitat through the water's edge, including the seafloor and all subsurface waters and marine habitat within 10 meters (m) of the seafloor, out to the 200-m depth contour line around the following ten areas: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island. Specific areas in the MHI include marine habitat from the 200-m depth contour line, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, through the water's edge 5 m into the terrestrial environment from the shoreline between identified boundary points on the islands of: Kaula, Niihau, Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui, and Molokai), and Hawaii. In areas where critical habitat does not extend inland, the designation ends at a line that marks mean lower low water. The total area proposed includes approximately 49,948 km^2 (19,280 mi^2) of marine habitat.
Hawaiian Islands insular false killer whale (*Pseudorca crassidens*) 82 FR 51186	Waters from 45 meters to 3,200 meters (49 to 3,500 yards) in depth surrounding the main Hawaiian Islands (from Niihau to Hawaii Island). This designation does not include most bays, harbors, or coastal in-water structures. Within this larger proposed area, NOAA Fisheries has excluded nine areas from the designation due to economic and national security impacts. In addition, two areas are ineligible for designation because they are managed under the Joint Base Pearl Harbor-Hickam integrated natural resources management plan that was found to benefit Main Hawaiian Islands insular false killer whales. The total area proposed includes approximately 49,701 km^2 (19,184 mi^2) of marine habitat.

Table 2. Designated critical habitat considered in this consultation.

Analysis of Effects

In order to determine that a proposed action is not likely to adversely affect ESA-listed species, NMFS must find that the effects of the proposed action are expected to be insignificant, discountable, or completely beneficial. As defined in the joint USFWS-NMFS Endangered Species Consultation Handbook, beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs[5]. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: 1) be able to meaningfully measure, detect, or evaluate insignificant effects; or 2) expect discountable effects to occur (USFWS & NMFS 1998). This standard, as well as consideration of the probable duration, frequency, and severity of potential interactions, was applied during the analysis of effects of the proposed action on ESA-listed marine species to determine if and which species are "not likely to be adversely affected".

The following potential stressors have been identified as those likely to affect ESA-listed species and designated critical habitat:

- Disturbance from human activity
- Entanglement in equipment and gear
- Exposure to elevated noise levels
- Collision with vessels
- Exposure to waste and discharge
- Hooking and entanglement
- Direct damage to coral species
- Prey limitation

	Disturbance from human activity	Entanglement in equipment and gear	Exposure to elevated noise levels	Collision with vessels	Exposure to waste and discharge	Hooking and entanglement	Direct damage to coral species	Prey limitation
Action 1	X	X		X	X			X
Action 2	X	X		X	X			
Action 3	X	X	X	X	X			
Action 4	X			X	X		X	
Action 5	X	X	X	X	X			

[5] Take" is defined by the ESA, 16 U.S.C. 1532(19), as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. In its ESA Harassment Guidance Memo (May 2, 2016), NMFS defines "harass" as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." NMFS defines "harm" as "an act which actually kills or injures fish or wildlife." 50 CFR 222.102. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Take of species listed as endangered is prohibited at the time of listing, while take of threatened species may not be specifically prohibited unless NMFS has issued regulations prohibiting take under section 4(d) of the ESA.

	Disturbance from human activity	Entanglement in equipment and gear	Exposure to elevated noise levels	Collision with vessels	Exposure to waste and discharge	Hooking and entangle ment	Direct damage to coral species	Prey limitation
Action 6	X		X	X	X			
Action 7	X	X		X	X	X		X
Action 8	X	X	X	X	X		X	
Action 9	X							
Action 10	X	X	X	X	X	X		X
Action 11	X	X	X	X	X	X		X
Action 12	X	X	X	X	X			
Action 13	X	X				X		X
Action 14	X	X	X	X	X	X		X
Action 15	X	X	X	X	X			
Action 16	X	X		X	X			
Action 17	X	X		X		X		
Action 18	X	X		X		X		X

Table 3. Proposed actions and effects matrix.

Action 1 - Sampling Pelagic Stages of Insular Fish Species
Action 2 - Spawning Dynamics of Highly Migratory Species
Action 3 - Cetacean Ecology Assessment
Action 4 - Marine Debris Research and Removal
Action 5 - Coral Reef Benthic Habitat Mapping
Action 6 - Deep Coral and Sponge Research
Action 7 - Insular Fish Life History Survey and Studies
Action 8 - Pacific Reef Assessment and Monitoring Program (RAMP)
Action 9 - Surface Night Light Sampling
Action 10 - West Hawaii Integrated Ecosystem Assessment (IEA) Cruise

Action 11 - Insular Fish Abundance Estimation Comparison Surveys
Action 12 - Gear and Instrument Development and Field Trials
Action 13 - Pelagic Troll and Handline Sampling
Action 14 - Mariana Resource Survey
Action 15 - Pelagic Oceanographic Cruise
Action 16 - Sampling of Juvenile-stage Bottomfish via Settlement Traps
Action 17 - Lagoon Ecosystem Characterization
Action 18 - Pelagic Longline, Troll, and Handline Gear Trials

Effects to Sea Turtles

Disturbance from Human Activity
Actions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

All proposed actions have the potential to expose ESA-listed sea turtles to some level of disturbance from human activity, which could simply be noise or visual stimuli resulting in a mild startle and/or flight response. Other potential disturbance could be exposure to slightly elevated turbidity, bubbles from SCUBA divers, and exposure to temporary night lighting at sea.

ESA-listed marine vertebrate species may experience a startle reaction should they encounter human activities which may result in active avoidance or fleeing of the area (Meadows 2004). Behavioral responses can be influenced by a number of factors (Andersen et al. 2012). However, the most frequent response to this type of interaction is a low energy behavioral avoidance leading to the animal temporarily leaving the area which may temporarily displace normal feeding and resting activities. This response is more likely for sea turtles given their wariness of humans. Seminoff et al. (2015) and Balazs et al. (1987) have also demonstrated that sea turtles may shift their foraging to night in order to avoid human disturbances. None of these potential disturbances is expected to cause any more than temporary behavioral modifications.

Thus, if an interaction occurs, the effects to its behavior will not affect these species in any meaningful way. No harm to any ESA-listed vertebrate species under NMFS' jurisdiction is expected. For these reasons, effects from disturbance from human activity are considered to be insignificant.

Entanglement
Actions 1, 7, 12, 13, 14, 17, 19

The deployment of vessel gear, research fishing gear or instruments during PIFSC fisheries and ecosystem research activities has the potential to incidentally capture or entangle sea turtles. Commercial and artisanal fisheries in the action area do result in the incidental capture and mortality of green, loggerhead, leatherback and hawksbill sea turtles. From 2004 through 2014, in the US shallow-set longline fishery in the Pacific, there were 94 loggerhead turtles, 85 leatherbacks, 4 olive Ridley and 7 green sea turtle captures. During the period 2015 through 2017 there were 49 loggerhead interactions, 14 for leatherbacks, 5 for olive ridleys and 2 for green sea turtles (NMFS 2017).

Because green and hawksbill sea turtles nest and bask on beaches in and around Hawaii, Guam and the CNMI, both adults and juveniles are more likely to be encountered in nearshore waters and are therefore more likely to be affected by nearshore fisheries. Gill nets generally represent the most problematic fishery for sea turtles because the nets are often left untended, increasing the likelihood of drowning. The state of Hawaii requires that nets be set and checked every two hours, and only set for a period of 4 hours out of every 24, while Guam law prohibits drift gill nets and requires that staked gill nets be moved every six hours; these regulations would be expected to reduce the probability of mortality for any turtles incidentally captured. The CNMI specifically prohibits the use of gill nets, and no monofilament nets are allowed.

Sea turtles can also be hooked or entangled in hook-and-line fisheries, though the chance of survival is considered higher than if caught in a gill net. Leatherback sea turtles are known to have been occasionally captured and retained by offshore by Guam-based fishermen, both incidentally and intentionally (Karen Frutchey, NMFS PIRO PRD, personal communication to Jordan Carduner, NMFS OPR, September 2014). In a study of stranded green turtles in Hawaii (those that are found on shore either injured, sick, or dead), the second and third most common known causes of stranding were fishing related. Hook-and-line fishing gear-induced trauma accounted for 7 percent, and gillnet fishing gear-induced trauma was responsible for 5 percent (Chaloupka et al. 2008b). However, most turtles that drown in fishing gear are likely never documented, making it very difficult to estimate the total number of turtles killed annually by nearshore fishing interactions, even in Hawaii where turtles are much better monitored and studied than in the Marianas.

There are no reported incidents of sea turtle entanglement in gear during PIFSC fisheries and ecosystem research activities conducted in the HARA, MARA, ASARA, or WCPRA. Several factors may explain the lack of previous sea turtle interactions with PIFSC fisheries and ecosystem research equipment in the PIFSC research areas, including configuration of the equipment and the type and size of hooks and the bait used for longline surveys, as well as the spatial and temporal distribution of sea turtles in the areas where research gear is deployed, which may be related to the presence of prey, seasonal migration patterns, and oceanographic features. The very small amount of fishing effort during cruises compared to commercial fisheries also keeps the potential for interactions down.

Based on this information, and the lack of reported interactions during previous research activities and implementation of all BMPs (e.g., visual scans for sea turtles and prohibiting longline surveys in areas where turtles are observed) the risk of future interactions with sea turtles has been determined to be small, and interactions would likely be extremely unlikely and therefore potential entanglement effects would be insignificant.

Underwater Noise
Actions 8, 10, 13, 16

Man-made sounds can affect animals exposed to them in three ways: non-auditory damage to gas-filled organs, hearing loss expressed in permanent threshold shift (PTS) or temporary threshold shift (TTS), and behavioral responses or changes. Little is known about the hearing ability of sea turtles and their response to acoustic disturbance and thus analogous species for which data are available are used to estimate the potential behavioral reactions to sound. Electrophysiological studies on the acoustic sensitivity of green sea turtles and loggerhead sea turtles using auditory brainstem response techniques determined that the effective range of hearing of these species is within low frequencies (100 to 500 Hz) (Bartol and Ketten 2003). Data suggests that sea turtles probably have functional hearing sensitivity between about 100 Hz and 1.2 kHz (Ketten and Bartol 2005; Dow, Piniak et al. 2012).

The response of a sea turtle to an anthropogenic sound will depend on the frequency, duration, temporal pattern, and amplitude of the sound, as well as the animal's prior experience with the sound and the context in which the sound is encountered (i.e., what the animal is doing at the time of the exposure). Distance from the sound source and whether it is perceived as approaching or moving away could also affect the way a sea turtle responds. Potential behavioral responses to anthropogenic sound could include startle reactions, disruption of feeding, disruption of migration, changes in respiration, alteration of swim speed, alteration of swim direction, and area avoidance.

NMFS adopted TTS thresholds for sea turtles (NMFS 2016c, Finneran 2016), which identified cumulative sound exposure levels that could cause temporary hearing loss, which are 200 dB SEL for continuous sounds and 189 dB SEL for impulsive noise.

The National Science Foundation's (NSF) 2011 document "Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey" provides a detailed analysis of potential impacts of seismic, multibeam, and subbottom sonars on sea turtles and marine mammals (NSF 2011). The research concluded that operation of multibeam systems and subbottom profilers are "not expected to affect sea turtles, because the associated frequency ranges are above the known hearing range of sea turtles."

Responses by as ESA-listed species to any potential disturbance by vessel noise generation or vessel movements are expected to be implemented in this study would be limited to temporary avoidance with no harm to the individual. It is highly unlikely that any such disturbance would cause any meaningful adverse effects to any ESA-listed sea turtle. Therefore, any potential behavioral effects from these stressors would be insignificant.

The frequencies of the active acoustic instruments used by PIFSC for fisheries and ecosystem research generally operate at frequencies in the 18 – 200 kHz range, which is well outside of the functional hearing sensitivity for sea turtles; therefore, the sounds generated by PIFSC active acoustic instruments are unlikely to be audible to sea turtles. Based on the auditory capabilities of sea turtles, active acoustic sources used in PIFSC research operations are extremely unlikely to affect sea turtles and are considered to be discountable.

Effects Due to Interactions with Fisheries and Ecosystem Research Vessels
Actions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19

Ship strikes are a poorly-studied threat to sea turtles, but have the potential to be highly significant (Work et al. 2010b). Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Although sea turtles can move rapidly, they apparently are not adept at avoiding vessels that are moving at more than 4 km/hr., or about 2.5 mph; most vessels move far faster than this in open water (Hazel and Gyuris 2006; Hazel et al. 2007; Work et al. 2010b). Both live and dead sea turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al. 2007).

Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. Based on Hawaii data for the period of 1998 to 2007 (NMFS 2008), the estimated total number of green turtles killed annually by boat collisions in the Main Hawaiian Islands (MHI) was between 25 and 50. The number of hawksbills similarly killed was much lower; between 0.2 and 0.4 turtles annually. The nearshore densities of boats and turtles are much lower around Guam and the CNMI than in Hawaiian nearshore waters, thus the number of green and hawksbill turtles killed annually by boat collisions around the Mariana Islands and surrounding waters is likely much lower. Although little information exists to quantify this impact, vessel collision has been implicated as the cause of three green turtle strandings in Apra Harbor between November 2002 and April 2008 (DAWR unpublished data). This number underestimates the actual number of boat strikes that occur since not every boat-struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem.

NMFS (2008) estimated 37.5 sea turtle vessel strikes and mortalities per year from an estimated 577,872 vessel trips per year in Hawaii. This calculates to a 0.006% probability of a vessel strike for all vessels and trips, many of who are not reducing speeds or employing lookouts for ESA-listed species. Because BMPs including employing a lookout and reducing speed will be implemented, potential effects from boat strikes to sea turtles as a result of vessel activities are discountable. The small number of vessels that will operate on the water as a result of the proposed actions are extremely unlikely to strike sea turtles in the action area given that: 1) the vessels will operate/travel at a slow speed such that sea turtles would have the speed and maneuverability to avoid contact with the vessel; and 2) sea turtles spend part of their time at depths out of range of a vessel collision. The risk of ship strikes to sea turtles from the proposed activities is therefore discountable.

Effects to Prey
Actions 1, 4, 5, 6, 7, 8, 10, 12, 15, 16, 17, 18

Sea turtles could be negatively affected by the loss of prey as a result of mobile fishing gear that removes or incidentally kills such prey during the proposed fishing actions. The equipment to be used during the proposed actions are expected to catch a variety of organisms including prey and forage species for some sea turtles such as jellyfish. However, due to the relatively low spatial density of the research activities within the research areas, the amount of potential prey that will be disturbed or removed is a very small percentage of available prey items. For example, Western Pacific leatherback turtles forage seasonally on dense aggregations of jellyfish off the west coast of the United States (Graham 2009). All life stages consume gelatinous organisms such as jellyfish and tunicates (USFWS Biological Technical Publication, BTP-R4015-2012). Several species of jellyfish are frequently caught as a result of PIFSC fisheries research activities; however, due to the extremely high densities of jellyfish encountered in leatherback foraging areas and the very small amounts of biomass affected by PIFSC fisheries and ecosystem research activities, the impact from the removal of jellyfish is too small to be meaningfully measured, detected, or evaluated. These effects would therefore be insignificant.

Green sea turtles feed mainly on sea grasses and seaweeds (McDermid et al. 2015), which may be disturbed or removed by some PIFSC research activities. Similar to the impacts to leatherback sea turtle prey, disturbance or removal of marine plants and grasses by PIFSC research activities are too small to be meaningfully measured, detected, or evaluated and the effect to green sea turtles would be insignificant.

Hawksbill sea turtles feed primarily on sponges and jellyfish in the nearshore, which would not be affected in any significant way by proposed actions. Pelagic loggerhead and olive ridley sea turtles are unlikely to have their prey items in the open ocean affected by a single vessel conducting any of the activities associated with the scientific cruises.

Thus, the proposed actions considered here are expected to have an insignificant effect on the availability of prey for sea turtles in the action area given that: 1) the number of fisheries and ecosystem research activities are limited in scope and duration; 2) the priority species that will be retained for scientific analysis are almost entirely fish species, which are not preferred prey; and 3) there is no evidence sea turtles are prey limited.

Effects to Pacific Corals

Disturbance from Human Activity

Actions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

While it has properly been assumed for ESA-listed vertebrate species that physical contact of equipment or humans with an individual constitutes an adverse effect due to high potential for harm or harassment, the same assumption does not hold for ESA-listed corals. For example, all corals are simple, sessile invertebrate animals that rely on their stinging nematocysts for defense, rather than predator avoidance via flight response. So whereas it is logical to assume that physical contact with a vertebrate individual results in stress that constitutes harm and/or harassment, the same does not apply to corals because they have no flight response ability.

In addition, most reef-building corals, including all the ESA-listed species, are colonial organisms, such that a single larva settles and develops into the primary polyp, which then multiplies into a colony of hundreds to thousands of genetically-identical polyps that are seamlessly connected through tissue and skeleton. Colony growth is achieved mainly through the addition of more polyps, and colony growth is indeterminate. The colony can continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. The individual of these ESA-listed species is defined as the colony, not the polyp, in the final coral listing rule (79 FR 53852). Thus, affecting some polyps of a colony does not necessarily constitute harm to the individual.

While SCUBA operations related to survey activities could potentially result in accidental contact between divers, dive gear, and coral, the risk of accidental contact with corals will be reduced by using highly qualified divers, providing extensive dive training, and adhering to best practices designed to minimize unnecessary contact with live reefs. No research actions will be directed at ESA-listed coral species. Because of these characteristics, we do not believe corals will be affected by SCUBA activities in any meaningful way and potential effects would be insignificant.

Bottom contact gear can disturb epifauna, including corals, by crushing them, burying them, removing them, or exposing them to predators, and can therefore reduce complexity and species diversity (Collie et al. 2000; Morgan and Chuenpagdee 2003). Physical effects to benthic habitat from bottom-contact gear increase with increasing frequency, duration, and footprint size. Many research surveys conducted by PIFSC are stratified random designs, which means that the exact location of bottom-contact gear is randomly determined each year within an area of interest. Areas known to have ESA-listed corals would be avoided. Repeated gear deployments in the same location are rare or infrequent. In addition, the footprint of bottom-contact gear is very small; therefore, effects to all epifauna from research surveys are expected to be short-term and site specific and potential impacts to ESA-listed corals would be too small to be meaningfully measured, detected, or evaluation and, therefore, would be insignificant.

Entanglement
Actions 1, 7, 12, 13, 14, 17, 19

There is very little chance that any of the gear used during research activities could entangle corals. Potential effects from gear that contacts the bottom are discussed above. Entanglement as it relates to effects to corals pertains primarily to the use of monofilament lines for fishing, as in action 19 (pelagic longline, troll and handline gear trials), but as the name implies, this action will take place in deep waters away from ESA-listed corals. Small amounts of this gear may break off and drift to areas where corals live, but the amount and extent is expected to be extremely small and potential effects will be insignificant for ESA-listed species of coral. Other scientific gear placed near corals will be carefully monitored and removed once the period of use is over. The chance of the loss of other types of gear that might cause entanglement, such as plankton nets, is unlikely and would result in a very small amount of potentially entangling mesh entering the water. Considering all of the above, it is unlikely, and discountable, that any corals will become entangled as a result of the proposed activities.

Underwater Noise
Actions 8, 10, 13, 16

There is very little information suggesting that corals react in any significant way to underwater noise. Free-swimming coral larvae, though, have been observed to use sound as at least one way to select a suitable settlement substrate (Vermeji et al. 2010). This suggests that some underwater noises may mask important sounds and suppress the larvae's ability to find suitable settlement areas during this key life history stage. We don't know the effects of specific sounds such as sonars used during research cruise activities on ESA-listed corals. More study is needed to make substantial conclusions. We expect that the effects of underwater noise generated from cruise activities, most of which occur in deeper offshore waters, would be extremely small and unmeasurable over the range of ESA-listed corals and such potential effects are thus considered discountable.

Effects Due to Interactions with Fisheries and Ecosystem Research Vessels
Actions 4, 5, 6, 7, 8, 13, 15, 18

NOAA personnel are highly trained to avoid grounding any vessel, so interactions between research vessels and corals would not occur. Anchoring of vessels will not take place in the presence of ESA-listed corals. Conservation measures observed by crews of all cruises don't allow the dumping or discharge of any pollutants or toxic materials into any waters. NOAA vessels are well maintained and have the trained personnel with proper materials to quickly and efficiently clean any such spills. NOAA divers are highly trained and will not contact or disturb ESA-listed corals during underwater work.

Effects to ESA-Listed Fish Species

Disturbance from Human Activity
Actions 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19

The oceanic white tip shark is a pelagic species and the scalloped hammerhead shark is a coastal pelagic species. Both are highly mobile and would be extremely unlikely to be affected by anything other than transit effects such as a vessel strike and potentially incidental hooking during fishing activities. The chance of a spill or release of toxic substances offshore where sharks occur is highly unlikely, and other disturbance such as night lighting and noise are highly unlikely to adversely affect a highly mobile pelagic shark in any meaningful way. All such potential effects are considered to be discountable.

The most significant threat to the giant manta ray determined during listing under the ESA was commercial overutilization. The giant manta ray does move into shallower waters where some research actions will take place, therefore minor disturbance and noise could affect an individual ray, causing a minor startle and/or flight response while the animal is near the surface. All such effects would be minor and short lived and would thus be insignificant.

Entanglement
Actions 1, 7, 12, 13, 14, 17, 19

Oceanic whitetip and scalloped hammerhead sharks are occasionally hooked in commercial fisheries and similar research fisheries may interact with the species. No such interactions have occurred during past fishing FER actions, and none are expected. In the extremely unlikely event that an interaction should occur, it will be reported and the fishing gear moved to a different area where shark presence is less likely. Other types of entanglements of pelagic whitetip sharks, such as entanglement in plankton or other nets, are not known to have occurred in any previous research cruises. Given the small amount of fishing effort of actions during planned cruises and the vast spatial distribution of the sharks throughout the ocean, potential effects from entanglement would be discountable.

Similarly, it is extremely unlikely that giant manta rays would be subject to effects from entanglement in FER gear, and potential effects would thus be discountable.

Underwater Noise
Actions 8, 10, 13, 16

NMFS adopted TTS thresholds for different hearing groups listed in Table 2 (NMFS 2016c, Finneran 2016) which identified cumulative sound exposure levels that could cause temporary hearing loss in the respective animals. There are no thresholds estimated for sharks or manta rays. We use the sea turtles' thresholds as a surrogate for elasmobranchs because their hearing is more comparable to sea turtles than the other hearing groups. Sharks and rays, like turtles, have primitive hearing organs. Sharks and rays, furthermore, lack a swim bladder and tend to have relatively poor auditory sensitivity and rely on detecting particle motion more than "hearing" to detect prey or potential hazards (Myrberg 2001). As for sea turtles, the effects of underwater noise is expected to be insignificant to oceanic whitetip and scalloped hammerhead sharks and giant manta rays.

Effects Due to Interactions with Fisheries and Ecosystem Research Vessels
All actions

The chance of vessel strikes exists whenever the research vessels are underway. However, it is highly unlikely that a research vessel would strike an individual shark or giant manta ray in the open ocean during transit. Work boats will be in shallower waters nearshore where ESA-listed oceanic whitetip and scalloped hammerhead sharks and giant manta rays are unlikely to occur. None have been observed in these areas in past FER cruises. All vessels will follow BMPs (attached) which will further decrease the likelihood of interactions. Potential effects from vessel interactions are therefore expected to be discountable.

Effects to Prey
Actions 1, 5, 7, 8, 10, 11, 13, 18
The oceanic whitetip shark is a top level predator, and prey consists of teleosts and cephalopods (Bonfil et al. 2008). Because these sharks are highly mobile, occurring in mainly tropical and subtropical surface waters circumglobally. There is very little chance that a single research vessel deploying a small amount of research gear could significantly affect prey sources for these sharks. Scalloped hammerhead sharks are also top level predators and feed primarily on reef areas at night on reef fishes and crustaceans. Very few of the hammerhead's prey items are expected to be taken by any of the proposed gear, and effects would be both temporally and spatially insignificant.

The giant manta ray is commonly found in oceanic waters and near productive coastlines, feeding on planktonic organisms such as euphausiids, copepods and larval shrimp. It is likely that plankton tows and other gears deployed by the research vessels would capture or disturb relatively small numbers of these planktonic organisms in a very small area of the ocean. No significant or measurable quantity of the giant manta ray prey base would be affected and the animals can easily move to other feeding grounds if disturbed. Therefore, potential effects to prey of these fish species would be insignificant.

Effects to Designated Critical Habitat

Designated Hawaiian Monk Seal Critical Habitat
Actions 7, 8, 10, 11, 16

Hawaiian monk seal critical habitat is designated only in the HARA.

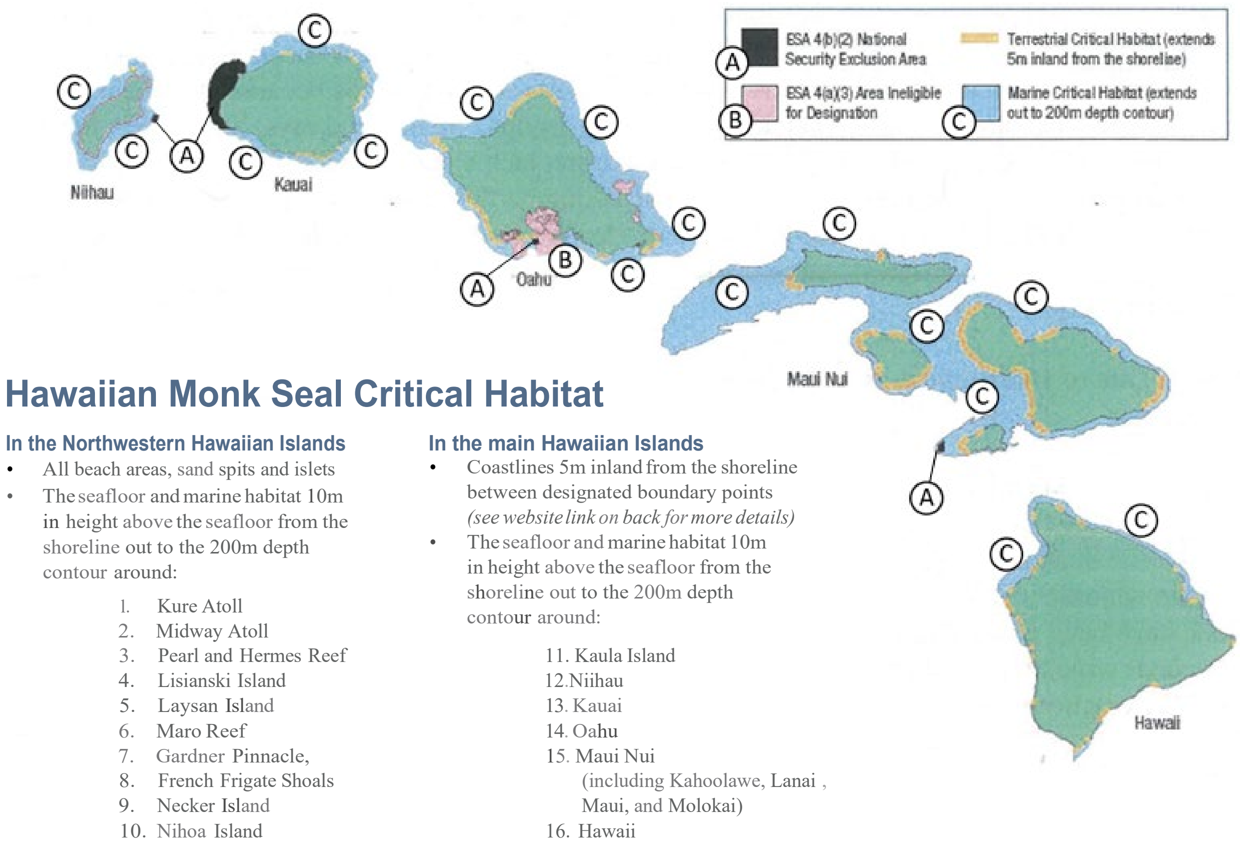

Figure 3. Hawaiian monk seal critical habitat in the main Hawaiian Islands

NOAA Fisheries revised Hawaiian monk seal critical habitat to include the main Hawaiian Islands and to describe habitat features and areas that support Hawaiian monk seal conservation. Specific areas designated include 16 occupied areas within the range of the Hawaiian monk seal. These areas contain one or a combination of the features essential to Hawaiian monk seal conservation including:

1. Preferred pupping and nursing areas;
3. Significant haul-out areas; and
4. Marine foraging areas out to 200 m in depth.

None of the proposed actions will in any way significantly impair or affect essential features 1 or 2. The only potential effect would be a grounding or a spill while transiting through or working in areas around the main and Northwestern Hawaiian Islands. NOAA research vessels are well maintained and piloted by professionals and there has never been a grounding of a research vessel in the Hawaiian Islands. Similarly, no spills have occurred, and in the unlikely event one does occur, it would be cleaned quickly and efficiently. Potential effects to Hawaiian monk seal critical habitat resulting from groundings or spills would be discountable.

Marine foraging may be affected through the targeting, catching and retaining of prey species for the Hawaiian monk seal, including reef fishes and lobsters, by research fishing, though the numbers and distribution of species affected would be very small in relation to the range of the monk seal and would be an insignificant portion of total diet.

Hawaiian Insular False Killer Whale Critical Habitat
Actions 5, 6, 7, 8, 10, 11, 12, 14, 15, 16, 17, 18

On November 3, 2017, NMFS published a proposed rule (82 FR 51186) to designate critical under the ESA for the main Hawaiian Islands insular false killer whale. On July 24, 2018, NOAA Fisheries published a final rule (83 FR 35062) to designate critical habitat in waters from 45 meters to 3,200 meters (49 to 3,500 yards) in depth surrounding the main Hawaiian Islands (from Niihau to Hawaii Island). This designation does not include most bays, harbors, or coastal in-water structures. Within this larger area, NOAA Fisheries excluded 10 areas from the designation due to economic and national security impacts. In addition, two areas are ineligible for designation because they are managed under the Joint Base Pearl Harbor-Hickam Integrated Natural Resources Management Plan that was found to benefit main Hawaiian Islands insular false killer whales. Critical habitat for the main Hawaiian Islands insular false killer whale is designated only in the HARA.

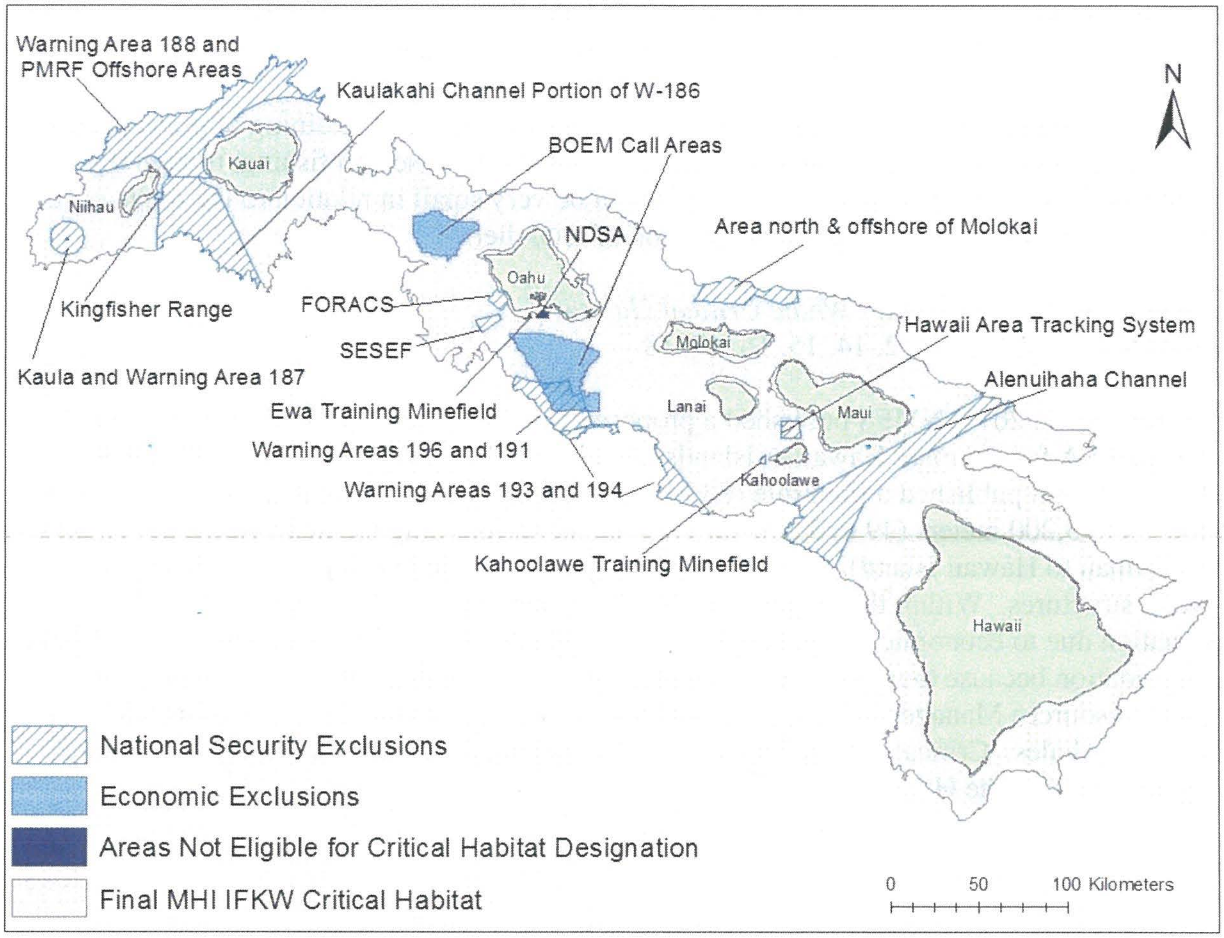

Figure 4. Hawaiian Islands insular false killer whale critical habitat.

Critical habitat for the main Hawaiian Islands insular false killer whale consists of one essential feature comprised of four characteristics:

1) Space for movement and use within shelf and slope habitat
2) Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth;
3) Waters free of pollutants of a type and amount harmful to MHI IFKWs; and
4) Sound levels that would not significantly impair false killer whales' use or occupancy.

Actions 7, 8, 9, 10, 11, 13, 16 and 18 may affect the essential feature through targeting, catching and retaining species known to be prey for the main Hawaiian Islands insular false killer whales, though the small spatial and brief temporal scale of these catches represent an extremely small portion of available prey within the range of the whales. Because whales can easily move to find alternate prey sources, and the amount of fish taken by research actions is very small, we don't expect this essential feature to be adversely affected by proposed research activities in any meaningful way and therefore expect potential effects would be insignificant.

Potential pollutants resulting from waste and discharge from research actions would primarily be in the form of fuels and lubricants. However, spills are extremely likely to occur and NOAA vessels and crews are well prepared to quickly clean any such spills. Amounts and effects of such spills are expected to be low to negligible as highly mobile animals such as the main Hawaiian Islands insular false killer whale can move away from potential effects of such spills. Such effects would there be discountable.

Underwater noise generated from equipment aboard the NOAA research vessels will occur within designated critical habitat during research actions 5, 6, 7, 8, 10, 11, 12, 14, 15, 16, and 17. Most underwater noise is outside the range of hearing for toothed whales and would not impair the value of the habitat or occupancy by main Hawaiian Islands insular false killer whales. Noise within the hearing range of the main Hawaiian Islands insular false killer whales will be of short duration, occur in very limited areas, and will be directed downward in a narrow cone which would only affect whales directly beneath the beam. The animal would need to be moving at the same speed in the direction of the vessels to be effected in any meaningful way.

According to the NOAA Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NOAA 2016c), the current defined threshold for the onset of TTS is 179 dB re 1 μPa, for mid-frequency cetaceans (false killer whale and sperms whales) is 178 dB, for phocid pinnipeds (Hawaiian monk seal) is 181 dB. Underwater noise would be generated by the Acoustic Doppler Current Profiler (ADCP) high resolution sonar, which operates at 75 kHz with a maximum expected SEL of 225 dB re. 1 μPa at 1 meter. The cone-shaped beam, with a width of 4 degrees, would be focused directly below the ship and would be used only during daylight hours. Observers would be stationed to watch for whales and the instrument would be turned off if any animals approach within 110 yards. The ADCP has been employed on many cruises and no marine mammal disturbance has been noted.

The National Science Foundation's (NSF) 2011 document "Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for Marine Seismic Research Funded by the National Science Foundation or Conducted by the U.S. Geological Survey" provides a detailed analysis of potential impacts of seismic, multibeam, and subbottom sonars on sea turtles and marine mammals (NSF 2011). Many marine mammals, particularly mysticetes, move away in response to the approaching higher-power sources or the vessel itself before the mammals are close enough for there to be any possibility of effects from the subbottom profiler's less-intense sounds. The possibility of PTS or TTS through exposure to multibeam systems and subbottom profilers sounds is considered negligible and PTS and TTS is not expected to occur. Burkhardt et al. (2008) concluded that immediate direct injury was possible only if a cetacean dove under the vessel into the immediate vicinity of the transducer. Furthermore, animals would likely have to be repeatedly or continuously exposed to the sounds to lose hearing. Sounds from multibeam systems would be readily audible to most and possibly all odontocetes when animals are within the narrow angular extent of the intermittent sound beam. According to the NSF research "...odontocete communications will not be masked appreciably by multibeam systems and subbottom profiler given their low duty cycles, the brief period (i.e., seconds) when an individual mammal would potentially be within the downward-directed multibeam system or subbottom profiler". Therefore, the "operation of multibeam systems and subbottom profilers are not likely to impact odontocetes."

Use of BMPs such as lookouts on the ship and use of sonar to detect presence, shutting down all noise generating equipment when whales are in the vicinity will further diminish the likelihood of the introduction of noise that would significantly impair the value of the habitat for false killer whales. Because of these reasons, potential effects to Main Hawaiian Islands insular false killer whale critical habitat would be insignificant.

Effects to Proposed and Candidate Species
Actions 6, 7, 8, 14, 17

Giant clams are known to occur in reef areas in both the ASARA and the WCPRA where the PIFSC conducts shallow reef assessments and research. No direct effects are expected and contact will be avoided, though work could occur around individuals resulting in minor secondary effects such as brief turbidity and disturbance. Clams are sessile invertebrates which attach themselves via byssal threads or bore into rock. Thus they cannot actively move away to avoid predators. However they can quickly contract and close their shell protecting their vital organs, tissues, and mantle. Behavioral responses by clam species would be minimal avoidance measures (Morton 1967; Soos and Todd 2014). Once a threats passed, clams extend their mantles and continue with the photosynthesis process and filter feeding. We do not expect these described operations to illicit any other responses by any giant clam species. Like coral, the candidate clam species have a planktonic larval stage. We do not expect these operations to affect this life stage cycle of these species as divers will avoid contact with substrate. Thus we do not expect the proposed activities to affect candidate giant clam species in any meaningful way. The effects of these activities to these species are thus insignificant.

The chambered nautilus is known to occur in the ASARA and are extreme habitat specialists, occurring in deep water on steep slopes up to 500 meters (Miller, 2017). Survey equipment could come in contact with a nautilus, causing temporary disturbance, though this is not known to have occurred in past surveys. Effects, should they occur, are expected to be very small in nature, both spatially and temporally, and would be insignificant.

Conclusion

Considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available about the biology and expected behaviors of the ESA-listed marine species considered in this consultation; NMFS concurs with your determination that the proposed action is not likely to adversely affect the following ESA-listed species: threatened Central North Pacific, Central West Pacific and Central South Pacific DPSs of green sea turtles; endangered hawksbill sea turtles; endangered leatherback sea turtle; endangered North Pacific and South Pacific loggerhead sea turtle DPSs; threatened olive ridley sea turtles; threatened Indo-West Pacific and Central Pacific DPSs of scalloped hammerhead sharks; threatened oceanic whitetip sharks; threatened giant manta rays; threatened corals species *Acropora globiceps*, *A. jacquelineae*, *A. retusa*, *A speciosa*, *Euphyllia paradivisa*, *Isopora crateriformis* and *Seriatopora aculeata*; designated critical habitat for the Hawaiian monk seal and the Hawaiian Islands insular false killer whale. We also have concluded that the proposed action would not jeopardize the continued existence of the proposed chambered nautilus and the candidate giant clam species *Hippopus hippopus*, *H. porcellanus*, *Tridacna costata*, *T. derasa*, *T. gigas*, *T. squamosal*, and *T. tevoroa*.

Only actions described and analyzed in this consultation are considered part of this programmatic consultation. Any deviations from actions as described should be forwarded via e-mail to the Interagency Coordination and Conservation Branch (ICCB) and discussed prior to proceeding. New actions are not covered under this programmatic consultation and should proceed with standard ESA Section 7 consultation. Annual meetings will be held between staff of the ICCB and the PIFSC to evaluate this consultation for relevance, effectiveness and efficiency and coordinate incorporation of suggested changes.

This concludes your consultation responsibilities under the ESA for species under NMFS's jurisdiction. If necessary, consultation pursuant to Essential Fish Habitat would be completed by NMFS' Habitat Conservation Division in a separate communication.

Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. Because so little is known about the marine distribution of many ESA-listed species throughout the proposed action area, the PIFSC should document exact times and locations of all sightings and encounters of ESA-listed species that may contribute to the body of knowledge regarding their distribution in marine waters.
2. The PIFSC, in conjunction with the PIRO and OPR, should evaluate development and implementation of additional mitigation and avoidance measures for ESA-listed species, as well as potential modification of current measures, to minimize interactions with protected resources while maximizing the efficiency and performance of PIFSC research activities.
3. The PIFSC, in conjunction with PIRO, should continue exploring and developing new approaches to improve the understanding of how ecosystem and climatic variables may affect the presence, abundance, and distribution of ESA-listed species and other protected resources to aid in their management and conservation during other federal actions on which we consult.

Reinitiation Notice

ESA Consultation must be reinitiated if: 1) Take occurs to an endangered species, or to a threatened species for which NMFS has issued regulations prohibiting take under section 4(d) of the ESA; 2) new information reveals effects of the action that may affect ESA-listed species or designated critical habitat in a manner or to an extent not previously considered; or 3) the identified action is subsequently modified in a manner causing effects to ESA-listed species or designated critical habitat not previously considered.

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized through a letter of authorization (LOA) under Section 101(a)(5) of the MMPA. That LOA will require a separate ESA section 7 consultation, and any incidental takes of mammals under the ESA will be analyzed in that consultation, and any anticipated takes will be described in an incidental take statement in a biological opinion prepared for that consultation. Accordingly, the terms of any such incidental take statement and the exemption from Section 9 of the ESA become effective only upon the issuance of MMPA LOA.

A request for rulemaking and LOA for the take of marine mammals incidental to FER activities in the Pacific Islands Region was submitted in November, 2015. An MMPA LOA is currently being developed for PIFSC actions and potential effects to marine mammal species are not considered in this consultation. Under the MMPA, applicants must ensure that the effects of their activities are mitigated to the level of least practicable adverse impact, regardless of the nature or intensity of those effects. Moreover, the proposed federal action may not proceed until the requirements of ESA section 7(a)(2) are fully satisfied with respect to the MMPA LOA.

Any mitigation measures or modifications of the proposed action as determined in the LOA or related MMPA regulations will be evaluated and reinitiation on this consultation may be required if the effects of those mitigation measures meet any of the reinitiation triggers.

If you have further questions, please contact Randy McIntosh at (808) 725-5154 or randy.mcintosh@noaa.gov. Thank you for working with NMFS to protect our nation's living marine resources.

Sincerely,

Ann M. Garrett
Assistant Regional Administrator
Protected Resources Division

Cc: Hoku Johnson

NMFS File No. (PCTS): PIR-2018-10420
PIRO Reference No.: I-PI-18-1653-AG

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Appendix A

Best Management Practices (BMP) for General In-Water Work Including Boat Operations

January 2015

NMFS Protected Resources Division recommends implementation of the following BMP to reduce potential adverse effects on protected marine species. These BMPs are not intended to supplant measures required by any other agency, and compliance with these BMP shall always be considered secondary to safety concerns.

All workers associated with this project, irrespective of their employment arrangement or affiliation (e.g. employee, contractor, etc.) should be fully briefed on required BMP and the requirement to adhere to them for the duration of their involvement in this project.

A. Constant vigilance shall be kept for the presence of ESA-listed marine species during all aspects of the proposed action, particularly in-water activities such as boat operations, diving, and deployment of anchors and mooring lines.

1. The project manager shall designate an appropriate number of competent observers to survey the areas adjacent to the proposed action for ESA-listed marine species.
2. Surveys shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one half hour. Periodic additional surveys throughout the work day are strongly recommended.
3. All work shall be postponed or halted when ESA-listed marine species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed within 50 yards after work has already begun, that work may continue only if, in the best judgment of the project supervisor, that there is no way for the activity to adversely affect the animal(s). For example; divers performing surveys or underwater work would likely be permissible, whereas operation of heavy equipment is likely not.
4. Special attention will be given to verify that no ESA-listed marine animals are in the area where equipment or material is expected to contact the substrate before that equipment/material may enter the water. This includes the requirement to limit anchoring to sandy areas well away from coral.
5. All objects will be lowered to the bottom (or installed) in a controlled manner. This can include the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
6. In-water tethers, as well as mooring lines for vessels and marker buoys shall be kept to the minimum lengths necessary, and shall remain deployed only as long as needed to properly accomplish the required task.

7. When piloting vessels, vessel operators shall alter course to remain at least 100 yards from whales, and at least 50 yards from other marine mammals and sea turtles.
8. Reduce vessel speed to 10 knots or less when piloting vessels at or within the ranges described above from marine mammals and sea turtles. Operators shall be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity, and if practicable, reduce vessel speed to 5 knots or less.
9. If despite efforts to maintain the distances and speeds described above, a marine mammal or turtle approaches the vessel, put the engine in neutral until the animal is at least 50 feet away, and then slowly move away to the prescribed distance.
10. Marine mammals and sea turtles shall not be encircled or trapped between multiple vessels or between vessels and the shore.
11. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed marine species.

B. No contamination of the marine environment shall result from project-related activities.

12. A contingency plan to control toxic materials is required.
13. Appropriate materials to contain and clean potential spills shall be stored at the work site, and be readily available.
14. All project-related materials and equipment placed in the water shall be free of pollutants.
15. The project manager and heavy equipment operators shall perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations shall be postponed or halted should a leak be detected, and shall not proceed until the leak is repaired and equipment cleaned.
16. Fueling of land-based vehicles and equipment shall take place at least 50 feet away from the water, preferably over an impervious surface. Fueling of vessels shall be done at approved fueling facilities.
17. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.
18. A plan shall be developed to prevent debris and other wastes from entering or remaining in the marine environment during the project.

Appendix B

Description of fisheries research projects conducted or funded by the Pacific Islands Fisheries Science Center and the mitigation measures that have previously been implemented.

Project Title	General Area of Operation	Distance From Shore [nm]	Vessel*	Days at Sea per Year	Survey Type/Gear	Mitigation Measure
Fisheries Research Based on NOAA Ship						
Highly Migratory Species Oceanographic Cruise	Pacific Ocean	20 – 1,000	R/V Oscar Elton Sette	Up to 30	Stauffer Modified Cobb Net (Mid-water Trawl)	Visual monitoring
Bottomfish Abundance Estimation Calibration Surveys	Main Hawaiian Islands	2 – 10	R/V Oscar Elton Sette	Up to 30	Hook-and-Line, and Active Acoustics	Visual monitoring
Kona Integrated Ecosystem Assessment Cruise	Hawaii Island	2 – 10	R/V Oscar Elton Sette	Up to 10	Stauffer Modified Cobb Net (Mid-water Trawl), and Small-mesh Towed Net (Surface Trawl)	Visual monitoring
Bottomfish Life History Survey and Studies	Main Hawaiian Islands	0.2 – 5	R/V Oscar Elton Sette	Up to 15	Hook-and-Line	Visual monitoring
			Small Boats	Up to 25		Visual monitoring
Spawning Dynamics of Highly Migratory Species in Hawaii	Main Hawaiian Islands	1 – 25	R/V Oscar Elton Sette	Up to 15	Small-mesh Towed Net (Surface Trawl)	Visual monitoring
			Small Boats	Up to 25		Visual monitoring
Sampling Pelagic Stages of Bottomfishes and Reef Fishes	Hawaiian Archipelago, American Samoa, Marianas Archipelago, and Pacific Remote Island Areas	1 – 200	R/V Oscar Elton Sette	Up to 30	Stauffer Modified Cobb Net (Mid-water Trawl), Plankton Net, and Small-mesh Towed Net (Surface Trawl)	Visual monitoring

Surface Night-Light Sampling	Main Hawaiian Islands	1 – 25	R/V Oscar Elton Sette	Up to 15	Net (Dip)	Visual monitoring
Longline Gear Research	Pacific Ocean	75 – 300	R/V Oscar Elton Sette	Variable	Longline	Adherence to existing longline fishery regulations: http://www.fpir.noaa.gov/SFD/SFD_regs_2.html
Pacific Reef Assessment and Monitoring Program (RAMP)	Mariana Archipelago, Hawaiian Archipelago, Pacific Remote Island Areas, and American Samoa Archipelago	0 – 20	R/V Oscar Elton Sette	30 – 75	Hand Gear (Spear Gun, Suction Device), including small boat operations	Visual monitoring
			R/V Hi'ialakai	30 – 75		
			Small Boats	50 – 110		
Cooperative Fisheries Research						
Bottomfish Life History Studies	Main Hawaiian Islands	0.2 – 5	Private fishing vessels	15-30	Hook-and-Line	Visual monitoring
Bottomfish Abundance Estimation Calibration Surveys	Main Hawaiian Islands	2 – 10	Private fishing vessels	Up to 30	Hook-and-Line	Visual monitoring
Chartered Fisheries Research						
Marlin Longline	Pacific Ocean	75 – 200 and High Seas	Private fishing vessels	70	Longline	Adherence to existing longline fishery regulations: http://www.fpir.noaa.gov/SFD/SFD_regs_2.html
Circle and Tuna Hook Trials	Pacific Ocean	75 – 500	Private fishing vessels	Variable	Longline	Adherence to existing longline fishery regulations: http://www.fpir.noaa.gov/SFD/SFD_regs_2.html
Bottomfish Abundance Estimation Calibration Surveys	Main Hawaiian Islands	2 – 10	Private fishing vessels	Up to 30	Hook-and-Line	Visual monitoring

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
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December 14, 2016

Mary Abrams Ph.D., Field Supervisor
Pacific Islands Fish and Wildlife Office
U.S. Fish and Wildlife Service
300 Ala Moana Blvd. Room 3-122
Honolulu, HI 96850

Re: Request for Concurrence of a 'May Affect, Not Likely to Adversely Affect' Determination under Section 7 of the Endangered Species Act

Dear Dr. Abrams:

The Pacific Islands Fisheries Science Center (PIFSC) is evaluating the incidental impacts of fisheries and ecosystem research activities on ESA-listed species and designated critical habitats. The PIFSC proposes to conduct and fund fisheries and ecosystem research activities annually as part of our mission; fisheries and ecosystem research activities conducted and funded by PIFSC produce scientific information that is necessary for the management and conservation of living marine resources in the Pacific Islands Region. This research promotes both the recovery of protected species and the long-term sustainability of fish stocks and other marine resources. Each of the research activities requires one or more scientific research permits and the issuance of these permits is a part of the primary Federal action. Per the requirements of the National Environmental Policy Act, we completed the enclosed draft programmatic Environmental Assessment (DPEA).

The proposed activities would occur in the Pacific Islands Region in four geographic areas that include: (1) the Hawaiian Archipelago Research Area (HARA), (2) the Mariana Archipelago Research Area (MARA), (3) the American Samoa Archipelago Research Area (ASARA), and (4) the Western and Central Pacific Research Area, including the Pacific Remote Islands (WCPRA). With this letter, a biological evaluation (enclosed), and mitigation measures, we request to initiate informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA).

As described in the enclosed DPEA, we have determined that the proposed action may affect, but is not likely to adversely affect, the following ESA-listed marine and terrestrial species in the action area: Green sea turtle - Central North, West and South Pacific Distinct Population Segments (DPS); Hawksbill sea turtle; Leatherback sea turtle; Loggerhead sea turtle – North and South Pacific Ocean DPS; Olive ridley sea turtle; Short-tailed albatross; Hawaiian petrel; Newell's shearwater; Band-rumped storm petrel; Nihoa millerbird; Nihoa finch; Laysan finch; and Laysan duck. We request your concurrence with our 'may affect but not likely to adversely affect' determination.

Please contact Ms. Hoku Johnson of my staff at hoku.johnson@noaa.gov or (808) 725-5323 regarding this consultation and for any additional information needs.

Sincerely,

Michael P. Seki Ph.D.

ec: Dawn Bruns - PIFWO
Evan Howell, Hoku Johnson – PIFSC
Mridula Srinivasan – NMFS Headquarters

Enclosure: Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center available in hard copy upon request.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2017-I-0073

FEB 2 1 2017

Dr. Michael P. Seki
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
1845 Wasp Boulevard, Building 176
Honolulu, Hawaii 96818

Subject: Informal Consultation Addressing U.S. Department of Commerce National Marine Fisheries Service Fisheries Ecosystem Research in the Pacific Islands Region

Dear Dr. Seki:

The U.S. Fish and Wildlife Service received your December 14, 2016, letter requesting our concurrence with your determination that the proposed implementation of fisheries and ecosystem research activities may affect but are not likely to adversely affect the endangered short-tailed albatross (*Phoebastria* (=*Diomedea*) *albatrus*), Hawaiian petrel (*Pterodroma phaeopygia sandwichensis*), band-rumped storm-petrel (*Oceanodroma castro*), and the threatened Newell's shearwater (*Puffinus auricularis newelli*) (collectively referred to as seabirds) the endangered Nihoa millerbird (*Acrocephalus familiaris kingi*), Nihoa finch (*Telespyza ultima*), Laysan finch (*Telespyza cantans*), and Laysan duck (*Anas laysanensis*), (collectively referred to as endemic Northwestern Hawaiian Island land birds), and the endangered hawksbill turtle (*Eretmochelys imbricate*), leatherback turtle (*Dermochelys coriacea*), loggerhead turtle (North and South Pacific Ocean Distinct Population Segments (DPS)) (*Caretta caretta*), and the threatened green turtle (*Chelonia mydas*) (Central North, West and South Pacific DPSs), and olive ridley turtle (*Lepidochelys olivacea*) (collectively referred to as sea turtles) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C 1531 et seq.).

The proposed research activities are detailed in your December 14, 2016, Biological Evaluation (NMFS 2016) and your November 2015 "Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center" (NMFS 2015). The proposed research activities will be conducted by U.S. Department of Commerce National Oceanic and Atmospheric Administration, National Marine

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Fisheries Service (NMFS) and your contractors including the University of Hawaii. Proposed research activities include assessments of fish stocks, threatened and endangered species surveys, deployment of experimental fishing gear and scientific instruments, distribution of barbless circle hooks at shore-based fishing tournaments, and marine debris survey and removal actions. Pelagic longline, troll, and handline gear trials will be conducted to collect data on catch efficiency, fish size, species, and fish survival. Up to 21 longline operations, conducted for 10 to 30 hours each will be conducted per year over the ten year project period. The proposed action will be conducted by commercial fishing, contractor, and NOAA vessels operating in the ocean waters of Hawaii, Guam and the Commonwealth of the Northern Mariana Islands (CNMI), Western Central Pacific, and American Samoa Archipelago Research Areas. In addition, onshore marine debris survey and removal activities will be conducted. Marine debris survey and removal activities will be limited to existing roads and trails, the intertidal dynamic shore zone, and in-water areas to avoid potential adverse effects to upland species.

EFFECTS OF THE ACTION

The proposed action has the potential to result in harm to seabirds due to injury or mortality suffered in interactions with project vessels and fishing gear. Injury or mortality of seabirds may also occur as a result of the project due to light attraction and fallout, changes in food availability due to removal of prey and overboard discards of food sources, contamination or degradation of habitat. Seabirds, sea turtles, and endemic Northwestern Hawaiian Island land birds may be harassed due to project-related noise disturbance. In addition, sea turtles may use sandy shoreline areas within the marine debris removal project sites for basking or nesting.

Seabirds:

Mortality of albatross in commercial fishing gear, especially longline gear, is a conservation concern for seabirds in the research areas. In addition, project-related lights and noise may adversely affect seabirds.

Take of Newell’s shearwater, Hawaiian petrel, and band-rumped storm petrel due to longline fishing has not been known to occur, possibly because the bait used in these swordfish, tuna and other ocean fisheries is too large to attract the smaller seabirds. Short-tailed albatross nest on Torishima Japan (78%), and Senkaku Islands (22%) in the Western Pacific. There have been recent breeding attempts at Kure Atoll in the Northwestern Hawaiian Islands and successful breeding during three seasons by a pair at Midway Atoll (Service 2014). The global population estimate for short-tailed albatross in 2014 was 4,354 (Service 2014). Short-tailed albatross nest on land but spend much of their year at sea. They dive into the upper two meters of the ocean hunting for fish, squid, and other aquatic species. Short-tailed albatross at-sea distribution is concentrated along the edge of the northern Gulf of Alaska, Aleutian Islands, and Bering Sea (Figure 1).

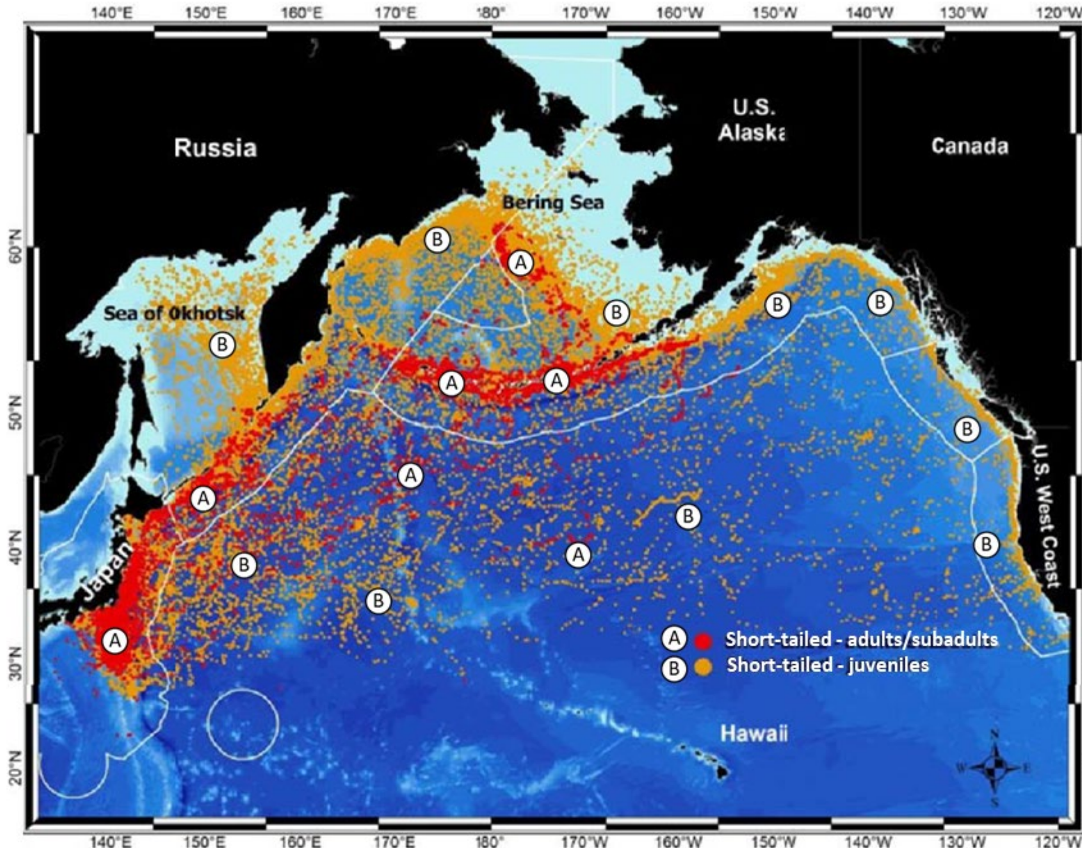

Figure 1. Locations of 99 short-tailed albatrosses tracked between 2002 and 2012, showing adult and juvenile distributions in the North Pacific (Suryan et al. 2006, 2007, 2008, Suryan and Fischer 2010, O'Connor 2013, Deguchi et al. 2014, and Yamashina Institute for Ornithology unpublished data).

The project's use of pelagic longline, troll, handline, and barbless circle hook fishing gear may result in bycatch and entanglement of seabirds. Seabirds can be entangled in fishing gear and the gear can pull the bird underwater. Albatross are particularly vulnerable to interaction with hook and line fishing gear when baited hooks are being deployed and when the catch is being retrieved because the fish, on hooks, are within two meters of the water surface. Between May 2014 and October 2012, the Hawaii longline observer program recorded the hooking of 517 non-listed albatross (Laysan and black-footed albatross), primarily when gear was being retrieved (Gilman et al 2014). In 2000, NMFS estimated that 2,433 total (listed and non-listed) seabird interactions occurred in the Hawaii longline fisheries. In 2004, NMFS implemented safe seabird handling and mitigation measures and NMFS estimated 123 total interactions with seabirds occurred in 2014 (NOAA Fisheries 2016). Longline fishing-related mortality of eight short-tailed albatross has been observed in the U.S. since 2010 (four in the Bering Sea (NOAA 2011, NOAA 2014a, NOAA 2014b, NOAA 2015), two in the Bering Sea/Aleutian Islands (NOAA 2010), one in the Pacific Ocean/Japan (Yio, pers. comm., 2014), and one in the Pacific Ocean/Oregon (U.S. Fish and Wildlife Service 2012). No short-tailed albatross take has been detected by NOAA fisheries observers or reported by fishermen in Hawaii or any of the other Pacific Island Region fisheries covered in this consultation.

Project actions, including those summarized below, minimize the potential for seabird interaction with fishing gear. Longline gear branchline and floatline length, branchline diameter, hook type, hook size and wire diameter, bait type, and number of hooks between floats of the longline gear in Hawaii, American Samoa, Guam, the Commonwealth of the Northern Marianas and EEZ's within the Pacific Insular Areas will adhere to the requirements on commercial longline gear pursuant to National Marine Fisheries Service regulations specified in 50 CFR 229, 300, 404, 600 and 665 as summarized online: http://www/fpir.noaa.gov/SFD/SFD_regs_2.html. The NMFS Pacific Islands Regional Office's Compliance Guide for Reducing and Mitigating Interactions between Seabirds and Hawaii-Based Longline Fishing will be implemented and regulations of the Western Pacific Regional Fisheries Management Council (2013) (975 FR 2262) will be implemented.

Project staff and the fishers will receive mandatory training in seabird identification and seabird deterrent fishing gear will be used. Bird curtains with streamers will be deployed to deter seabirds from diving in areas where hooks are in shallow water (Figures 1 and 2). Strategic offal discard practices will be used to decrease attraction of seabirds to areas where they may be injured.

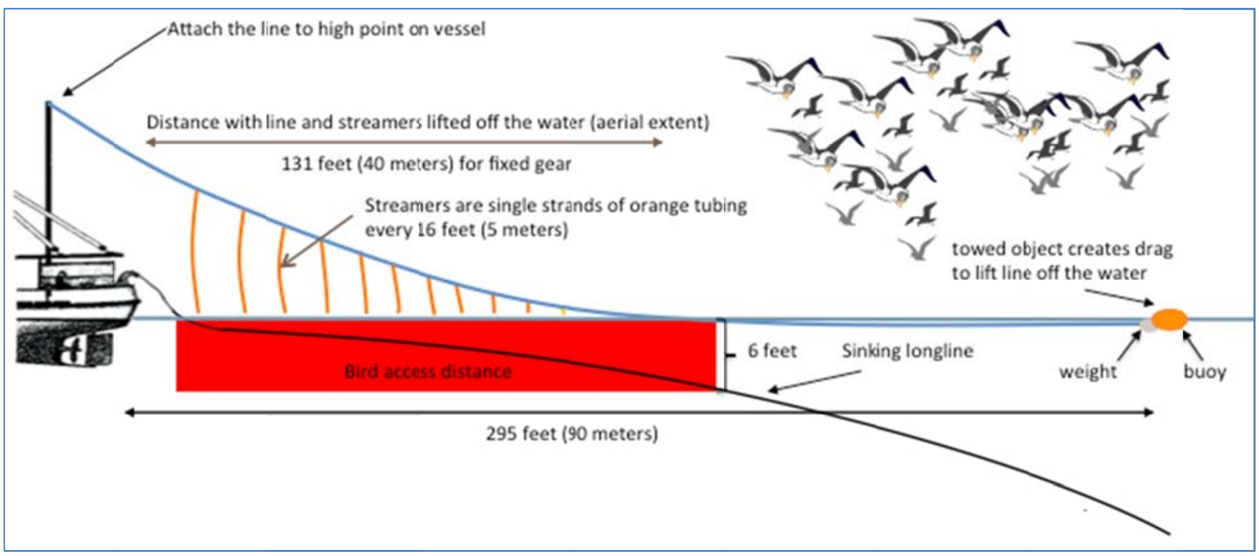

Figure 1. Example diagram of streamer line use to keep seabirds away from baited hooks (University of Washington Sea Grant, in NMFS 2014).

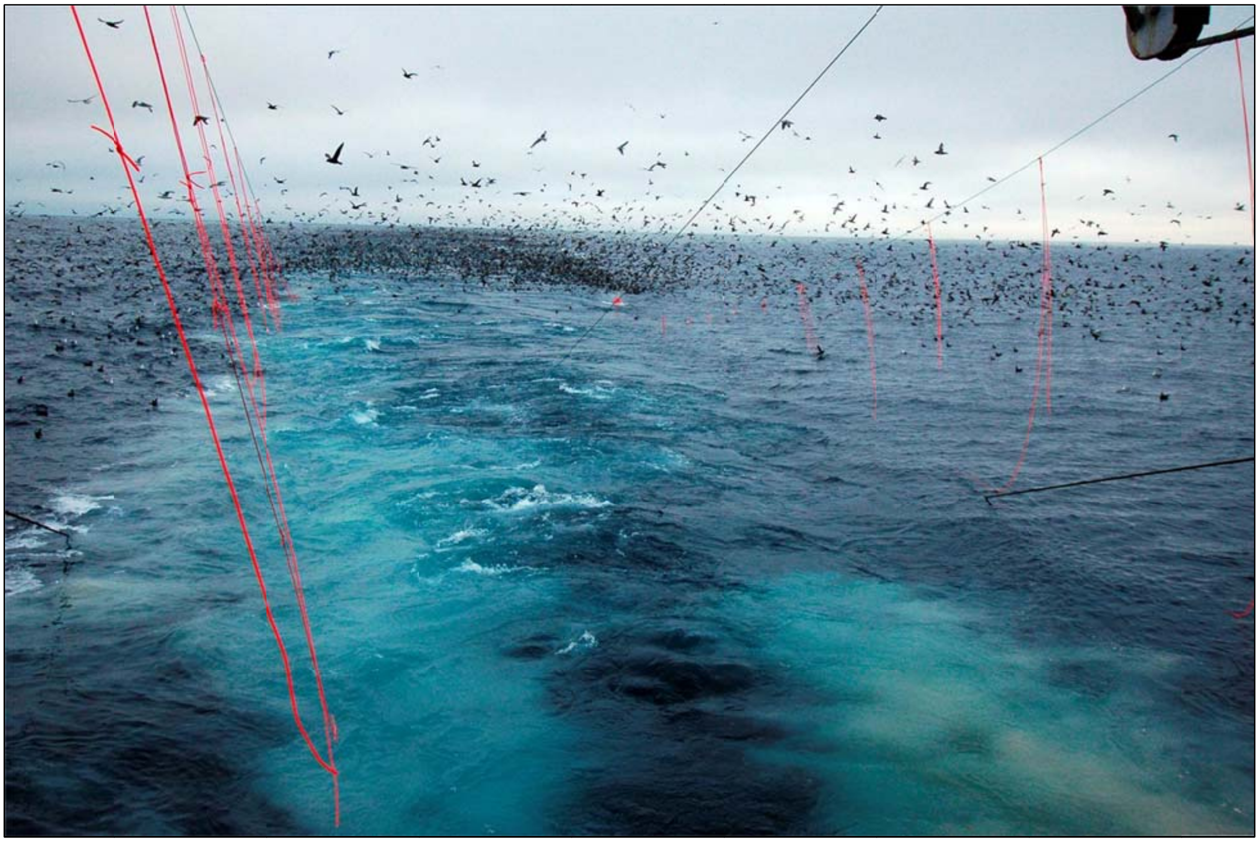

Figure 2. The bright vertical streamers on longline fishing gear keeps the seabirds away from the hazardous area (NMFS 2014).

Approximately 18,000 pelagic longline sets are made in Hawaii each year with 100% observer coverage of the operations. The proposed action would entail set of 21 or fewer longlines per year in NOAA's entire Pacific Island Region. Because the number of longline sets is low, it is extremely unlikely that a listed seabird will interact with the fishing gear associated with the proposed research action.

Seabirds may be attracted to lights on project-related vessels. The birds may be disoriented by the lights, strike or be entangled by fishing gear or other structures, or fall to the deck or into the water due to exhaustion. Young inexperienced birds (fledglings) are particularly vulnerable. Any increase in nighttime lighting, particularly during each year's peak fallout period (September 15 through December 15) could result in seabird injury or mortality. To minimize potential project impacts to seabirds during their breeding season, the use of lights and lighting intensity will be minimized.

In addition to seabird conservation measures and measures NMFS has implemented in the past, the proposed action will include several additional measures to further reduce the potential for adverse effects to seabirds: 1.) the ratio of floating versus sinking lines will be reduced to reduce the risk of entanglements in floating lines; 2.) where practical, additional measures known to reduce seabird bycatch due to longline retrieval, beyond those specified herein, will be implemented; 3.) project-related vessels will, to the extent possible, retrofit their lights with fully shielded fixtures so the bulb can only be seen from below bulb height and use lights only when necessary; and 4.) when fishing staff or researchers see a seabird flying in the ship's lights, the lights will be turned off, when feasible, so the bird will leave the area.

Because the number of longline sets will be small and all required and practical measures will be taken to minimize project-related attraction and interaction with listed seabirds, it is extremely unlikely that the proposed project will adversely affect a listed seabird. The likelihood of an adverse project effect to seabirds is discountable.

Endemic Northwestern Hawaiian Island Land Birds and Sea Turtles:

Project-related noise has the potential to harass endemic Northwestern Hawaiian Island land birds and sea turtles. In addition, ground-based efforts to remove marine debris has the potential to result in harm sea turtles that may bask or nest on sandy shoreline areas near research and marine debris removal project sites.

Operation of Unmanned Aircraft Systems (UAS) may temporarily flush land birds and cause disturbance to nesting and basking sea turtles. The proposed UAS (the APH-22 hexacopter) operates at a noise level ranging from 31.3 decibels (dB) to 57.8 dB (Goebel 2015). NMFS researchers have been operating UAS for protected species research (Hawaiian monk seal, sea turtle and cetacean research) since 2014 and have developed protocols to operate UAS without adversely affecting wildlife. Project-related UAS operations occurring over land and intertidal areas would continue to adhere to the following protocols to minimize potential adverse effects of noise to endemic Northwestern Hawaiian Island land birds and sea turtles: (1) In order to avoid flushing birds, refrain from repeatedly launching and recovering UAS in the same geographic location; (2) Conduct regular pre-flight checks and routine maintenance to ensure the UAS is in proper working order prior to launch; (3) Maintain battery power thresholds to avoid power losses and subsequent crashes; (4) Operation of UAS only within the visual range of the pilot for no more than 20 minutes at a time; (5) For every PIFSC UAS operation, a wildlife observer will note animal disturbance or interactions with birds in the air and interactions with any ESA-listed species would be reported to the U.S. Fish and Wildlife Service.

Marine debris researchers will follow the mitigation measures discussed in Section 2.2.1 and 2.3.1 of the 2015 Draft EA to avoid and minimize disturbance to seabirds, land birds and hauled out sea turtles including the following: 1.) Before approaching any shoreline or exposed reef, all observers will examine the beach, shoreline, reef areas, and any other visible land areas within the line of sight for seabirds and turtles; and 2.) Land vehicle (trucks) operations will occur in areas of marine debris where vehicle access is possible from highways or rural/dirt roads adjacent to coastal resources. Prior to initiating any marine debris removal operations, marine debris personnel (marine ecosystem specialists) will thoroughly examine the beaches and nearshore environments/waters to ensure the area is clear of any nesting birds and sea turtles before approaching marine debris sites and initiating removal activities.

Based on implementation of the aforementioned mitigation measures for all project-related UAS and marine debris removal operations, the potential for disturbance or change in behavior due to physical presence and sound sources to endemic Northwestern Hawaiian Island land birds and sea turtles is expected to be insignificant and discountable. Because marine debris poses an entanglement and nutritional hazard to seabirds and sea turtles, marine debris removal operations will benefit these species.

CONCLUSION

We concur with your determination the proposed implementation of fisheries and ecosystem research within the Pacific Islands Region of the National Marine Fisheries Service is not likely to adversely affect the three endangered and one threatened seabird species, four endemic Northwestern Hawaiian Island land bird species, three endangered and two threatened sea turtle species addressed in this informal consultation. Unless the project description changes, or new information reveals that the proposed project may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to section 7 of the ESA is necessary.

Thank you for participating with us in the protection of listed species and critical habitat. If you have any further questions regarding this consultation, please contact Dawn Bruns, Section 7 and HCP Specialist, (808) 792-9469, dawn_bruns@fws.gov. When referring to this project, please include this reference number: 01EPIF00-2017-I-0073.

Sincerely,

for Mary M. Abrams, Ph.D.
Field Supervisor

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U.S. DEPARTMENT OF COMMERCE
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September 8, 2021

Ms. Ann Garrett
Protected Resources Division
NMFS, Pacific Islands Regional Office
1845 Wasp Blvd., Bldg. 176
Honolulu, Hawai'i 96818

Re: Request for Consultation under Section 7 of the Endangered Species Act for Fisheries and Ecosystem Research Conducted and Funded by NMFS's Pacific Islands Fisheries Science Center

Dear Ms. Garrett:

The Pacific Islands Fisheries Science Center (PIFSC) proposes to conduct and fund fisheries and ecosystem research activities annually as part of our mission. This research promotes both the recovery of protected species and the long-term sustainability of fish stocks and other marine resources. The proposed activities would occur in the Pacific Islands Region in four geographic areas that include: (1) the Hawaiian Archipelago Research Area, (2) the Mariana Archipelago Research Area, (3) the American Samoa Archipelago Research Area, and (4) the Western and Central Pacific Research Area, including the Pacific Remote Islands.

With this letter and the enclosed biological assessment (BA), we request to initiate consultation under Section 7 of the Endangered Species Act (ESA) for listed species and critical habitat in the Pacific Islands Region. The information in the BA provides a full description of PIFSC fishery and ecosystem surveys (including specific gear) for research planned over the 5-year period from 2021 – 2026. The gear types consist of several categories: pelagic surface and midwater trawl gear used at various levels in the water column, pelagic longlines with multiple hooks, and other gear (e.g., various fine-meshed plankton nets, active and passive acoustic instruments, video recording equipment, autonomous underwater vehicle, and Conductivity Temperature Depth profiler). In addition, the BA considers all potential impacts including direct, indirect and cumulative effects from the proposed research on all ESA-listed species within the aforementioned areas,

We look forward to working with PIRO to complete the ESA consultation process for PIFSC fisheries and ecosystem research activities. Please contact Justin Rivera of my staff at Justin.Rivera@noaa.gov regarding this consultation and for any additional information needs.

Sincerely,

Michael P. Seki, Ph.D.
Director, Pacific Islands Fisheries Science Center

Enclosure:
(Electronic) ESA Section 7 Biological Assessment for Fisheries Research Conducted and Funded by the Pacific Islands Fisheries Science Center. August 2021.

ESA SECTION 7
BIOLOGICAL ASSESSMENT
for
FISHERIES RESEARCH CONDUCTED AND FUNDED
by the
PACIFIC ISLANDS FISHERIES SCIENCE CENTER

August 2021

Prepared For:
National Marine Fisheries Service

Prepared by:

ECO49 Consulting LLC
907-903-9714
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ACRONYMS AND ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
ARMS	Autonomous Reef Monitoring Structures
ASARA	American Samoa Archipelago Research Area
AUV	Autonomous underwear vehicle
BA	Biological Assessment
BiOp	Biological Opinion
BMP	Best Management Practice
BMU	Bioerosion Monitoring Unit
BMUS	Bottomfish Management Unit Species
BRUVS	Baited Remote Underwater Video Systems
CAU	Calcium Acidification Units
CCR	Closed-circuit Rebreather
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
cm	centimeter
CNMI	Commonwealth of the Northern Mariana Islands
CTD	Conductivity, Temperature, and Depth
DAS	days at sea
DAWR	Guam Division of Aquatic and Wildlife Resources
dB	decibels
DNA	deoxyribonucleic acid
DOSITS	Discovery of Sound in the Sea
DPS	Distinct Population Segment
DSLL	deep-set longline
EAR	Ecological Acoustic Recorder
eDNA	Environmental DNA
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
FR	Federal Register
ft	feet
g	gram
HARA	Hawaiian Archipelago Research Area
HARP	High-frequency acoustic recording package
HOV	Human Occupied Vehicle
Hz	hertz
IWC	International Whaling Commission
in.	inch
kg	kilograms

kHz	kilohertz
km	kilometers
km^2	square kilometers
kts	knots
lb	pound
LFC	Low Frequency Cetacean
m	meters
MARA	Mariana Archipelago Research Area
MFC	Mid Frequency Cetacean
MHI	Main Hawaiian Islands
mHz	megahertz
min	minutes
ml	milliliter
mm	millimeter
MMPA	Marine Mammal Protection Act
ms	millisecond
M/SI	Mortality and Serious Injury
mt	metric ton
N/A	Not applicable
NEPA	National Environmental Policy Act
nm	nautical mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NWHI	Northwestern Hawaiian Islands
OPR	Office of Protected Resources
PBR	Potential Biological Removal
PEA	Programmatic Environmental Assessment
%	percent
PIFSC	Pacific Islands Fisheries Science Center
PIR	Pacific Islands Region
PIRO	Pacific Islands Regional Office
PIT	Passive Integrated Transponder
PRIA	Pacific Remote Island Areas
PSATs	Pop-off Satellite Archival Transmitting Tags
PTS	Permanent Threshold Shift
PUC	Programmable Underwater Collection Unit
RAMP	Reef Assessment and Monitoring Program
RAS	Remote Access Samplers
RFFA	Reasonably Foreseeable Future Action
ROV	Remotely Operated Vehicle
SCUBA	Self-Contained Underwater Breathing Apparatus

SEL	Sound Exposure Level
SfM	Structure-from-Motion
TTS	Temporary Threshold Shift
UAS	Unmanned Aerial Systems
μPa	microPascal
U.S.	United States
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USV	Unmanned Survey Vehicle
wt	weight
WTR	Water Temperature Recorder
WCPRA	Western and Central Pacific Research Area
WPRFMC	Western Pacific Regional Fisheries Management Council
XBT	Expendable bathythermograph

1 INTRODUCTION

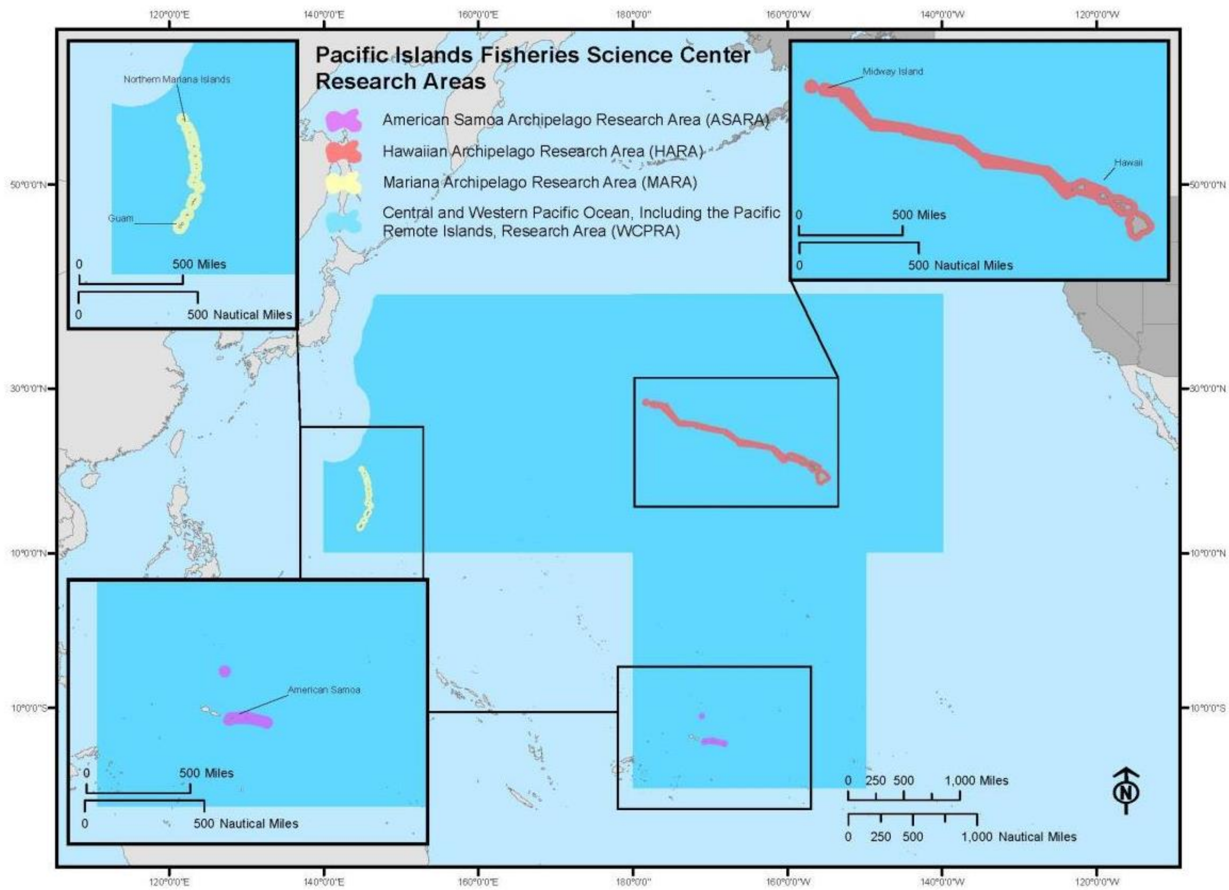
1.1 Background

The Pacific Islands Fisheries Science Center (PIFSC), National Marine Fisheries Service (NMFS), conducts research and provides scientific advice to manage fisheries and conserve protected species for the State of Hawai‘i, Territory of American Samoa, Territory of Guam, the Commonwealth of the Northern Mariana Islands (CNMI) and the Pacific Remote Island Areas (PRIA). Research activities conducted by PIFSC occur in four different research areas (Figure 1-1): 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) Western and Central Pacific including the Pacific Remote Islands Research Area (WCPRA). Originally called the Honolulu Laboratory and part of the Southwest Fisheries Science Center for over 40 years, PIFSC became its own science center when the NOAA Fisheries Pacific Islands Region was established in 2003.

To fulfill National Environmental Policy Act (NEPA) requirements, the PIFSC is currently analyzing the potential environmental effects of fisheries and ecosystem research in a *Draft Programmatic Environmental Assessment (PEA) for Fisheries Research Conducted and Funded by the Northeast Fisheries Science Center*. The PEA provides a programmatic-level assessment of the potential impacts on the biological and human environments associated with the proposed PIFSC research programs and provides a baseline for future management actions.

While the PEA provides the analytical framework to evaluate future research activities, the PIFSC NMFS is initiating a consultation under the Endangered Species Act (ESA) to consider all potential impacts to all ESA-listed species (as required), including all potential direct, indirect and cumulative effects of ongoing research as well as any impacts from the proposed research. The information provided in the PEA and this Biological Assessment (BA) provide the information necessary to comply with ESA Section 7 requirements for future research planned over the 5-year period from 2021 – 2026.

FIGURE 1-1. PACIFIC ISLANDS FISHERIES SCIENCE CENTER RESEARCH AREAS



Source: PIFSC

1.2 Action Area

NMFS defines the outer boundary of an Action Area for a project as the point where no detectable or measurable effect from the project would occur. Therefore, for purposes of this request for rulemaking, the Action Area is defined consistent with ESA regulations as the area within which all relevant direct and indirect effects of fisheries and ecosystem research would occur.

PIFSC's fisheries research activities take place in the nearshore and offshore areas of the HARA, MARA, ASARA, and the WWCPRA Figure 1-1. The HARA includes waters surrounding the Hawaiian Islands to a seaward extent of approximately 24 nautical miles (nm). PIFSC conducts research surveys in the HARA, primarily inside the Insular Pacific-Hawaiian LME boundary. The Insular Pacific-Hawaiian LME has a surface area of approximately one million km², extending 1,500 miles from the MHI to the outer northwest islands, including a range of islands, atolls, islets, reefs and banks (WPRFMC 2009a). The MARA includes waters surrounding the CNMI and the Territory of Guam to a seaward extent of approximately 24 nm. The ASARA includes waters surrounding the American Samoa archipelago to a seaward extent of approximately 24 nm. The WCPRA includes part of the high seas (i.e., international ocean waters) considered under the jurisdiction of the WCFPC. The WCPRA also includes the PRIA comprised of Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Atoll, and Palmyra Atoll. This large area essentially captures all past, present, and future PIFSC high seas research surveys (e.g. oceanography, longline gear research) that occur outside of the HARA, MARA, and ASARA, while also approximately aligning with various other geopolitical boundaries.

1.3 ESA-Listed Species and Critical Habitat in the Action Area

Table 1-1 shows the ESA-listed species that may be found within the PIFSC research areas. The table also notes whether critical habitat has been designated in the areas for any of the species. Details regarding effect determinations are described in Section 4.0.

TABLE 1-1. ESA-LISTED SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

Species	Population or Distinct Population Segment (DPS)	ESA Status	Does Critical Habitat Occur in Action Area?	Effect Determination for Species/DPS	Effect Determination for Critical Habitat
Marine Fish					
Scalloped Hammerhead shark (*Sphyrna lewini*)	Indo-West Pacific DPS	Threatened	Not designated	Likely to adversely affect	N/A
Oceanic Whitetip shark (*Carcharhinus longimanus*)	N/A	Threatened	Not designated	Likely to adversely affect	N/A
Giant Manta ray (*Manta birostris*)	N/A	Threatened	Not designated	Likely to adversely affect	N/A
Marine Mammals					
False Killer whale (*Pseudorca crassidens*)	Main Hawaiian Islands Insular DPS	Endangered	Yes	May affect, not likely to adversely affect	Not likely to destroy or adversely modify
Sperm whale (*Physeter microcephalus*)	Hawai‘i population	Endangered	Not designated	Likely to adversely affect	N/A
Blue whale (*Balaenoptera musculus*)	Central North Pacific population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
Fin whale (*Balaenoptera physalus*)	Hawai‘i population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
Sei whale (*Balaenoptera borealis*)	Hawai‘i population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
North Pacific right whale (*Eubalaena japonica*)	Eastern North Pacific population	Endangered	No	May affect, not likely to adversely affect	No effect

Species	Population or Distinct Population Segment (DPS)	ESA Status	Does Critical Habitat Occur in Action Area?	Effect Determination for Species/DPS	Effect Determination for Critical Habitat
Hawaiian Monk seal (*Neomonachus schauinslandi*)	N/A	Endangered	Yes	May affect, not likely to adversely affect	No Effect
Sea Turtles[1]					
Leatherback Turtle (*Dermochelys coriacea*)	N/A	Endangered	No	May affect, not likely to adversely affect	No Effect
Loggerhead Turtle (*Caretta caretta*)	North Pacific Ocean DPS South Pacific Ocean DPS	Endangered	No	May affect, not likely to adversely affect	No Effect
Olive Ridley Turtle (*Lepidochelys olivacea*)	Mexico's Pacific coast breeding population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
Green Turtle, (*Chelonia mydas*)	Central North Pacific DPS Central West Pacific DPS Central South Pacific DPS	Threatened	No	May affect, not likely to adversely affect	No Effect
Hawksbill Turtle (*Eretmochelys imbricate*)	N/A	Endangered	No	May affect, not likely to adversely affect	No Effect
Corals[2]					
Acropora globiceps	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Acropora jacquelineae	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Acropora retusa	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Acropora speciosa	N/A	Threatened	Proposed	Likely to adversely affect	N/A

Species	Population or Distinct Population Segment (DPS)	ESA Status	Does Critical Habitat Occur in Action Area?	Effect Determination for Species/DPS	Effect Determination for Critical Habitat
Euphyllia paradivisa	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Isopora crateriformis	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Seriatopora aculeata	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Mollusks					
Chambered nautilus (*Nautilus pompilius*)	N/A	Threatened	Not designated	May affect, not likely to adversely affect	N/A

[1]USFW Consultation No. 01EPIF00-2017-1-0073 concurred that proposed research is not likely to adversely affect ESA-listed sea turtles.
[2]On Nov. 27, 2020 NMFS proposed seventeen specific areas containing physical features essential to the conservation of the seven coral species in U.S. waters as critical habitat. The areas cover about 600 km^2 of marine habitat (85 FR 76262).

2 DESCRIPTION OF PROPOSED ACTION

2.1 Proposed PIFSC Research Surveys

Table 2-1 provides a detailed description of proposed surveys, including specific gear used and average range for Days-At-Sea (DAS), planned for the period 2021 to 2026. PIFSC fisheries research surveys are conducted annually and within four primary geographic areas: the HARA, the MARA, the ASARA, and WCPRA (see Figure 1-1). The gear types fall into several categories: pelagic surface and midwater trawl gear used at various levels in the water column, pelagic longlines with multiple hooks, and other gear (e.g., various fine-meshed plankton nets, active and passive acoustic instruments, video recording equipment, autonomous underwater vehicle [AUV], Conductivity Temperature Depth [CTD] profiler). Appendix A provides detailed descriptions of the gear types noted in the table.

TABLE 2-1. PROPOSED PIFSC RESEARCH ACTIVITIES

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
1) Sampling Pelagic Stages of Insular Fish Species	Results of sampling inform life history and stock structure studies for pelagic larval and juvenile stage specimens of insular fish. Additional habitat information is also collected. Target species are snapper, grouper, and coral reef fish species within the 0-175 meter (m) depth range. Pelagic stages sampling is conducted both at midwater depths using a "Stauffer" modified Cobb trawl (Cobb trawl) or a 10-foot (ft) Isaacs-Kidd trawl, and at the surface using a 6-ft Isaacs-Kidd trawl. Surveys may occur every year in the HARA, but approximately once every three years in the MARA, ASARA, and WCPRA.	HARA MARA ASARA WCPRA 3-200 nm from shore	Year-round HARA: up to 20 DAS MARA, ASARA, WCPRA: up to 30 DAS approximately once in research area every three years Midwater Research trawls are conducted at night, Surface trawls are conducted day and night	Cobb trawl (midwater trawl) with OES Netmind or Isaacs-Kidd 10-ft midwater trawl	Tow speed: 2.5-3.5 knots (kts) Duration: 60-240 minutes (min) Depth: Deployed at various depths during same tow to target fish at different water depths, usually to 250 m	40 tows per survey per year
				Isaacs-Kidd 6-ft trawl (surface trawl) Dip net (surface)	Tow speed: 2.5-3.5 kts Duration: 60 min Depth: Surface	40 tows per survey per year
2) Spawning Dynamics of Highly Migratory Species	Early life history studies provide larval stages for population genetic studies and include the characterization of habitat for early life stages of pelagic species. Egg and larval collections are taken in surface waters using a variety of plankton gear, primarily Isaacs-Kidd 6-ft surface trawl, but also sometimes including 1-m ring net and surface neuston net.	HARA MARA ASARA WCPRA 1-25 nm from shore	Year-round HARA: up to 25 DAS MARA, ASARA, WCPRA: up to 25 DAS approximately once in research area every three years Surface trawls are conducted day and night	Isaacs-Kidd 6-ft (surface)	Tow speed: 2.5-3.5 kts Duration: 60 min Depth: Surface	140 tows per survey per year
				Neuston tows (surface) 1-m ring net (surface)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min Depth: 0-3 meters (m)	140 tows per survey per year
3) Cetacean Ecology Assessment	Survey transects conducted in conjunction with cetacean visual and acoustic surveys within the Hawai'i Exclusive Economic Zone (EEZ) to develop ecosystem models for cetaceans. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.	HARA MARA ASARA WCPRA	Variable, up to 180 DAS depending on area surveyed Midwater trawls are conducted at night, surface trawls are conducted day and night All other gear and instruments are conducted day and night	Cobb midwater trawl	Tow speed: 3 kts Duration: 60-240 min	180 trawls per research area
				Small-mesh towed net (surface trawl)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min	180 tows total per year
				Active acoustics (splitbeam Simrad EK60, OES Netmind)	38-200 kilohertz (kHz)	Intermittent continuous during surveys
				Acoustic Doppler Current Profiler (ADCP) (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
				CTD profiler	90 min Profiles from surface down to 1000 m depth	Up to 180 per survey per year
				Expendable bathythermograph (XBT)	10 min duration. Profiles from surface down to1000 m depth	Maximum 900 per survey per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
	Passive Acoustics Calibration - Transmit sound (synthetic pings, dolphin whistles or echolocation clicks, etc.) to passive acoustic recording devices for purposes of in-situ calibration, needed to understand detection distances and received level or frequency-dependent variation in the device performance.	HARA MARA ASARA WCPRA		Underwater sound playback system (Lubell LL916 piezoelectric underwater speaker)	Includes underwater projector and amplifier suspended from small boat or ship. Projection depth may vary from near surface to 100 m.	Intermittent
	Stationary Passive Acoustic Recording - Placement of long-term acoustic listening devices for the purposes of recording cetacean occurrence and distribution, ambient and anthropogenic noise levels, and presence of other natural sounds. Recorders are typically deployed and retrieved once or twice per year at each monitoring location.	HARA MARA ASARA WCPRA		High-frequency acoustic recording package (HARP), ecological acoustic recorder (EAR), or similar device	Deployed in seafloor package or mooring configuration consisting of recorder, acoustic releases, anchor and flotation	Up to ten long-term monitoring sites
	Passive Acoustic Monitoring - Deployment of passive acoustic monitoring devices in conjunction with other sampling measures, such as on fishing gear or free-floating.	HARA MARA ASARA WCPRA		Miniature HARPs, sonobuoys, or similar platforms	Autonomous recorder package modified for attachment to longline gear, oceanographic mooring, or free-floating. Various configurations may have surface buoys with recorder up to 1000 feet (ft) below, or may have smaller form factor with entire package not exceeding 1m length.	Continuous
	Passive Acoustic or Oceanographic Gliders - Autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle provide measure of cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide oceanographic measures over several months duration.	HARA MARA ASARA WCPRA		Seaglider; WaveGlider; or similar platform	AUV.	Continuous
	Collection of Environmental DNA (eDNA) samples – Shipboard eDNA samples would be collected via the ship's CTD to identify cryptic cetaceans.	HARA MARA ASARA WCPRA	Casts would generally occur during night	eDNA water samples collected via Niskin bottles on CTD frame	Water samples collected at depths ranging from 10 – 1000 m. Water would be collected in Niskin bottles and decanted into 10 liter carboys for processing.	200 casts per research area

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
4) Marine Debris Research and Removal	These surveys: (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. Team members systematically survey reefs using shoreline walks, swim surveys, and towed-diver surveys to locate submerged derelict fishing gear in shallow water. Debris type, size, fouling level, water depth, GPS coordinates, and substrate of the adjacent habitat are recorded. Nets are evaluated before removal actions to determine appropriate removal strategies. Attempts to remove marine debris encountered at sea are variable and can be unfeasible because of operational, vessel, or safety constraints. However, by attaching a satellite-tracked marker to debris, it will be possible to locate that debris in the future and to track and analyze its drifting patterns.	HARA MARA ASARA WCPRA	HARA: annually or on an as needed basis, up to 30 DAS ASARA: Occurred once in 2009 after a tsunami Surface trawls are conducted day and night Unmanned Aerial systems (UAS) are conducted during the day or night In-water and beach activities are conducted during the day	Knives, lift bags, scissors, shovels, cargo nets Helicopters (Main Hawaiian Islands [MHI] only)	Gear used to a depth of 30 m in around islands and atolls.	HARA: average of 48 metric tons (mt) per survey per year 1996 - 2013 ASARA: 4 mt per survey per year
	Surface and midwater plankton tows to quantify floating microplastic in seawater	HARA MARA ASARA WCPRA	Annually, or on an as-needed basis, up to 30 DAS Surface trawls are conducted day and night UAS are conducted during the day or night In-water and beach activities are conducted during the day	Neuston, or similar, plankton nets surface towed alongside ship and/or small boats	Tow Speed: varied Duration: < 1 hour	Up to 250 tows per survey per year
	The use of UAS platforms can aid in efficiency during survey and removal operations by directing efforts to high density areas	HARA		UASs (e.g., NOAA PUMA or NASA Ikhana systems, hexacopter)	Deployed from shore, small boat, or ship. Operate along shoreline or over water around atoll.	Less than 20 operations per island or atoll per year
	Adding more frequent marine debris research and removal activities to other research areas.	MARA WCPRA	Additional 30 DAS	Same as above	Same as above	Same as above

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
	Collection and sieving of mesoplastics from beach sand located between the low and high tide lines. Plastics are removed for sampling and further study.	HARA		Sieves	Sieving of mesoplastics (> 500 microns in size) from sand.	100 samples per atoll
	Structure-from-Motion (SfM) surveys consist of marking off plots on the seafloor (1-3 m depth) with cable ties and/or stainless steel pins, collecting photographs of the plots and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images.	HARA MARA ASARA WCPRA	Annually, or on an as-needed basis, up to 30 DAS.	Cable ties, stainless steel pins, camera	Temporarily deployed on the seafloor to mark off plots, removed once photos are taken.	
5) Coral Reef Benthic Habitat Mapping	Produces comprehensive digital maps of coral reef ecosystems using multibeam sonar surveys and optical validation data collected using towed vehicles and AUVs.	HARA MARA ASARA WCPRA	Year-round, up to 30 DAS Day and night	Active acoustics (will vary by vessel): Multibeam Simrad EM3002 D and EM300, multibeam Reson 8101 ER, Imagenex 837 DeltaT, split-beam Simrad EK60	38-300 kHz	Continuous
6) Deep Coral and Sponge Research	Research includes opportunistic surveys on distribution, life history, ecology, abundance, and size structure of deep corals and sponges using ROV, divers, and submersibles. Besides visual surveys, sampling protocols include collection of coral and sponges for genetic, growth and reproductive work and an array of data loggers (temperature, currents, particulate load) placed on the bottom for recovery in future years. This survey will not sample ESA-listed species.	HARA MARA ASARA WCPRA	Opportunistically, depending on ship availability Year-round, 50 DAS	Remotely operated vessel (ROV), divers, submersibles, AUV, landers, instrument packages, Ship-based multibeam echosounders (SeaBeam 3012 multibeam, EK-60 18kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz)	ROVs include the Super Phantom S2 ROV system operated by the Undersea Vehicles Program at the University of North Carolina at Wilmington. Subs include Pices V and Pices IV and similar Human Occupied Vehicles (HOV) AUV includes Seabed and other unmanned systems Hull-mounted 3.5-30 kHz multibeam	HARA: 200 MARA: 200 ASARA: 200 WCPRA: 200 DNA specimens N=100, mean weight (wt) = 10 grams (g) Voucher specimens N=60 wt = 10-500 g Paleo-specimens N=40, wt=500-2000 g

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
7) Insular Fish Life History Survey and Studies	Provide size ranges of deepwater eteline snappers, groupers, and large carangids to determine sex-specific length-at-age growth curves, longevity estimates, length and age at 50% reproductive maturity within the Bottomfish Management Unit Species (BMUS) in Hawaiʻi and the other Pacific Islands Regions. Specimens are collected in the field and sampled at markets.	HARA: (0.2 -5 nm from shore) every year. MARA ASARA WCPRA	HARA: July-September, up to 15 DAS/yr. Other areas: Year-round, up to 30 DAS for each research area once every three years Day and night	Hook-and-line	Hand line, Electric or hydraulic Reel: Each operation involves 1-3 lines with.4-6 hooks per line; soaked 1-30 min. Squid bait on circle hooks (typically 10/0 to 12/0).	HARA: 350 operations per survey per year Other areas: 240 operations per survey per year for each research area
8) Pacific Reef Assessment and Monitoring Program (RAMP)	Ecosystem surveys that include rapid ecological assessments; towed-diver surveys; coral disease, invertebrates, fish, and algae surveys; and oceanographic characterization of coral reef ecosystems. Surveys also include training to conduct surveys which occur between 0-3nm from shore, year-round, using small boats, Self-Contained Underwater Breathing Apparatus (SCUBA) or closed circuit rebreathers (CCR) diver surveys, sampling, and deployment of various equipment. Samples and specimens collected in the field would be analyzed in the laboratory.	HARA MARA ASARA WCPRA; 0-20 nm from shore	Year-round; Annual (each research area is surveyed triennially) 30-120 DAS depending on which area is surveyed In-water activities with divers are conducted during the day, all other activities are conducted day and night	Hand gear used by SCUBA and free divers. EARs, Water samplers (programmable Under water Collection Units [PUCs], Remote Access Samplers [RAS], Surface Temperature Recorders [STRs], Water Temperature Recorders [WTRs], and hand collecting devices) Carbonate sensing instruments [SEAFET (pH), SAMI (pH), SAMI (pCO_2)] Calcium Acidification Units (CAUs) Bioerosion Monitoring Units (BMUs)	Spear gun, slurp gun (a clear plastic tube designed to catch small fish by sliding a plunger backwards out of the tube), hand net, including small boat operations with SCUBA Hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, core-punch, hand snipping Temporary transect line, surface marker buoy, 1 m long plastic spacer pole with camera. Sensors are deployed by use of ~ 70 pound (lb) anchors guided into place by divers. CTD sized instruments are anchored to a dead portion of the reef with coated weights and cable ties, typically deployed at 5-30 m depth.	MARA: Ad hoc fish collections from 2009, less than 20 specimens. Up to but no more than 500 samples per year including corals, coral products, algae and algal products, and sessile invertebrates, fragments to entire individuals/colonies. Some of these may be ESA-listed species 25 EARs per year, typically deployed for 1-3 years 500 water samples per year, deployed 1-7 days 150 deployments per year, deployed for approximately 1-3 years Up to 500 BMUs and CAU per year Collection of 1900 cm^3 of live rock (e.g., dead Porites sp.) to provide clean coral skeletons to generate new BMUs to measure bio erosion rates, and study bio erosion.
				Pneumatic/hydraulic drill for	Approx 4 cm masonry drill bit used	30 coral cores per survey per

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
				coral coring	to extract a 2.5 x 5-70 centimeter (cm) sample	year
				Active acoustics: will vary by vessel (Multi-beam: Reson8101 ER; split-beam: Simrad EK60)	38-200 kHz	Continuous
				BMUs	1 x 2 x 5 cm pieces of relic calcium carbonate, placed next to the reef and deployed at 0-40 m	150 deployments per survey per year Deployed for approximately 1-3 years
				Autonomous reef monitoring structures (ARMS)	36 x 46 x 20 cm structure placed on pavement or rubble (secured to bottom by stainless steel stakes and weights) in proximity to coral reef structures	150 deployments for a duration of typically1-3 yr each
				Sea Bird Electronics SBE56 temperature recorders	Instrument and mounting brackets are 10 x 5 x 30 cm, anchored to a dead portion of the reef with two coated 3 lb dive weights and cable ties, typically deployed at 5-25 m, but may reach 30 m	Typically deployed for 1-3 years
				ADCP	Nortek Aquadopp Sideseeing Profiler, 2 megahertz (mHz) down to 30 m	Continuous during transects
				CTD profiler (shallow-water and deep-water)	Shallow-water CTDs will be conducted from small boats to a depth of 30 meters Deep-water CTDs will be conducted from larger vessels to a maximum depth of 500 m.	Hundreds to thousands of casts per survey per year
				Baited remote underwater video system (BRUVS)	35 kg system weight with 1 kilogram (kg) of bait Deployed down to100 m to the seafloor	Up to 600 deployments per survey per year Deployed for approx. 1 hour
				CAUs	Each CAU consists of 2 PVC plates (10 x 10 cm) separated by a 1 cm spacer and mounted on a stainless steel rod which is installed by divers into the bottom (avoiding corals) down to 30 m	150 deployments per survey per year Deployed for approximately 1-3 years

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
	UAS would be used to collect coral reef ecosystem mapping & monitoring data. Initially testing and field trials would be conducted using multispectral, hyperspectral, or IR sensors. Surveys would be conducted around the MHI.	HARA MARA ASARA WCPRA		UASs (e.g., NOAA PUMA or NASA Ikhana systems, hexacopter)	Deployed from shore, small boat, or ship. Operate along shoreline or over water around atoll.	Less than 20 operations per island or atoll per year
	USV – Unmanned Surface Vehicles	HARA MARA ASARA WCPRA Nearshore areas		*Emily* Unmanned Survey Vehicle (USV) will be used to conduct nearshore sampling of surface and bottom variables, as well as ambient atmospheric conditions near the USV.		
	Visual reef fish surveys	HARA MARA ASARA WCPRA	Year-round, additional 21 DAS	SCUBA and free divers	Visual fish identification and abundance surveys, benthic photo-transect	None
	Photomosaics to collect coral community composition data.	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed.	SCUBA, digital cameras and video camera	Camera system with two SLR digital cameras and a single video camera mounted to a custom frame.	None
	Carbonate budget assessments to assess reef material production rates	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed.	SCUBA divers	Visual benthic, fish, and urchin identification, size, and abundance surveys	None
9) Surface Night-Light Sampling	Conducted opportunistically for decades aboard PIFSC research vessels. Sampling goals: collect larval or juvenile stages of pelagic or reef fish species that accumulate within surface slicks during daylight hours and those attracted to surface and submerged lights from research vessels at night.	HARA; primarily 1-25 nm from shore; adjacent to the Kona coast, but also out to 200 nm and beyond in the WCPRA	Year-round Up to 30 DAS Along with scheduled NOAA research cruises or opportunistically aboard other vessels. Conducted during the night	Net (dip)	Scoop nets (0.5 m diameter sometimes attached to 3-4 m long poles) used while vessel is drifting	30 night-light operations on all vessels combined. Total catch (all species) ≤ 1500 specimens of larval or juvenile fish per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
10) Pelagic Troll and Handline Sampling	Surveys would be conducted to collect life history and molecular samples from pelagic species. Other target species would be tagged-and-released. Different tags would be used depending upon the species and study, but could include: passive, archival, ultrasonic, and satellite tags. Fishery observers or NOAA scientists conduct on-board documentation of catch and survival.	HARA, MARA, ASARA, 0 to 24 nm from shore (excluding any special resource areas)	Variable, up to 14 DAS Day and night	Pelagic troll and handline (hook-and-line) fishing. NOAA research vessels or the equivalent, or contracted fishing vessels.	Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook trolling lures at 4-10 kts. Pelagic handline (hook-and-line) fishing at primarily 10-100 m midwater depths and down to bottomfish depths of 600 m, with hand, electric, or hydraulic reels. Up to 4 lines. Each line is baited with 4 hooks.	A total of up to 2 operations of any of these gear types per DAS, totaling 28 operations (all types combined) for the survey.
11) West Hawai'i Integrated Ecosystem Assessment Cruise	Survey transects conducted off the Kona coast and Kohala Shelf area to develop ecosystem models for coral reefs, socioeconomic indicators, circulation patterns, larval fish transport and settlement. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection. This survey is usually performed along with passive acoustic surveys as described under the Cetacean Ecological Surveys	HARA; 2-10 nm from shore	Variable timing, depending on ship availability, up to 10 DAS Day and night	Large-mesh midwater Cobb trawl	Tow speed: 3 kts Duration: 60-240 min Depths: Deployed at various depths during same tow to target fish at different water depths, usually to 200 m	15-20 tows per survey per year
				Hook-and-line	Electric or hydraulic reel: Each operation involves 1-3 lines, with squid lures, soaked 10-60 min at depths between 200m to 600m.	No more than 50 hours of effort. Approximately 10 mesopelagic squid caught per year
				Small-mesh surface and midwater trawl nets (Isaacs-Kidd 6-ft and 10-ft, neuston, ring, bongo nets, 1-m plankton drop net)	Tow speed: 3 kts Duration: up to 60 min Depth: 0-200 m	15-20 tows per survey per year (any combination of the nets described)
				Active acoustics (split-beam: Simrad EK60; trawl mounted OES Netmind; Didson 303)	Hull mounted: 38-200 kHz Surveys typically from surface to 1000 m depth Didson is usually operated between 400 m and 700 m depth. Range is 30 m	Intermittent continuous during surveys Up to 12 Didson casts for up to 120 min per survey.
				ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
				CTD profiler	90 min/cast	50 tows per survey per year, alternating with Oceanography Cruise

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
12) Sampling of Juvenile-stage Bottomfish via Settlement Traps	Sampling activity to capture juvenile recruits of eteline snappers and grouper that have recently transitioned from the pelagic to demersal habitat. The specimens will provide estimates of birthdate, pelagic duration, settlement date, and pre-and post-recruitment growth rates derived from the analysis of otoliths. The target species include Deep-7 bottomfish and the settlement habitats these stages are associated with.	MHI; 0.2-5 nm from shore	July-September Up to 25 DAS Day and night	Trap (Settlement)	Cylindrical with dimensions up to 3 m long and 2 m diameter. Frame composed of semi-rigid plastic mesh of up to 5 cm mesh size. Folded plastic of up to 10 cm mesh is stuffed inside as settlement habitat, and cylinder ends are then pinched shut. Traps are clipped throughout the water column onto a vertical line anchored on bottom at up to 400 m, supported by a surface float.	10 traps per line set; up to 4 line sets soaked per day, from overnight up to 3 days. Up to 100 lines of traps set per year. Catch of 2500 juvenile stage bottomfish per year
13) Barbless Hook Donation	Donations of barbless circle hooks are made primarily at shore-based fishing tournaments or other outreach events to encourage replacement of barbed hooks in normal (legal) use. PIFSC has no control over the use of the hooks after the donation.	HARA	Year round, no DAS Conducted during the day	Barbless circle hooks	Hooks have the barbs crimped flat (barbs effectively removed)	Up to 35 events (days of donating hooks) per year. Up to 35,000 hooks donated per yr
14) Insular fish Abundance Estimation Comparison Surveys	Comparison of Fishery-Independent Methods to Survey Bottomfish Assemblages in the MHI: Coordinated research between PIFSC ESD and FRMD, State of Hawai‘i Department of Land and Natural Resources, University of Hawai‘i at Manoa, University of Miami. Day and night* surveys are used to develop fishery-independent methods to assess stocks of economically important insular fish. Methods include: active acoustics, stereo baited underwater video camera systems (BotCam, Modular Optical Underwater Survey System [MOUSS], BRUVS), AUV equipped with stereo video cameras, towed optical assessment device (TOAD), and hook-and-line fishing.	HARA MARA ASARA WCPRA	Variable, up to 30 DAS per research area per year, HARA surveyed annually, ASARA, WCPRA surveyed every 3 years	Hook-and-line	Hand, Electric, Hydraulic reels. Each vessel fishes 2 lines. Each line is baited with 4-6 hooks. 1-30 minutes per fishing operation.	HARA: 7,680 operations per year MARA: 1.920 every 3rd year (average 640 operations per year) ASARA: 1,920 every 3rd year (average 640 per year) WCPRA: 1,920 every 3rd year (average 640 per year)
				Active acoustics (split multi-beam: Reson8101 ER; deep water: Simrad EK60; trawl mounted OES Netmind), various fish finder devices	Hull mounted 38-240 kHz	Intermittent continuous during surveys
				Underwater Video Camera (BotCam BRUVS, MOUSS)	Duration: deployed 30-60 min. Depth: 350m	HARA: 7,680 drops per year MARA: 1.920 every 3rd year (average 640 per year) ASARA: 1,920 every 3rd year (average 640 per year) WCPRA: 1,920 every 3rd year (average 640 per year)

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
				AUV	Speed: 0.5 kts Duration: 3 hours/deployment	HARA: 480 deployments per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average 27 per year) WCPRA: 80 every 3rd year (average 27 per year)
				ROV	Duration: 1 hr	HARA: 480 deployments per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average27 per year) WCPRA: 80 every 3rd year (average 27 per year)
				TOAD	Tow speed: 6 kts Duration: 1 hr	HARA: 480 per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average 27 per year) WCPRA: 80 every 3rd year (average 27 per year)
				Niskin bottles attached to ship's CTD, MOUSS frame (aboard small boats), or equivalent	Bottles attached to frame would be triggered at different depths (10 – 1000 m). Water would be stored and processed upon conclusion of the cruise.	250 casts / 250 L of water per research area per year
				Ship-based multibeam echosounders (SeaBeam 3012 multibeam, EK-60 18kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz)	Hull mounted	Intermittent continuous during surveys

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
15) Gear and Instrument Development and Field Trials	Field trials to test the functionality of the gear prior to the field season, or to test new gear or instruments described elsewhere in this table, but outside the geographic scope specified for other surveys.	HARA (Primarily in the waters south of Pearl Harbor on the Island of O‘ahu)	Year-round, up to 15 DAS Day and night	Nets, lines, instruments Calibration of Simrad EK60	38-200 kHz	Intermittent for 24-48 hours
16) Mariana Resource Survey	Sampling activity to quantify baseline bottomfish and reef fish resources in the MARA. Various artificial habitat designs will be developed, enclosed in mesh to retain captures, and evaluated. Cobb trawl and Isaacs-Kidd trawls will collect pelagic-stage specimens of reef fish and bottomfish species. Large fish traps (1m x 1m x 2m) will be deployed overnight to assess bottomfish composition relative to hook-and-line fishing and the quality of each habitat for recent recruits. Traps will be set along or perpendicular to the bottom contour primarily in mesophotic habitats (50-200 m depths) and in deep-slope bottomfish habitats (200-500 m).	MARA 0-25 nm from shore	May - August Up to 102 DAS (once every three years) Midwater trawls are conducted at night, surface trawls are conducted day and night In-water activities are conducted during the day All other activities are day or night	Large-mesh midwater Cobb trawl	Tow speed: 3 kts Duration: 60-240 min trawls; 2 tows per night Depth(s): Deployed at various depths during same tow to target fish at different water depths, usually between 100 m and 200 m	15-20 tows per survey per year
				Small-mesh surface and midwater trawl nets (Isaacs-Kidd, neuston, ring, bongo nets)	Tow speed: 3 kts Duration: up to 60 min Depth: 0-200 m	15-20 tows (any combination of the nets described) per survey per year

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
				Traps (Kona crab, enclosure)	Nylon nets, meshing 2 1/2 inches attached to a wire ring with bait. Up to ten nets can be tied together with a buoy on the end. Soak for about 20 min. Enclosure traps are Fathoms Plus shellfish "lobster" traps or similar. Dome-shaped, single-chambered, two entrance cones with inside mesh dimensions of 45mm x 45mm. Weighted and baited with the remains of life history samples and attached to two surface floats. Two strings of six traps deployed at night on not coral substrate, and retrieved the next morning. Up to 20 traps per string, separated by 20 fathoms of ground line; two depths 10-35 fathoms. Up to 2 strings per DAS. Trap dimensions up to 1m high, 1 m wide, and 2 m long. Traps have outer mesh covering from 0.5-3.0 inch mesh and 1-2 funnel entrances. Trap is baited with fish using an inside baiter. Trap door swings open to retrieve catch and baiter.	25 gear sets per cruise Up to 400 strings set per survey per year
				Simrad split-beam EK60, OES Netmind	38-200 kHz	Intermittent continuous during surveys
				Hook-and-line	Electric or hydraulic reel: Each operation involves 1-3 lines, with squid lures, soaked 10-60 min at depths between 200 m to 600 m.	1000 sets per survey per year
				Divers (spear)	Speargun	1000 reef fish

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
17) Pelagic Oceanographic Cruise	Investigate physical (e.g., fronts) and biological features that define the habitats for important commercial and protected species of the North Pacific Ocean, especially tuna and billfishes, which are targeted by longline fishers. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; surface and water column oceanographic measurements and water sample collection.	Pacific Ocean; Western and Central tropical and subtropical Pacific 25-1000 nm from shore in any direction	Annual (season variable) Up to 30 DAS Midwater trawls are conducted at night, surface trawls are conducted day and night All other activities are conducted day and night	Large-mesh midwater Cobb trawl Plankton drop net (stationary surface sampling)	Tow speed: 3 kts Duration: 60-240 min 1-meter diameter plankton drop net would be deployed down to 100 m	20 tows per year, alternating with West Hawai‘i IEA cruise 4 liters of micronekton per tow 20 drops per year (collections would be less than one liter of plankton)
				Small-mesh surface and midwater trawl nets (Isaacs-Kidd, neuston, ring, bongo nets)	Duration: up to 60 min Depth: 0-200 m	15-20 tows (any combination of the nets described) <1 liter of organisms per tow
				Active acoustics (split multi-beam: Reson8101 ER; deep water: Simrad EK60, OES Netmind)	38-200 kHz	Intermittent continuous during surveys
				ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
				CTD profiler	45-90 min cast duration	60 casts per year, alternating with West Hawai‘i IEA cruise 60 tows/year
18) Lagoon Ecosystem Characterization	Measure the abundance and distribution of reef fish (including juvenile bumphead parrotfish) in any of the lagoons in the WCPRA over a two-week-long period by employing standardized transect and photo-quadrant techniques using SCUBA and snorkeling gear. A collection net may also be used to non-lethally sample fish species inhabiting the lagoon to determine genetic identity. Hook-and–line and spear may also be used to lethally collect specimens.	Throughout WCPRA	Up to 14 DAS Conducted during the day	Divers with Hand Net or speargun	SCUBA, snorkel, 12-inch diameter small mesh hand net	10 dives per survey 10 fin clips collected for genetic analyses
				Hook-and-line	Standard rod and reel using lures or fish bait from shoreline or small boat	1-30 min casts 60 casts per survey

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
19) Pelagic Longline, Troll, and Handline Gear Trials	Investigate effectiveness of various types of hooks, hook guards, gear configurations, or other modified fishing practices for reducing the bycatch of non-target species and retaining or increasing target catch. Data collected on catch efficacy, fish size, species selectivity, and survival upon haul-back Investigate the vertical distribution of pelagic species catch and capture time with TDRs and hook-timers. Investigate behavior of catch and bycatch in relation to fishing operations using cameras, hydrophones, or other sensors. Catch may be tagged and released and specimens may be kept for genetic, physiological, and ecological studies. Troll and handline fishing for pelagic species may also be investigated, with tag and release of catch and collection of specimens.	Longline fishing would occur outside of: (1) all longline exclusions zones in the Hawaiʻi EEZ; (2) the Insular False Killer Whale range, and (3) all special resource areas. Longline fishing would occur up to approximately 500 nm from the shores of the Hawaiʻi Archipelago.	21 DAS Day and night	Pelagic Longline from contracted longline fishing vessels	Gear (See Appendix A). Soak time: 600-1800 min	Up to 21 longline operation per survey per year
		25 to 500 nm from shore (excluding any special resource areas)		Trolling and handline (hook-and-line)	Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook troll lures at 4-10 kts Pelagic handline (hook-and-line) fishing at 10-100 m midwater depths, with hand, electric, or hydraulic reels. Up to 4 lines. Each line is baited with 4 hooks. Up to 4 hrs per troll or handline operation	Up to 21 troll or handline (combined) operations per survey per year
20) Fishing Impacts of Non-Target Species	Bycatch reduction research, post release survival and ecological research on sharks commonly encountered in commercial purse seine, longline, and small-scale fisheries in the Pacific Ocean, including ESA-listed scalloped hammerhead and oceanic whitetip sharks. Research would include post-release survival studies to identify and develop best handling methods in recreational,	HARA MARA ASARA WCPRA	Up to 60 DAS per year	Tags (SPOT, SPAT, miniPAT, dart tags, Coded 69 kHz acoustic transmitters (V16 Vemco).	SPOT = up to 87 x 37 x 23 millimeter (mm) and 57 g fin mounted tags SPAT = 124 x 38 mm and 60 g attached by tether and anchor miniPAT = 124 x 38 mm and 60 g attached by tether and anchor Dart tags = 160 x 1.6 mm attached	50 sharks/year per species, (including scalloped hammerhead and oceanic whitetip sharks) 3 milliliter (ml) blood samples from the same

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
	purse seine and longline fisheries for improved post-release survival rates and ensuring crew safety. The deployment and analysis of electronic tags would generate robust post-release survival estimates which would improve the rigor of stock assessments and aid in the development of best handling practices for fisheries impacting shark populations.				at base of dorsal fin Acoustic transmitters = 90 x 9 mm, surgically implanted into abdominal wall	
21) Oceanic Whitetip Shark Tagging	Tagging, tracking and biological sampling of oceanic whitetip sharks (*Carcharhinus longimanus*) incidentally captured in the Hawaii small-boat tuna fishery. Research activities under this project would be directed by (or managed by) PIFSC and include training fishers participating in the Hawaii Community Tagging Program to tag, photograph, collect tissue samples and or collect interaction data from oceanic whitetip sharks captured incidentally during fishing operations targeting pelagic tuna, billfish and bottomfish teleost species. Incidentally caught sharks would be either tagged OR tissue sampled.	HARA	N/A	Microwave Telemetry Inc. Pop-off Satellite Archival Transmitting Tags (PSATs,), acoustic tags or conventional identification tags. From small boats used in the tuna fishery	Fishing techniques that might interact with these sharks include: nighttime handline fishing, trolling, jigging, bottom-fishing and spearfishing.	About 27 individuals may be captured and tagged in a given year
22) Giant Manta Ray Tagging	Tagging, tracking and biological sampling of giant manta rays incidentally caught in Pacific longline and purse seine fisheries. Research activities would be directed by PIFSC and include training fishery observers to tag, photograph, collect tissue samples and/or collect interaction data from giant manta rays captured incidentally during fishing operations in the western and central Pacific ocean	HARA MARA ASARA WCPRA	N/A	PSATs	Incidental catch in commercial longline or purse seine fisheries	Approximately 30 individuals may be captured, tagged and/or sampled in a given year
23) Coastal Pelagic Ecology, Coastal Fishery Oceanography, Opelu Koas	Investigate physical and biological features that define the key habitats for important coastal pelagic species around Hawaiian Islands, especially the mackerel scad locally called opelu, *Decapterus macarellus*, which are targeted by fishers and an important forage fish for the coastal pelagic ecosystem. Sampling includes using 360-degree video cameras in the water column; scientific fishing operations; plankton nets; surface and water column oceanographic	HARA	Annual (season variable) Up to 20 DAS, daytime operations	Plankton drop net (stationary surface sampling)	1-meter diameter plankton drop net would be deployed down to 100 m	200 drops per year (collection total would be less than five liters of plankton)

Survey Name	Survey Description	General Area of Operation	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx)	Total Number of Samples (Approx)
	measurements; water sample collection for biogeochemical properties, physical properties, and eDNA. These surveys will be conducted in waters within and adjacent to these key habitats.					
				Small-mesh surface towed nets (neuston, ring, bongo nets)	Duration: up to 60 min Depth: 0-100 m	15-20 tows (any combination of the nets described) <1 liter of organisms per tow
				CTD profiler (portable unit)	15-30 min cast duration	60 casts per year
				Towed and stationary video cameras	Less than 1 hour duration	Up to 20 deployments per year
				Hook-and-line	Standard rod and reel using jigging lures from small boat at ~ 25 meters depth	2 lines used at daytime only. 10-20 small boat trips per year. Less than one hour per trip.
				Water sample collection	Duration: 15-30 min; Depth:0-100m; Water samples collected at depths ranging from 0 – 100 m. Water would be collected in Niskin bottles and decanted into 10 L carboys for processing.	60 casts per year

2.2 Mitigation Measures for Protected Species and Habitats

Table 2-3 summarizes proposed mitigation measures by gear type. This assessment does not cover directed research on protected species that involves intentional pursuit or capture of marine mammals, fish, sea turtles, seabirds, and invertebrates for tagging, tissue sampling, or other intentional takes under the marine Mammal Protection act (MMPA) or ESA which require directed scientific research permits. Directed research on ESA-listed species is covered by other environmental review processes and consultations under applicable ESA permitting regulations.

TABLE 2-2. PROPOSED MITIGATION AND MONITORING MEASURES

	Proposed Action
Midwater Trawl Surveys	Visual Monitoring Measures • The officer on watch, Chief Scientist (or other designee), and crew standing watch visually scan for marine mammals, sea turtles, and other ESA-listed species (protected species) using binoculars. The monitor should have no other duties while monitoring and should be trained in species identification methods. Because trawling is typically conducted at night, sight distance is generally limited to no more than 20 m beyond the ship. If trawling is conducted during the day, an approximately 1-km radius is scanned. Operational Procedures • “Move-on” Rule: When trawling is conducted during the day, if any marine mammals are sighted by the Chief Scientist or designee within a 1 km radius of the vessel in the 30 minutes before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear at the discretion of the officer on watch in consultation with the Chief Scientist. When trawling is conducted at night, the visible distance would be limited to 20 m. Small moves within the sampling area can be accomplished without leaving the sample station. After moving on, if marine mammals are still visible from the vessel and appear to be at risk, the officer on watch may decide, in consultation with the Chief Scientist, to move again or to skip the station. The officer on watch will first consult with the Chief Scientist or other designated scientist and other experienced crew as necessary to determine the best strategy to avoid potential takes of these species based on those encountered, their numbers and behavior, position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel might not require any move or only require a short move from the initial sampling site while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if they follow the vessel. In most cases, trawl gear is not deployed if marine mammals have been sighted from the ship in the previous 30 minutes unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the Chief Scientist and officer on watch. The efficacy of the “move-on” rule is limited during nighttime or other periods of limited visibility; although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval. • Trawl operations are usually the first activity undertaken upon arrival at a new station in order to reduce the opportunity to attract marine mammals and other protected species to the vessel. However, in some cases, CTD casts may immediately precede trawl deployment. The order of gear deployment is determined on a case-by-case basis by the Chief Scientist based on environmental conditions and other available information at the sampling site. Other activities, such as water sampling or plankton tows, are conducted in conjunction with, or upon completion of, trawl activities. • Once the trawl net is in the water, the officer on watch, the Chief Scientist or other designated scientist, or crew standing watch continue to monitor the waters around the vessel and maintain a lookout for marine mammal presence as far away as environmental conditions allow (as noted previously, visibility is very limited during night trawls). If these species are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. Generally, if a marine mammal is incidentally caught, it would happen during haul-back operations, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. The risk of catching an animal may be reduced if the trawling continues and the haul-back is delayed until after the marine mammal has lost interest in gear, or left the area. In other situations, swift retrieval of the net or cutting the cables may be the best course of action. The appropriate course of action to minimize the risk of incidental take of protected species is determined by the professional judgment of the officer on watch and appropriate crew based on all situation variables, even if the choices compromise the value of the data collected at the station.

	Proposed Action
	• If trawling operations have been delayed because of the presence of marine mammals, the vessel resumes trawl operations (when practicable) only when these species have not been sighted within 30 minutes or else otherwise determined to no longer be at risk. This decision is at the discretion of the officer on watch and will depend upon the circumstances of the situation. • Care is taken when emptying the trawl, including opening the cod end, as close to the deck as possible in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not protected species are present. It may be necessary to cut the net to remove the protected species. <u>Tow Duration</u> • Standard tow durations for midwater Cobb trawls are between two and four hours as target species are relatively rare, and longer haul times are necessary to acquire the appropriate scientific samples. However, trawl hauls will be terminated and the trawl retrieved upon the determination and professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary, that this action is warranted in order to avoid an incidental take. <u>Marine mammal excluder devices</u> • PIFSC currently uses two types of midwater trawl nets; the Cobb trawl and the Isaacs-Kidd trawl. The Cobb trawl and the Isaacs-Kidd trawl have been used throughout the Pacific Islands Region (PIR) with no interactions with protected species. There are no plans to develop or install marine mammal excluder devices for these types of trawls in this region. <u>Speed limits and course alterations</u> • Vessel speeds are restricted on research cruises in part to reduce the risk of ship strikes with marine mammals. Transit speeds vary from six to ten knots, but average nine knots. The vessel's speed during active Cobb trawl operations and active acoustic surveys is typically two to four knots due to trawl net and sea-state constraints. Thus, these much slower speeds greatly reduce the risk of ship strikes. In addition, PIFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them. • At any time during a survey or while in transit, any crew member that sights marine mammals that may intersect with the vessel course immediately communicates their presence to the bridge for appropriate course alteration or speed reduction as possible to avoid incidental collisions, particularly with large whales. <u>Gear modifications</u> • As applicable, sinking line would be used for approximately the top 1/3 of the line. The other approximately lower 2/3 would still be floating line. This configuration would allow any excess scope in the line to sink to a depth where it would be below where most whales and dolphins commonly occur. Specific line lengths, and ratios of floating line to sinking line, would vary with actual depth and the total line length. This mitigation measure would not preclude the risk of whales or dolphins swimming into the submerged line, but this risk is believed to be lower relative to line floating on the surface.
Longline Gear	<u>Operational Procedures</u> Longline research is currently conducted in conjunction with commercial fisheries, and operational characteristics of the longline gear follows the requirements specified in 50 Code of Federal Regulations (CFR) 229, 300, 404, 600, and 665. PIFSC will generally follow the following procedures when setting and retrieving longline gear: • When shallow-setting anywhere and setting longline gear from the stern: Completely thawed and blue-dyed bait will be used (two 1-lb. containers of blue-dye will be kept on the boat for backup). Fish parts and spent bait with all hooks removed will be kept for strategic offal discard. Retained swordfish will be cut in half at the head; used

	Proposed Action
	heads and livers will also be used for strategic offal discard. Setting will only occur at night and begin 1 hour after local sunset and finish 1 hour before next sunrise, with lighting kept to a minimum. • When deep-setting north of 23°N and setting longline gear from the stern: 45 g or heavier weights will be attached within 1 m of each hook. A line shooter will be used to set the mainline. Completely thawed and blue-dyed bait will be used (two 1-lb. containers of blue-dye will be kept on the boat for backup). Fish parts and spent bait with all hooks removed will be kept for strategic offal discard. Retained swordfish will be cut in half at the head; used heads and livers will also be used for strategic offal discard. • When shallow-setting anywhere and setting longline gear from the side: Mainline will be deployed from the port or starboard side at least 1 m forward of the stern corner. If a line shooter is used, it will be mounted at least 1 m forward from the stern corner. A specified bird curtain will be used aft of the setting station during the set. Gear will be deployed so that hooks do not resurface. 45 g or heavier weights will be attached within 1 m of each hook. • When deep-setting north of 23°N and setting longline gear from the side: Mainline will be deployed from the port or starboard side at least 1 m forward of the stern corner. If a line shooter is used, it will be mounted at least 1 m forward from the stern corner. A specified bird curtain will be used aft of the setting station during the set. Gear will be deployed so that hooks do not resurface. 45 g or heavier weights will be attached within 1 m of each hook. • The “move-on” rule may be implemented if any protected species are present near the vessel and appear to be at risk of interactions with the longline gear; longline sets are not made if marine mammals or sea turtles have been seen within in 1km from the vessel within the past 30 min and represent a potential for interaction with the longline gear, as determined by the professional judgment of the Chief Scientist or officer on watch. Longline gear is always the first equipment or fishing gear to be deployed when the vessel arrives on station. Longline gear is set immediately upon arrival at each station provided the conditions requiring the move-on rule have not been met. • If marine mammals are detected while longline gear is in the water, the officer on watch exercises similar judgments and discretion to avoid incidental take of these species with longline gear as described for trawl gear. The species, number, and behavior of the protected species are considered along with the status of the ship and gear, weather and sea conditions, and crew safety factors. The officer on watch uses professional judgment and discretion to minimize risk of potentially adverse interactions with protected species during all aspects of longline survey activities. • If marine mammals are detected during setting operations and are considered to be at risk, immediate retrieval or halting the setting operations may be warranted. If setting operations have been halted due to the presence of these species, setting does not resume until no marine mammals have been observed for at least 30 min. • If marine mammals are detected while longline gear is in the water and are considered to be at risk, haul-back is postponed until the officer on watch determines that it is safe to proceed. Marine mammals caught during longline fishing are typically only caught during retrieval, so extra caution must be taken during this phase of sampling. <u>Gear Modifications</u> • Use of sinking line as described above for trawl surveys.
Plankton Nets, Small-mesh Towed Nets, Oceanographic Sampling Devices, Active Acoustics, Video Cameras, AUV, and Remotely Operated Vessel (ROV) Deployments	• PIFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises, such as plankton nets, oceanographic sampling devices, video cameras, low-power high-frequency active acoustics directed underneath the ship as a beam, AUVs and ROVs. It is not anticipated that these types of gear or equipment would interact with protected species and are therefore not subject to specific mitigation measures. However, the officer on watch and crew visually monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to protected species during deployment of all research equipment (e.g., reduced boat speed). Often these types of gear are deployed from small boats, not ships, and therefore visual monitoring is the best measures to avoid interactions with protected species.

<table>
<tr><th></th><th>Proposed Action</th></tr>
<tr><td>Reef Assessment and Monitoring Program and Marine Debris Research and Removal Activities</td><td>
The following measures are carried out when working in and around shallow water coral reef habitats. These measures are intended to avoid and minimize impacts to protected species and benthic habitats, as well as avoid introducing non-native invasive species. These activities generally include small boat operations and divers in the water.
<u>Small Boat and Diver Operations</u>

Transit from the open ocean to shallow-reef survey regions (depths of < 35 m) of atolls and islands should be no more than 3 nm, dependent upon prevailing weather conditions and regulations. Each team conducts surveys and in-water operations with at least 2 divers observing for the proximity of protected species sightings, a coxswain driving the small boat, and a topside spotter working in tandem. Topside spotters may also work as coxswains, depending on team assignment and boat layout. Spotters and coxswains will be tasked with specifically looking out for divers, protected species, and environmental hazards.
Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species. Scientists, divers, and coxswains follow the Best Management Practices (BMPs) for boat operations and diving activities. These practices include but are not limited to the following precepts:

Constant vigilance shall be kept for the presence of protected species
When piloting vessels, vessel operators shall alter course to remain at least 100 m from marine mammals and at least 50 m from sea turtles
Reduce vessel speed to 10 km or less when piloting vessels in the proximity of marine mammals
Reduce vessel speed to 5 km or less when piloting vessels in areas of known or suspected turtle activity
Marine mammals and sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore
If approached by a marine mammal or turtle, put the engine in neutral and allow the animal to pass
Unless specifically covered under a separate permit that allows activity in proximity to protected species, all in-water work will be postponed until whales are within 100 yards or other protected species are within 50 yards. Activity will commence only after the animal(s) depart the area
Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s)
Do not attempt to feed, touch, ride, or otherwise intentionally interact with any protected species

<u>Protocol for Minimizing Benthic Disturbance (including coral reefs)</u>

Research dives, using scuba, will focus on the goal of data collection for research and monitoring purposes. All care will be taken during anchoring small boats, with sand or rubble substrate targeted for anchorage to minimize benthic disturbance or coral damage. The operational area will be continuously monitored for protected species, with dive surveys being altered, postponed, or canceled and small boats on standby, neutral, or relocating to minimize disturbances or interactions. The anchor will be lowered rather than thrown, and a diver will check the anchor to make sure it does not drag or entangle any benthos or listed species.
ESA coral taxa would be collected as sparingly as possible and would never exceed more than 10 samples per taxon per year. Voucher samples would be small (2 cm by 2 cm) and would only be collected from well-established colonies using gloved hands or hammer and chisel with tools bleached between uses.

</td></tr>
</table>

	<u>Protocol for Minimizing the Spread of Disease and Invasive Species</u> The following actions are routinely required to minimize the spread of diseases to coral reef organisms and spreading invasive species on equipment and vessels. *Equipment and Gear* • Equipment (e.g., gloves, forceps, shears, transect lines, photographic spacer poles, surface marker buoys) in direct contact with potential invasive species, diseased coral tissues, or diseased organisms are soaked in a freshwater 1:32 dilution with commercial bleach for at least 10 min and only a disinfected set of equipment is used at each dive site. • All samples of potentially invasive species, diseased coral tissues, or diseased organisms are collected and sealed in at least 2 of a combination of bags or jars underwater on-site and secured into a holding container until processing. • Dive gear (e.g., wetsuit, mask, fins, snorkel, buoyancy compensator, regulator, weight belt, booties) is disinfected by one of the following ways: a 1:52 dilution of commercial bleach in freshwater, a 3 percent free chlorine solution, or a manufacturer's recommended disinfectant-strength dilution of a quaternary ammonium compound in "soft" (low concentration of calcium or magnesium ions) freshwater. Used dive gear is disinfected daily by performing the following steps: (1) physical removal of any organic matter and (2) submersion for a minimum of 10 min in an acceptable disinfection solution, followed by a thorough freshwater rinse and hanging to air dry. All gear in close proximity to the face or skin, such as masks, regulators, and gloves, are additionally rinsed thoroughly with potable water following disinfection. *Small Boats* • Small boats that have been deployed in the field are cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, is physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external surfaces of vessels are rinsed daily with freshwater and always rinsed between islands before transits. Vessels are allowed to dry before redeployment the following day. <u>Sea Turtles and Hawaiian Monk Seals</u> • To avoid interactions with listed species during surveys and operations, team members and small boat coxswains will monitor areas while in transit to and from work sites. If a listed species is sited, the vessel will alter course in the opposite direction. If unable to change course, the vessel will slow or come to a stop awaiting the animal to be clear of the boat as long as passenger safety is not compromised. Currently, there are no known strikes or incidental takes of a listed protected species from a vessel or propeller of a Pacific RAMP vessel in the Northwestern Hawaiian Islands (NWHI), or other surveyed areas around the Pacific. • As part of due diligence, protected species monitoring will continue throughout all dive operations by at least one team member aboard each boat and two divers working underwater. Operations will be altered and modified as previously listed. • Mechanical equipment will also be monitored to ensure no accidental entanglements occur with protected species (e.g., with Passive Acoustic Monitoring [PAM] float lines, transect lines, and oceanographic equipment stabilization lines). Team members will immediately respond to an entangled animal, halting operations and providing an onsite response assessment (allowing the animal to disentangle itself, assisting with disentanglement, etc.), unless doing so would put divers, coxswains, or other staff at risk of injury or death. • Before approaching any shoreline or exposed reef, all observers will examine the beach, shoreline, reef areas, and any other visible land areas within the line of sight for marine mammals and sea turtles. The Pacific RAMP teams typically do not participate during terrestrial surveys and operations as part of their mandate, and, therefore, minimize the potential for disturbances of resting animals along shorelines. • Land vehicle (trucks) operations will occur in areas of marine debris where vehicle access is possible from highways or rural/dirt roads adjacent to coastal resources. Prior to initiating any marine debris removal operations, marine debris personnel (marine ecosystem specialists) will thoroughly examine the beaches and nearshore

	Proposed Action
	environments/waters for Hawaiian monk seals, false killer whales, green sea turtles, and hawksbill sea turtles before approaching marine debris sites and initiating removal activities. Debris will be retrieved by personnel who are knowledgeable of and act in compliance with all federal laws, rules and regulations governing wildlife in the Papahānaumokuākea Marine National Monument and Main Hawaiian Islands (MHI). This includes, but is not limited to: 1. Decontamination of clothing/soft gear taken ashore by prior freezing for 48 hours, or use of new clothing/soft gear as indicated by U.S. Fish and Wildlife Service (USFWS) regulations; 2. Avoidance of seabird colonies; and 3. Avoidance of marine turtles and Hawaiian monk seals, maintaining a minimum distance of 50 yards from all monk seals and turtles, and a minimum of 100 yards from female seals with pups.
Autonomous Underwater Vehicles (AUVs) and Unmanned Aircraft Systems (UAS)	• In order to minimize malfunction of the AUV's during operations, a pre-deployment test of all operating systems will be run to ensure that the AUV is operating correctly and there are no visually apparent physical defects in the AUV. • All AUV deployment missions will have a deployment and retrieval plan to minimize lag time in water and ensure that the AUV is properly retrieved. • In order to minimize the spread of invasive species, all AUV's will be inspected and cleaned of any organic material including algae and other organisms prior to deployment. • All UAS will undergo a pre-flight test prior to deployment to ensure that the equipment is working properly and weather conditions are conducive to flying a mission. • All UAS operations will be conducted with a pilot and a spotter to ensure that the UAS is monitored at all times. • Should any UAS make an emergency landing in the water, small boats will be deployed immediately to retrieve the equipment to minimize potential for pollution (e.g. loss of gas or batteries into the marine environment). • A submersible dive plan will be in place for each dive that details each mission, locations, and deployment/recovery times to minimize the potential for collision with the substrate or groundings. • Each submersible will be inspected and cleaned of any organic material including algae other organisms, and chemicals, oils or other pollutants prior to deployment, in order to minimize the spread of invasive species and ensure no pollutants are released into the ocean.
Bottom Fishing Hook and Line Research Gear	• Researchers and contracted fishers will use pre-existing mapping data to avoid sensitive areas (areas of high coral cover) when conducting bottomfishing operations Visual monitoring for marine mammals before gear is set and implementation of the "move-on" rule as described for longline gear. • To avoid attracting any marine mammals to a bottom fishing operation, dead fish and bait will not be discarded from the vessel while actively fishing. Dead fish and bait may be discarded after gear is retrieved and immediately before the vessel leaves the sampling location for a new area. • If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity of a bottom fishing operation, then the gear would be retrieved immediately and the vessel would move to another sampling location where marine mammals are not present. • If a hooked fish is retrieved and it appears to the fisher that it has been damaged by a monk seal, then visual monitoring will be enhanced around the vessel for the next ten minutes. Fishing may continue during this time. If a shark is sighted, then visual monitoring would be returned to normal. If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity of a bottom fishing operation, then the gear would be retrieved immediately and the vessel would be moved to another sampling location where marine mammals are not present. Catch loss would be tallied on the data sheet, as would a "move-on" for a marine mammal.

	Proposed Action
	• If bottom fishing gear is lost while fishing, then visual monitoring will be enhanced around the vessel for the next ten minutes. Fishing may continue during this time. If a protected shark or ray, monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity, it would be observed until a determination can be made of whether gear is sighted attached to the animal, gear is suspected to be on the animal (i.e., it demonstrates uncharacteristic behavior such as thrashing), or gear is not observed on the animal and it behaves normally. If a cetacean or monk seal is sighted with the gear attached or suspected to be attached, then the procedures and actions for incidental takes would be initiated. Gear loss would be tallied on the data sheet, as would a "move-on" because of a marine mammal.
Unknown Future PIFSC Research Activities	In addition to the activities identified above, PIFSC may propose additional surveys or modify existing research activities within the timeframe covered by this BA. Over the next five years advancements in technology may lead to new and better sampling instruments and gear, such as video equipment and UAS. Evaluation of proposed future research activity would: • Determine if the activity would be conducted within the geographic scope of the region evaluated • Evaluate the seasonal distribution of the activity and the gear types proposed to determine if coverage is present.

2.3 Protected Species Training

PIFSC considers the current suite of monitoring and operational procedures to be necessary and sufficient to minimize adverse interactions with protected species and still allow PIFSC to fulfill their scientific mission. However, many of the mitigation measures could also be considered “best practices” for safe seamanship and avoidance of hazards during fishing. PIFSC researchers are aware of the explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species. However, the specific conditions for implementing these mitigation measures in all situations have not been formalized or widely discussed among all scientific parties and vessel operators. PIFSC therefore proposes a series of improvements to its protected species training, awareness, and reporting procedures moving forward. PIFSC expects these new procedures will facilitate and improve the implementation of current mitigation measures. The enhanced mitigation measures are anticipated to be sufficient for and required by NMFS under MMPA and ESA authorizations for the specified research activities affiliated with PIFSC.

- Some mitigation measures such as the move-on rule require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Ship captains and Chief Scientists are charged with making those judgments at sea. They are all highly experienced professionals but there may be inconsistencies across the range of research surveys conducted and funded by PIFSC in how those judgments are made. In addition, some of the mitigation measures described above could also be considered “best practices” for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species may not have been formalized and clearly communicated with all scientific parties and vessel operators. PIFSC therefore proposes a series of improvements to its protected species training, awareness, and reporting procedures. PIFSC expects these new procedures will facilitate and improve the implementation of the described mitigation measures.
- PIFSC will initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted above, there are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal interactions before and during the time research gear is in the water. The intent of this mitigation measure would be to draw on the collective experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. PIFSC would coordinate not only among its staff and vessel captains but also with those from other fisheries science centers with similar experience.
- Another new element that would be required for all PIFSC research projects is the proposed development of a formalized protected species training program for all crew members that may be posted on monitoring duty or handle incidentally caught protected species. Training programs would be conducted on a regular basis and would include topics such as monitoring and sighting

protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. PIFSC will work with the Pacific Islands commercial fisheries Observer Program to customize a new protected species training program for researchers and ship crew. The Observer Program currently provides protected species training (and other types of training) for NMFS-certified observers placed on board commercial fishing vessels. PIFSC Chief Scientists and appropriate members of PIFSC research crews will be trained using similar monitoring, data collection, and reporting protocols for protected species as is required by the Observer Program. All PIFSC research crew members that may be assigned to monitor for the presence of marine mammals during future surveys will be required to attend an initial training course and refresher courses annually or as necessary. The implementation of this training program would formalize and standardize the information provided to all research crew that might experience protected species interactions during research activities.

- For all PIFSC research projects and vessels, written cruise instructions and protocols for avoiding adverse interactions with protected species will be reviewed and, if found insufficient, made fully consistent with the Observer Program training materials and any guidance on decision-making that arises out of the two training opportunities described above. In addition, informational placards and reporting procedures will be reviewed and updated as necessary for consistency and accuracy. All PIFSC research cruises already include pre-sail review of protected species protocols for affected crew but PIFSC will review its briefing instructions for consistency and accuracy.
- PIFSC will convene a workshop with NMFS Pacific Islands Regional Office (PIRO) Protected Species, PIFSC fishery scientists, NOAA research vessel personnel, and other NMFS staff as appropriate to review data collection, marine mammal interactions, and refine data collection and mitigation protocols, as required.
- In addition, PIFSC fisheries research personnel working in nearshore or onshore locations in proximity to Hawaiian monk seals will document any disturbances to seals. Such documentation will include date, location, number and reaction of seals, type of disturbance and nature of fisheries research activity being conducted. Reports from such events will be compiled and reviewed on an annual basis for review by PIFSC leadership in order to devise alternative strategies for reducing any future take. Take events will be reported annually to NMFS Office of Protected Resources (OPR) as required by authorization.

2.4 Protected Species Handling Procedures

For the Pacific Islands Region, PIFSC follows the guidance on the identification, handling, and release of protected species that has been provided by the NOAA PIRO (Appendix B).

2.4.1 Marine Mammals

Based on previous PIFSC research activities, it is not anticipated that any marine mammals would be captured during the proposed research. However, if a marine mammal was accidentally captured live or injured, then it would be extracted from the research gear and returned to the water as soon as possible. Animals would be released without removing them from the water if possible. Data collection would be conducted in such a manner as not to delay release of the animal and should include species identification, sex identification if genital region is visible, estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount and description of gear remaining on the animal), and photographs. The Chief Scientist or crew should collect as much data as possible from hooked or entangled animals, considering the disposition of the animal; if it is in imminent danger of drowning, it should be released as quickly as possible. Biological specimens would not be collected from marine mammals. If a large whale is alive and entangled in fishing gear, the vessel should immediately call the U.S. Coast Guard (USCG) at VHF Ch. 16 or the appropriate Marine Mammal Health and Stranding Response Network.

2.4.2 Sea Turtles

Based on previous PIFSC research activities, it is not anticipated that any sea turtles would be captured during the proposed research. However, if a dead, injured, or stranded sea turtle was encountered, then PIFSC would follow the existing regulations (50 CFR 223.206 and 222.310) and PIRO guidance. If possible, data would be collected in such a manner as not to delay release of the animal(s) and should include species identification, sex identification if genital region is visible, estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal) and photographs. If scientific personnel onboard the vessel have the appropriate permits for sea turtle research, then they may elect to install Passive Integrated Transponder (PIT) tags in the flippers of animals that have not already been tagged. Captured turtles are quickly processed and released in accordance with established handling procedures.

2.4.3 Rays (including Giant Manta Rays)

Based on previous PIFSC research activities and by following mitigation measures for midwater trawls, it is not anticipated that any rays would be captured during the proposed research. However, if a ray is incidentally captured, it should be released quickly but with care and kept in the water to the maximum extent possible. Also following these measures, up to 30 giant manta rays captured incidentally during commercial fishing efforts would be tagged as released as described in Table 2-1. These would be considered as 30 research takes. The mitigation measures are based on Carlson *et al*. (2018) and while specifically developed for *Mobuldae* species, are generally applicable to all rays.

2.4.3.1 Mitigation Measures Applicable During Any Survey

Make every effort to disentangle the animal from the gear.

- If possible to do without causing injury, use the gear (i.e., netting, line and leader, etc.) to maneuver the ray alongside the vessel to disentangle while fully submerged to keep the ray in the water.
- Do not cut off the tail.
- Do not gaff the animal.
- Do not lift, drag or carry the ray by the gill slits or cephalic lobes.
- Do not punch holes through the body to pass hoisting cables through it or bind wire around the animal to move it.

- Bringing a ray onboard a vessel: If it is not possible to remove the netting while the animal is in the water, carefully bring it on board without causing damage to the body by supporting at least two points of contact or preferably have two to three people carry the ray (specifically for *Mobuldae* species) by the sides of each wing.
- To release from onboard a vessel: Have two or three people (especially for *Mobuldae* species) carry each wing and release ray over the side of the vessel.

2.4.3.2 Trawl or Gillnet Surveys

Follow the steps above. Otherwise, if netting cannot be removed while the animal is in the water, carefully cut netting/mesh off the body and retain netting on board then release following the steps above.

2.4.3.3 Purse Seine Surveys

Release *Mobuldae* species directly from the brailer (i.e., scoop net) if possible. Otherwise, follow the steps above.

2.4.3.4 Longline Surveys

Follow the steps above plus the measures listed here. Use the line and leader to maneuver the animal alongside the vessel.

- Do not attempt to pull hooks out until assessing whether it can be done safely. If the ray is hooked through the mount with a barbed hook, it can be safely dislodged by using a turtle dehooker or cutting the hook below the barb with bolt cutters.
- If the hook has been swallowed, or “foul hooked” (i.e., any place but the jaw), do not try to retrieve the hook. Cut the leader as close to the hook as possible and release.
- Animals should be released with no or little to no trailing line or hook.

3 STATUS OF SPECIES AND CRITICAL HABITATS

3.1 ESA-Listed Fish

3.1.1 Scalloped Hammerhead Sharks

The scalloped hammerhead shark (*Sphyrna lewini*) is a circumpolar species and ranges from the intertidal and surface to depths of approximately 500 m. Scalloped hammerhead sharks are highly mobile and partly migratory (Maguire *et al*. 2006). In Kaneʻohe Bay, Hawaiʻi, scalloped hammerhead sharks can travel as far as 5.1 km in the same day (Duncan and Holland 2006).

Based on analysis of available data, the scalloped hammerhead shark can be characterized as a long lived (20-30 years), late maturing, and relatively slow growing species (Miller *et al.* 2014). Juvenile and adult scalloped hammerhead sharks can live as solitary individuals, pairs, or in schools. Neonate and juvenile aggregations are common in nearshore nursery habitats, such as In Kaneʻohe Bay, coastal waters off Oaxaca, Mexico, Guam's inner Apra Harbor, coastal areas in the Republic of Transkei, and coastal intertidal habitats in Cleveland Bay, Australia (Duncan and Holland 2006; Diemer *et al*. 2011; Tobin *et al*. 2014).

There are six different DPS for the scalloped hammerhead shark, four of which are listed under the ESA. Two DPS occur in the PIFSC region: the Central Pacific DPS (not ESA-listed) and the Indo-West Pacific DPS (threatened). The Indo-West Pacific DPS was listed as Threatened in July 2014 (79 FR 38213). The Indo-West Pacific DPS includes scalloped hammerhead sharks in the area bounded to the south by 36° S. lat., to the west by 20° E. longitude, and to the north by 40° N. latitude. In the east, the boundary line extends from 175° E. longitude, then due south to 4° S. latitude, then due east along 4° S. latitude to 130° W. longitude, and then extends due south along 130° W. longitude. Critical habitat has not been designated for the Indo-West Pacific DPS of scalloped hammerhead shark.

3.1.2 Oceanic Whitetip Sharks

On January 30, 2018, NMFS published a final rule to list the oceanic whitetip shark as threatened under the ESA (83 Federal Register [FR] 4153). While information on the size of the global population of the oceanic whitetip shark is lacking, evidence suggests that the species, once common and abundant, has experienced significant declines globally due to significant fishing pressure and lack of regulatory protection. They are frequently caught in pelagic longline, purse seine, and gillnet fisheries worldwide and their fins are highly valued in the international trade for shark products. Ongoing threats of fishing pressure and related mortality are expected to continue, as the species is still regularly caught as bycatch in global fisheries and incidents of illegal finning and trafficking of their fins have occurred recently despite CITES protections (Young *et al*. 2018). The Northwest Atlantic and Hawaii populations appear to have stabilized and, given the strict fishing regulations in U.S. waters, these stabilizing trends are expected to continue (83 FR 4153). In 2020, NMFS determined that there are no areas within the jurisdiction of the United States that meet the definition of critical habitat for the oceanic whitetip shark (85 FR 12898).

3.1.3 Giant Manta Ray

On November 10, 2015, NMFS received a petition to list the giant manta ray as threatened or endangered under the ESA throughout its range. In addition, the petition requested that critical habitat be designated alongside the ESA listing. The main threat to the giant manta ray is commercial fishing; the species is both targeted and caught as bycatch in a number of global fisheries throughout its range. Manta rays are particularly valued for their gill rakers, which are traded internationally. Demand for the gills of manta and other mobula rays has risen dramatically in Asian markets. With the expansion of the international gill raker market and increasing demand for manta ray products, estimated harvest of giant manta rays, particularly in many portions of the Indo-Pacific, frequently exceed numbers of identified individuals in those areas and is accompanied by observed declines of up to 95% in sightings and landings of the species.

NMFS announced a final rule to list the giant manta ray as threatened on January 22, 2018 (83 FR 2916) throughout its range. In 2019, NMFS published the findings of a comprehensive review to evaluate the need to designate critical habitat for giant manta rays, concluding "a designation of critical habitat is not prudent at this time" (84 FR 66652).

3.2 ESA-Listed Marine Mammals

3.2.1 False Killer Whale

There are currently three demographically-independent populations in Hawaiian waters as follows: 1) MHI insular DPS including animals within 72 km (approx. 38.9 nm) of the MHI; 2) NWHI DPS including animals within a 93 km (50 nm) radius of the NWHI and Kaua‘i; 3) Hawai‘i pelagic DPS includes animals in waters more than 11 km (5.9 nm) from the MHI; 4) Palmyra Atoll stock includes animals within the U.S. EEZ of Palmyra Atoll, and 5) American Samoa stock includes animals within the U.S. EEZ of American Samoa (Carretta *et al*. 2019). The MHI insular DPS is the only stock listed under the ESA as endangered (77 FR 70915, November 28, 2012). Hawaiian insular false killer whales have been declining over the past 20 years. The minimum population estimate for the MHI insular false killer whales is 149 animals and the Potential Biological Removal (PBR) for this stock is 0.3 animals (Carretta *et al*. 2021).

Designated critical habitat for this DPS of killer whales includes waters from the 45-m depth contour to the 3200-m depth contour around the MHI from Niihau east to Hawai‘i, but excludes 14 areas from the designation because NMFS determined that the benefits of exclusion outweigh the benefits of inclusion, and exclusion will not result in extinction of the species (see 83 FR 35062).

3.2.2 Sperm Whale

The Hawai‘i population of sperm whales includes animals found within the Hawaiian Islands EEZ and in adjacent international waters. In 1970, the sperm whale was listed as endangered throughout its range (35 FR 18319). Encounter data from a 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ was recently reevaluated. Model-based abundance for sperm whales in the Hawaiian Islands EEZ was determined to be 5,707 animals, with a PBR of 18 sperm whales per year (Carretta *et al*. 2021). Critical habitat has not been designated for sperm whales.

There are no recent fishery-related mortalities or serious injuries of sperm whales in the Hawaiian Islands EEZ (Carretta *et al*. 2019). One observed interaction with the Hawaiʻi-based deep-set longline fishery occurred during the period 2011 – 2015 which resulted in a prorated probability of serious injury or mortality of 75 percent Given the absence of recent recorded fishery-related mortality or serious injuries in U.S. EEZ waters, total fishery mortality and serious injury for sperm whales can be considered insignificant and approaching zero. The increasing level of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales particularly for deep-diving whales like sperm whales (Richardson *et al.* 1995).

3.2.3 Blue Whale

Blue whales throughout their range were listed as endangered under the ESA in 1970 (35 FR 18319). They are uncommon in the Hawaiian EEZ. A 2010 line-transect survey of the Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 133 blue whales (Bradford *et al*. 2017 in Carretta *et al.* 2020). Although currently considered the best available estimate for Hawaiian waters, most blue whales from this population were likely feeding in higher latitudes during the time of the survey (Carretta *et al*. 2020). The PBR for this population in the Hawaiian Islands EEZ is 0.1 per year, based on a minimum population estimate of 63 whales Carretta *et al*. 2020). Critical habitat has not been designated for blue whales.

There have been no fishery-related mortalities or serious injuries of blue whales reported within the Hawaiian Islands EEZ (Carretta *et al*. 2020).

3.2.4 Fin Whale

The Hawaiʻi population of fin whales includes animals within the Hawaiian Islands EEZ and adjacent high-seas waters. In 1970, the fin whale was listed as endangered throughout its range (35 FR 18319). Encounter data from a 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ was recently reevaluated. Model-based abundance for fin whales in the Hawaiian Islands EEZ was estimated to be 203 animals, with a PBR of-- 0.2 sperm whales per year based on a minimum population size of 101 (Carretta *et al*. 2021). Critical habitat has not been designated for fin whales.

3.2.5 Sei Whale

The sei whale Hawaiʻi population includes whales within the Hawaiian Islands EEZ and in adjacent high-seas waters. The sei whale is listed as endangered under the ESA throughout its range (35 FR 12222). Encounter data from a ship-based survey from 2010 were recently evaluated resulting in an abundance estimate of 77 for the Hawaiʻi population of sei whales (Carretta *et al*. 2020). Although this is currently the best available abundance estimate for this population, most sei whales would be expected to be feeding in higher latitudes waters during the time of the survey. The minimum estimate is 204 whales and the PBR is 0.4 sei whales per year (Carretta *et al*. 2020). Critical habitat has not been designated for sei whales.

A single sei whale was seen entangled in heavy-gauge polypropylene line in 2011; the source of the line was not determined. There have been no other observed fisheries-related mortalities and serious injuries. The estimated rate of fisheries-related mortality and serious injury of sei whales in the Hawaiian Islands EEZ is 0.2 animals per year for the period from 2011 to 2015 (Carretta *et al*. 2020).

3.2.6 North Pacific Right Whale

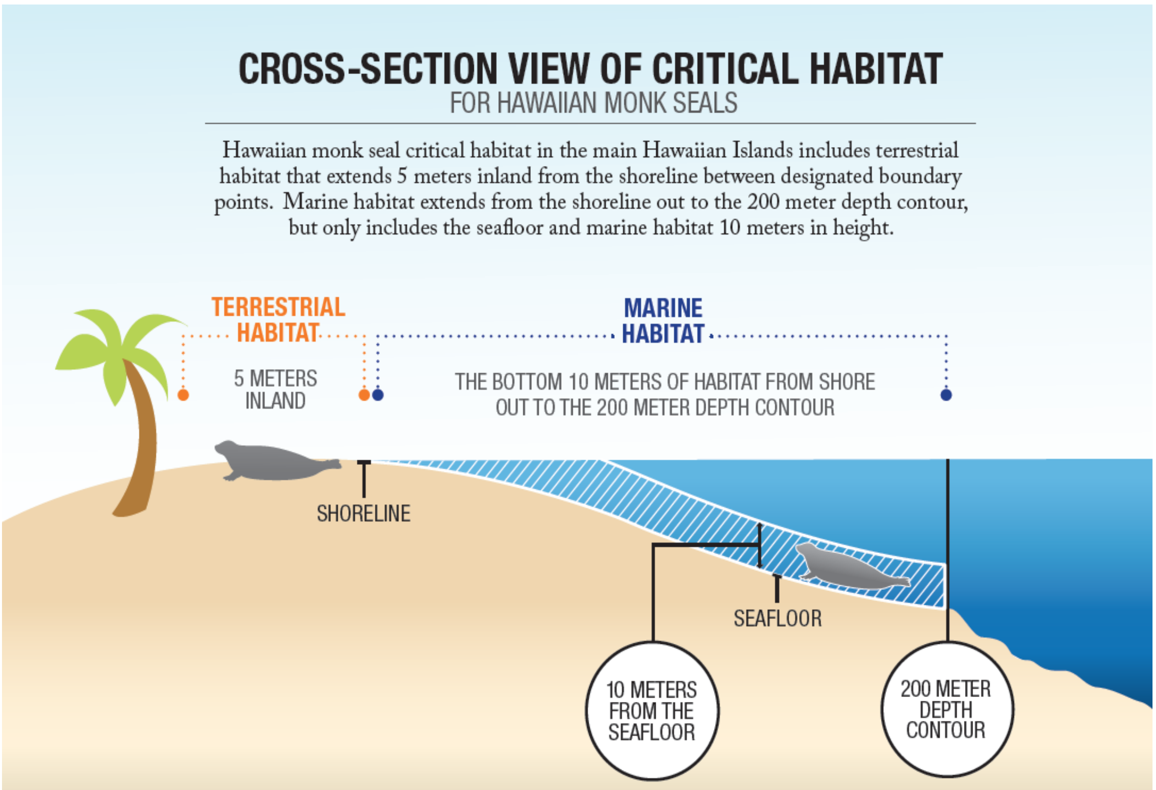
North Pacific right whales are found in temperate and sub-polar waters of the North Pacific Ocean. The species was originally listed with the North Atlantic right whale (i.e., "Northern" right whale) as endangered in 1970. The North Pacific right whale was listed separately as endangered on March 6, 2008 (73 FR 12024). Migratory patterns of North Pacific right whales are unknown, although it is thought they migrate from high-latitude feeding grounds in summer to more temperate waters during the winter (Muto *et al.* 2020). There have been two sightings in Hawaiian waters, one in 1996 and one in 1979 (Muto *et al.* 2020). Based on photo-identification from 1998 to 2013 it is estimated that the population of this stock is only 31 animals (Wade *et al*. 2011 as cited in Muto *et al.* 2020). The calculated PBR level for this stock is 0.05, which would be equivalent to one take every 20 years. Critical habitat has been designated in the Bering Sea and Gulf of Alaska for North Pacific right whales. There is no designated critical habitat for this species in the PIFSC research areas.

3.2.7 Hawaiian Monk Seal

Hawaiian monk seals occur throughout the MHIs and the NWHI, with subpopulations at French Frigate Shoals, Laysan Island, Lisianski Island, Pearl and Hermes Atoll, Midway Atoll, Kure Atoll, and Necker and Nihoa Islands (the southernmost islands in the NWHI), and Johnston Atoll (Carretta *et al.* 2021). They are endangered throughout their range and were listed under the ESA in 1976 (41 FR 51611). The current best estimate of the total population size is 1,437 with a PBR of 4.8 (Carretta *et al*. 2021). The population grew at an average rate of about 2% per year from 2013 to 2018 (Carretta *et al*. 2021).

Critical habitat around was originally designated In 1986 (51 FR 16047) and expanded in 1988 (53 FR 18988). On August 21, 2015 (80 FR 50925), a final rule was published in the Federal Register revising critical habitat for Hawaiian monk seals across the Hawaiian Archipelago. The revised boundaries include 16 occupied areas within the range of the species: ten areas in the NWHI and six in the MHI . These areas contain one or a combination of habitat types: preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas. Specific areas in the NWHI include all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and including marine habitat through the water's edge, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, out to the 200-m depth contour line around the following ten areas: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island. Specific areas in the MHI include marine habitat from the 200-m depth contour line, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, through the water's edge 5 m into the terrestrial environment from the shoreline (Figure 3-1) between identified boundary points on the islands of: Ka‘ula, Ni‘ihau, Kaua‘i, O‘ahu, Maui Nui (including Kaho‘olawe, Lāna‘i, Maui, and Moloka‘i), and Hawai‘i. In areas where critical habitat does not extend inland, the designation ends at a line that marks mean lower low water.

Certain areas within these general boundaries were excluded from designation because they were inaccessible, lacked natural areas to support seals, presented national security benefits for exclusion, or were managed under Integrated Natural Resource Management Plans (see 80 FR 50925). The final rule became effective September 21, 2015.



Source: PIFSC

FIGURE 3-1. CROSS-SECTION VIEW OF DESIGNATED CRITICAL HABITAT FOR HAWAIIAN MONK SEAL

3.3 ESA Listed Sea Turtles

Five species of sea turtles can be found within the area of the proposed PIFSC research activities: leatherback, Olive ridley, green, loggerhead, and hawksbill sea turtles. All of the sea turtles found in the area of the PIFSC research activities are listed as endangered or threatened.

3.3.1 Leatherback Sea Turtle

Leatherback sea turtles are globally distributed from approximately 71°N to 47° S Latitude and nest from 38°N to 34°S latitude (NMFS and USFWS 2013b). The leatherback sea turtle is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances that allow it to forage into the colder waters (NMFS and USFWS 1995). They can consume twice their own body weight in prey per day, feeding exclusively on soft-bodied invertebrates like jellyfish and tunicates. Sea nettle jellyfish and other species of the genus *Chrysaora* are preferred prey for leatherback sea turtles. The Pacific Ocean leatherback population is generally smaller in size than that in the Atlantic Ocean. In the Pacific, the IUCN notes that most leatherback nesting populations have declined more than 80 percent. In other areas of the leatherback's range, observed declines in nesting populations are not as severe, and some population trends are increasing or stable (Western Pacific Regional Fisheries Management Council [WPRFMC] 2009a).

Leatherback turtles forage widely in temperate pelagic waters, and only leave their pelagic lifestyle during the nesting season when gravid females return to tropical beaches to lay eggs. Males are rarely observed near nesting areas, and it has been proposed that mating most likely takes place outside of tropical waters, before females move to their nesting beaches (Eckert and Eckert 1988). Leatherbacks are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Eckert 1998). Leatherback may swim more than 10,000 km in a single year (Eckert 1998). There are no known nesting grounds at any of the PIFSC research areas.

Declines in the leatherback population have resulted from fishery interactions as well as exploitation of the eggs (Spotila *et al*. 1996). Eckert and Eckert (2005) and Spotila *et al*. (1996) reported that adult mortality has also increased substantially, particularly as a result of driftnet and longline fisheries. The sharp decline in leatherback populations has been attributed to the combination of the loss of long-lived adults in fishery related mortality, and the lack of recruitment, stemming from elimination of annual influxes of hatchlings because of egg harvesting. Leatherbacks are also susceptible to entanglement in lobster and crab pot gear (Zug and Parham 1996 as cited in WPRFMC 2009a).

3.3.1.1 Leatherback Sea Turtles in the HARA

Data from genetic research suggest that Pacific leatherback stock structure (natal origins) may vary by region. Due to the fact that leatherback turtles are highly migratory and that stocks mix in high-seas foraging areas, and based on genetic analyses of samples collected by both Hawai‘i-based and west-coast-based longline observers, leatherback turtles inhabiting the northern and central Pacific Ocean comprise individuals originating from nesting assemblages located south of the equator in the western Pacific (e.g., Indonesia, Solomon Islands) and in the eastern Pacific along the Americas (e.g., Mexico, Costa Rica; Dutton *et al*. 1999). Recent information on leatherbacks tagged off the west coast of the United States has also revealed an important migratory corridor from central California to south of the Hawaiian Islands, leading to western Pacific nesting beaches. Leatherback turtles originating from western Pacific beaches have also been found along the U.S. mainland (WPRFMC 2009a). They are regularly observed in offshore waters at the southeastern end of the Hawaiian archipelago (NMFS and USFWS 1998c).

3.3.1.2 Leatherback Sea Turtles in the MARA

There have been occasional sightings of leatherback turtles around Guam and in the pelagic waters of the CNMI (Eldredge 2003; NMFS and USFWS 1998c). During aerial surveys of Guam from 1989 to 1991, 2.6 percent of the observed sea turtles were leatherbacks (NMFS and USFWS 1998c). However, the extent that leatherback turtles are present around Guam and CNMI is unknown (WPRFMC 2009b).

3.3.1.3 Leatherback Sea Turtles in the ASARA

In 1993, the crew of an American Samoa government vessel engaged in experimental longline fishing, pulled up a small freshly dead leatherback turtle about 5.6 km south of Swains Island. This was the first leatherback turtle seen by the vessel's captain in 32 years of fishing in the waters of American Samoa (NMFS and USFWS 1998c). The nearest known leatherback nesting area to the Samoan archipelago is the Solomon Islands (Grant 1994).

3.3.1.4 Leatherback Sea Turtles in the WCPRA

There are no known reports of leatherback sea turtles in waters around the WCPRA, however, these waters are within the habitat, and migration routes, of leatherback turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the WCPRA.

3.3.2 Olive Ridley Sea Turtle

Olive ridley sea turtles migrate annually between pelagic foraging areas and coastal nesting areas. Trans-Pacific ships have observed olive ridley sea turtles over 4,000 km from shore. They are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian Oceans. In the Eastern Pacific, they occur from Southern California to Northern Chile. In the eastern Pacific, arribadas (massive synchronized nesting events) occur from June through December on certain beaches on the coasts of Mexico, Nicaragua, and Costa Rica and on a single beach in Panama (NOAA 2013). It is theorized that young olive ridley sea 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, similar to the juvenile loggerheads mentioned previously (WPRFMC 2009a).

Potential threats to olive ridley sea turtles include marine pollution, oil and gas exploration, lost and discarded fishing gear, changes in prey abundance and distribution due to commercial fishing, habitat alteration and destruction from fishing gear and practices, agricultural runoff, and sewage discharge (NMFS and USFWS 2007b).

Occurrences of olive ridley sea turtles in the HARA are rare, but sightings have increased in the last few decades (NMFS and USFWS 1998e). Olive ridley sea turtles have been incidentally caught in the western

Pacific longline fishery operating near the Hawaiian Islands (NMFS and USFWS 1995). More recently, Polovina *et al*. (2004) tracked 10 olive ridley sea turtles caught in the Hawai‘i-based longline fishery. The only known nesting ground in the U.S. was a single observed nesting on the island of Maui in the HARA (Balazs and Hau 1986 in NMFS and USFWS 1998e).

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

There are no known reports of olive ridley turtles in waters around the MARA (WPRFMC 2009e) or WCPRA. However, PRIA waters are within the habitat, and migration routes of olive ridley turtles and they may be present but unobserved due to the largely uninhabited nature of the PRIA (WPRFMC 2009d).

3.3.3 Green Sea Turtle

Green sea turtles are a circumglobal and highly migratory species, nesting and feeding in tropical and subtropical regions with a preference for water temperatures above 20°C (68°F) (WPRFMC 2009a). A comprehensive status review of the species was conducted and published as the ‘‘Status Review of the Green Turtle (*Chelonia mydas*) under the Endangered Species Act’’ (Seminoff *et al*. 2015). Based on the best scientific information presented in the status review, a final rule was published on March 23, 2015 (80 FR 15271) which removed the existing ESA listings, changing them to three endangered DPSs and eight threatened DPSs. PIFSC research areas are within three different DPSs: the Central North Pacific DPS in the HARA, the Central West Pacific DPS in the MARA, and the Central South Pacific DPS in the ASARA. There is no designated critical habitat or green turtles in the PIFSC research areas.

Mortality related to commercial fishing accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities such as dredging, pollution, and habitat destruction account for an unknown level of other mortality. Removal of green sea turtles has been recorded by sea sampling coverage in the pelagic driftnet, pelagic longline, sea scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries (WPRFMC 2009a).

3.3.3.1 Green Sea Turtles in the HARA

In the Pacific, the only major (> 2,000 nesting females) populations of green turtles occur in Australia and Malaysia. Smaller colonies occur in the insular Pacific islands of Polynesia, Micronesia, and Melanesia (Wetherall 1993) and on six small sand islands at French Frigate Shoals, a long atoll situated in the middle of the Hawaiian Archipelago (Balazs *et al*. 1994). Approximately 90-95 percent of the nesting and breeding activity in the HARA occurs at the French Frigate Shoals, and at least 50 percent of that nesting takes place on East Island. In October 2019, Hurricane Walaka washed away approximately 11 acres of East Island, resulting in losing approximately 19 percent of nests laid by green turtles that year. East Island is now effectively gone, leaving only Tern and Gin Islands for suitable nesting habitat in these shoals (https://www.fisheries.noaa.gov/feature-story/motherload-story-fertile-turtle-hawaiian-islands). Long-term monitoring studies suggest that there is strong island fidelity within the regional rookery. Low-level nesting also occurs at Laysan Island, Lisianski Island, and on Pearl and Hermes Atoll (NMFS and USFWS 1998a).

The nesting population of Hawaiian green turtles has gradually increased following the establishment of the ESA in 1973 (Balazs 1996; Balazs and Chaloupka 2004). Between 1973 and 1977, the mean annual nesting abundance of green sea turtles on East Island was 83 females. Nester abundance increased rapidly at this rookery during the early 1980s, leveled off during the early 1990s, and again increased rapidly during the late 1990s to the present. The most recent survey from 2002 to 2006 counted a mean annual nesting abundance of 400 females. This increase over the last 30 years corresponds to an approximate increase of 5.7 percent per year (NMFS and USFWS 2007a). This increase is likely attributed to increased female survivorship since the harvesting of turtles was prohibited in addition to the cessation of habitat damage at the nesting beaches since the early 1950s (Balazs and Chaloupka 2004). While the Hawaiian green sea turtle stock has exhibited a sustained increase in nesting females since its protection 25 years ago, there are still substantial threats to the survival of the population (e.g., rising sea levels and the subsequent loss of nesting habitat in the NWHI, disease, loss of shoreline in the MHI, and marine debris). A major gap would be created in the global range of the species if all turtles were lost from this vast geographic area (Seminoff *et al.* 2015).

3.3.3.2 Green Sea Turtles in the MARA

An estimated 1,000 to 2,000 green sea turtles forage in the MARA, including the islands of Rota, Tinian, and Saipan (NOAA 2005). For the Central West Pacific DPS, there are approximately 51 nesting sites and 6,518 nesting females (Seminoff *et al*. 2015). Nesting surveys for green sea turtles in Guam have been conducted since 1973 with the most consistent data collected since 1990. The annual number of nesting females on Guam from 1990 to 2001 fluctuated between 2 and 60 females (NMFS and USFWS 2007a). More recently, aerial surveys from 1994 to 2002 show a fairly constant nearshore abundance of 150 to 250 nesting females on Guam (Cummings 2002).

The green sea turtle is a traditional food of the native population and although harvesting them is illegal, divers have been known to take them at sea and others have been taken as nesting females (Seminoff *et al.* 2015). Turtle eggs are also harvested in the CNMI. Nesting beaches and seagrass beds on Tinian and Rota are in good condition but beaches and seagrass beds on Saipan have been impacted by hotels, golf courses and general tourist activities (WPRFMC 2009b).

3.3.3.3 Green Sea Turtles in the ASARA

The only confirmed nesting area within the ASARA is at Rose Atoll, with an estimated 25 to 35 nesting females (NMFS and USFWS 1998a). Green turtles leave Rose Atoll When they finish laying their eggs and migrate to their feeding grounds somewhere else in the South Pacific. After several years, the turtles will return to Rose Atoll to nest again. Every turtle returns to the same nesting and feeding areas throughout its life, but that does not necessarily imply that all turtles nesting at Rose Atoll will migrate to exactly the same feeding area (WPRFMC 2009c). A tagging study, conducted in the mid-1990s tracked eight tagged green sea turtles by satellite telemetry from their nesting sites at Rose Atoll to Fiji (Balazs *et al.* 1994).

3.3.3.4 Green Sea Turtles in the WCPRA

Green sea turtles are reported to nest at Palmyra and Jarvis Islands within the WCPRA. Resident green sea turtles inhabit the lagoon waters of Wake and Palmyra Atolls. Green turtles have also been observed around Howland Island, Baker Island, Kingman Reef, and Johnston Atoll but nesting at these areas is unknown.

Seawall construction at Johnston Atoll negates the potential for nesting (NMFS and USFWS 1998a). Beach erosion has been targeted as a problem at Palmyra Atoll, causing barriers to adult and hatchling turtle movements, and degrading nesting habitat (WPRFMC 2009d).

3.3.4 Loggerhead Sea Turtle

Loggerhead sea turtles (*Caretta caretta*) occur throughout the temperate and tropical regions of the Pacific, Atlantic, and Indian Oceans in a wide range of habitats. These include open-ocean, continental shelves, bays, lagoons, and estuaries (NMFS and USFWS 1998d). In the Pacific, loggerheads can be found throughout the tropical to temperate waters. However, their breeding grounds are restricted to a number of sites in the North Pacific and South Pacific (NMFS and USFWS 2009). Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz 1999; Witherington *et al*. 2006). Under certain conditions, they may also scavenge fish (NMFS and USFWS 1998d). As they age, loggerheads begin to move into shallower waters, where, as adults, they forage over a variety of benthic hard- and soft-bottom habitats (reviewed in Dodd 1988).

In September of 2011 NMFS and the USFWS determined that the loggerhead sea turtle is composed of nine DPS listed as threatened or endangered. In the Pacific Ocean (and within the PIFSC research areas) two were named: the North Pacific Ocean population and the South Pacific Ocean population; both are listed as endangered. As of yet there is no critical habitat associated with these DPS (76 FR 58868).

Loggerheads face threats on both nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead turtle populations worldwide is incidental capture in fishing gear, primarily in longlines and gillnets, but also in trawls, traps and pots, and dredges. The main anthropogenic threats impacting loggerhead nesting habitat include the destruction and modification of coastal habitats worldwide. Beachfront lighting, placement of erosion control structures and other barriers to nesting, vehicular and pedestrian traffic, sand extraction, beach erosion and pollution, beach sand placement, removal of non-native vegetation and planting of non-native vegetation all represent serious threats to loggerhead nesting habitat (NMFS and USFWS 2009).

In general, during the last 50 years, North Pacific loggerhead nesting populations have declined 50–90 percent (Kamezaki *et al*. 2003 as cited in WPRFMC 2009a). The occurrence of loggerhead sea turtles in the HARA is rare. There have only been four records of loggerhead sea turtles in the HARA; they most likely drifted or traveled to the area from Mexico to the east or Japan to the West (NMFS and USFWS 1998d).

There are no known reports of loggerhead turtles in waters around the MARA (WPRFMC 2009b) or ASARA (Tuatoʻo-Bartley *et al*. 1993). In addition, there are no known reports of loggerhead turtles in waters around the WCPRA, however, these waters are within the habitat, and migration routes, of loggerhead turtles and therefore they may be present but unobserved due to the largely uninhabited nature of the WCPRA.

3.3.5 Hawksbill Sea Turtle

Hawksbill sea turtles occur from approximately latitudes 30° N to 30° S within the Atlantic, Pacific, and Indian Oceans and associated bodies of water (NMFS and USFWS 1998b). They feed primarily on a wide variety of sponges but also consume bryozoans, coelenterates, and mollusks. Hawksbill turtles use different habitats at different stages of their life cycle, but are most commonly associated with healthy coral reefs (WPRFMC 2009a).

The oceanic stage of juvenile hawksbill sea turtles are believed to occupy the pelagic environment. In the Pacific, the pelagic habitat of hawksbill juveniles is unknown. After a few years in the pelagic zone, small juveniles recruit to coastal foraging grounds; their size at recruitment is approximately 15 inches (38 centimeters) in carapace length in the Pacific. This shift in habitat also involves a shift in feeding strategies, from feeding predominantly at the surface to feeding below the surface primarily on animals associated with coral reef environments. In the Indo-Pacific, hawksbills continue eating a varied diet that includes sponges, other invertebrates, and algae (NMFS 2013). After reproduction, some turtles remain close to their rookery and others are highly mobile, traveling hundreds to thousands of km between nesting and foraging areas (NMFS and USFWS 2013b).

Hawksbills face threats on both nesting beaches and in the marine environment with the primary global threat to hawksbills being the loss of coral reef communities. In the Pacific, directed harvest of nesting females and eggs on the beach and hawksbills in the water is still widespread. Directed mortality is a major threat to hawksbills in American Samoa, Guam, the Republic of Palau, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, and the Republic of the Marshall Islands (NMFS and USFWS 1998b). In addition to directed harvest, increased human presence is a threat to hawksbills throughout the Pacific. In particular, increased recreational and commercial use of nesting beaches, beach camping and fires, litter and other refuse, general harassment of turtles, and loss of nesting habitat from human activities negatively impact hawksbills. Incidental capture in fishing gear (primarily in gillnets and monofilament) and vessel strikes also adversely affect the species' recovery (NMFS 2013).

3.3.5.1 Hawksbill Sea Turtles in the HARA

Hawksbill turtles occur in waters around the Hawaiian Archipelago and nest on Maui and the southeast coast of the Big Island (WPRFMC 2009a). There are fewer than 20 annual nesting females in Hawaiʻi, a substantial drop from the historical abundance of this species (NMFS and USFWS 2013a). Most of these nesting sites are used consistently by nesting hawksbills and appear critical to species reproduction in Hawaiʻi.

The primary threats to the Hawaiian population of nesting hawksbill sea turtles are incompatible human activity, non-native egg and hatchling predators, habitat loss by invasive weeds, changes in beach conformation, volcanism, and tidal inundation resulting in nest overcrowding and/or damage to nests and injury to hatchlings (NMFS and USFWS 2013a).

3.3.5.2 Hawksbill Sea Turtles in the MARA

Approximately 5-10 annual nesting hawksbill females occur in the MARA (NMFS and USFWS 2013a). In 2009, four hawksbill nests and in 2010, three hawksbill nests were reported on the Island of Guam (Guam Division of Aquatic and Wildlife Resources [DAWR] 2011). The populations of hawksbill sea turtles in Guam are thought to be declining (NMFS and USFWS 2013a).

3.3.5.3 Hawksbill Sea Turtles in the ASARA

Fewer than 30 annual nesting females are reported in the ASARA (NMFS and USFWS 2013a). Between October 2011 and March 2012, a total of six hawksbill nests were documented on two beaches on the island of Ofu (Tagarino 2012). They are most commonly found at Tutuila Island and the Manu‘a Islands, and are also known to nest at Rose Atoll and Swains Island (Utzurrum 2002).

3.3.5.4 Hawksbill Sea Turtles in the WCPRA

There are no records of hawksbill turtles nesting in the WCPRA (NMFS and USFWS 2013a). However, the hawksbill sea turtle is regularly sighted in the waters of Palmyra Atoll and has been reported from Baker, Howland and Jarvis Islands (WPRFMC 2009d). The Recovery Plan indicates that waters around the WCPRA may provide marine feeding grounds for this species (NMFS and USFWS 1998b).

3.4 ESA-Listed Corals

NMFS published a final rule in September 2014 to list 20 species of corals as threatened under the ESA (79 FR 53852, 10 September 2014). Seven of the 20 ESA-listed coral species may occur within the PIFSC research areas as shown in Table 3-1.

TABLE 3-1. ESA THREATENED CORALS THAT MAY OCCUR IN PIFSC RESEARCH AREAS

Scientific Name	HARA	MARA	ASARA	WCPRA
Acropora globiceps	X	X	X	X
Acropora jacquelineae			X	
Acropora retusa			X	X
Acropora speciosa			X	X
Euphyllia paradivisa			X	
Isopora crateriformis			X	
Seriatopora aculeata		X		

On Nov. 27, 2020 NMFS proposed seventeen specific areas containing physical features essential to the conservation of these seven coral species in U.S. waters as critical habitat. The areas cover about 600 km^2 of marine habitat (85 FR 76262). On March 29, 2021, the public comment period on the proposed critical habitat designation for these corals was extended to May 26, 2021.

3.4.1 Acropora globiceps

Acropora globiceps colonies are small and compact, with the size and appearance of branches depending on the degree of exposure to wave action. This species is distributed from the oceanic west Pacific to the central Pacific as far east as the Pitcairn Islands. It occurs on upper reef slopes, reef flats, and adjacent habitats at depths from 0 to 8 m (NOAA 2014). This species has been observed in the NWHI (NMFS unpublished data). Based on results from Richards *et al*. (2008) and Veron (2014), the absolute abundance of this species is likely at least tens of millions of colonies.

3.4.2 Acropora jacquelineae

Acropora jacquelineae colonies consist of flat plates up to 1 m in diameter. This species is distributed mostly in the Coral Triangle area. There are also confirmed records in eastern Micronesia, and it has been identified by two coral scientists in American Samoa *Acropora jacquelineae* occurs on subtidal walls, ledges, and shallow reef slopes at depths from 10 to 35 meters (NOAA 2014). The total population size of *Acropora jacquelineae* is estimated at 31,599,000 colonies (Richards *et al*. 2008).

3.4.3 Acropora retusa

Acropora retusa is a species of coral found in U.S. waters in Guam, American Samoa, and the Pacific Remote Island Areas[1]. Colonies of *Acropora retusa* are made up of flat plates with short, thick finger-like branches. Branches look rough and spiky because radial corallites are variable in length. Colonies are typically brown or green in color. Based on results from Richards *et al*. (2008) and Veron (2014), the absolute abundance of this species is likely in the millions.

3.4.4 Acropora speciosa

Acropora speciosa colonies form thick cushions or bottlebrush branches with large and elongate axial corallites. This species is distributed from Indonesia to the Marshall Islands in the western and central Pacific Ocean. This species also occurs in the Maldives in the Indian Ocean and at least one site in French Polynesia. *Acropora speciosa* occurs on lower reef slopes and walls at depths from 12 to 30 meters. It is often associated with clear water and high Acropora diversity (NOAA 2014). The total population size of *Acropora speciosa* is estimated at 10,942,000 colonies (Richards *et al*. 2008).

3.4.5 Euphyllia paradivisa

Euphyllia paradivisa colonies consist of branching separate corallites. This species is distributed mostly in the Coral Triangle area, but is confirmed to occur in American Samoa. This species is found in environments protected by wave action on upper reef slopes, mid-slope terraces, and lagoons at depths of 2 to 25 meters (NOAA 2014). Based on results from Richards *et al.* (2008) and Veron (2014), the absolute abundance of this species is likely at least tens of millions of colonies.

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[1] From https://www.fisheries.noaa.gov/species/acropora-retusa-coral

3.4.6 Isopora crateriformis

Isopora crateriformis forms flattened solid encrusting plates that may reach over a meter in diameter. This species is distributed within the Coral Triangle area and some western Pacific waters, including New Caledonia, the Samoas, and the Marshall Islands. This species predominantly occurs in shallow, high-wave energy environments, including reef flats and lower reef crests, and upper reef slopes. *Isopora crateriformis* has also been reported from low tide to at least 12 meters in depth, and may occur in the mesophotic zone below 50 meters (NOAA 2014). Based on results from Richards *et al.* (2008) and Veron (2014), the absolute abundance of this species is likely at least millions of colonies.

3.4.7 Seriatopora aculeata

Seriatopora aculeata colonies have thick, short, tapered branches that are usually fused in clumps. This species is distributed mostly in the Coral Triangle area. It has not yet been reported from American Samoa and the PRIA, but is considered to occur in Guam and CNMI[2]. This species occurs in a wide range of habitats on the reef slope and back-reef, including upper reef slopes, mid-slope terraces, lower reef slopes, reef flats, and lagoons at depths of 3 to 40 m (NOAA 2014). Based on results from Richards *et al.* (2008) and Veron (2014), absolute abundance of *Seriatopora aculeata* is likely at least millions of colonies.

3.5 ESA-Listed Mollusk – Chambered Nautilus

NMFS received a petition on May 31, 2016 to list the chambered nautilus (*Nautilus pompilius*) as a threatened species. In response, NMFS initiated a status review (81 FR 58895) and on October 23, 2017, announced a 90-day finding and proposed rule to list chambered nautilus as threatened under the ESA (82 FR 48948). The final rule to list chambered nautilus was published on September 28, 2018 (83 FR 48976). The final rule also concluded critical habitat for the chambered nautilus is not determinable because data sufficient to perform the required analyses are lacking.

Chambered nautilus are found in coastal reef and deep-water habitats in the Indo-Pacific and considered an “extreme habitat specialist” given particular physiological constraints (82 FR 48948). The species is found in habitats with steep-sloped forereefs with sandy, silty or muddy bottoms at depths between 100 and 500 m (CITES 2016 as cited in 82 FR 48948). Global abundance of chambered nautilus is currently unknown given the lack of historical baseline population data. The harvest of coral reefs and destructive and unselective fishing practices off the coast of Philippines, Indonesian and Malaysia are considered a significant threat to this species (83 FR 48948). Other threats include pollution, sedimentation, ocean warming and acidification, and overutilization for commercial, recreational, scientific or educational purposes.

[2] https://media.fisheries.noaa.gov/dam-migration/seriatopora-aculeata-coral-report-508.pdf

4 EFFECTS OF THE PROPOSED ACTION

4.1 Definition of Terms

The following terms are used to describe the potential effects of PIFSC research activities on ESA-listed species within the Action Area.

- Direct Effects - Those immediate effects caused by the proposed action and occurring concurrently with the proposed action (e.g., loss of habitat for human use; increased noise during construction).
- Indirect Effects - Those effects for which the proposed action is an essential cause and which will result from the proposed action *later in time*, but which are still reasonably certain to occur (e.g., increased vessel traffic due to a new dock; increased erosion leading to loss of habitat). If an effect will occur whether or not the action takes place, the action is not an essential cause of the indirect effect;
- Cumulative Effects – The ESA[3] defines cumulative effects as "those effects of future State, city/county, or private activities that are reasonably certain to occur within the Action Area. Cumulative effects do not include future federal activities that are physically located within the Action Area of the particular federal action under consultation". This definition applies only to Section 7 analyses and should not be confused with the broader use of this term in the National Environmental Policy Act or other environmental laws; and
- Take – ESA Section 3(18) defines the term "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.
- Harass – in 2016 NMFS published an Interim Guidance on the ESA Term "Harass" (NMFS 2016). In the document, NMFS recognizes the benefit of providing this guidance to ensure nationwide consistency. For use on an interim basis, NMFS interprets harass in a manner similar to the USFWS regulatory definition for non-captive wildlife:
    - *Create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering*
    - NMFS interprets the phrase *significantly disrupt normal behavioral patterns* to mean a change in the animal's behavior (breeding, feeding, sheltering, resting, migrating, etc.) that could reasonably be expected, alone or in concert with other factors, to create or increase the risk of injury to an ESA-listed animal when added to the condition of the exposed animal before the disruption occurred.
- Harm - NMFS further interprets "harm" under the ESA to include significant habitat modification or degradation which " actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns" as described in the definition of 'harass' (50 CFR 222.102).
- No Effect – Pursuant to the ESA a "no-effect" determination means there would be no impacts, positive or negative, to listed or proposed resources. For purposes of this assessment, a 'no effect'

[3] 50 CFR §402.02

determination generally means that the resource would not be found within the Action Area or be exposed to the proposed activities described in the BA. If measurable effects are observed they would be negligible and considered discountable.

- May Effect, but is not likely to Adversely Affect – Pursuant to the ESA, a 'may affect, but is not likely to adversely affect' determination means that all effects from the proposed action are beneficial, insignificant, or discountable. For purposes of this assessment, 'may affect but is not likely to adversely affect' suggests that any potential effects are highly unlikely, would be of a short duration, would not have any adverse effects to the species or critical habitat, and would not be measurable.
- Destruction or Adverse Modification – Pursuant to the ESA, "Destruction or adverse modification" means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species. Significant habitat modification or degradation is also included in the definition of "harm" under the ESA (see above).

4.2 Effects on ESA-Listed Fish

4.2.1 Mechanisms for Effects on ESA-Listed Fish

Effects on ESA-listed fish species from PIFSC research activities could include:

- Direct mortality caused by fisheries research activities
- Indirect disturbance and changes in behavior due to sound sources from research activity
- Indirect effects due to contamination from discharges during research activity.

4.2.1.1 Direct Mortality

Fish are caught in a variety of gear types, some of which involve experimental tests of gears designed to reduce incidental catch of non-target species or protected species. The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. In comparison to commercial fisheries-related mortality, mortality due to research activities occurs in small areas, with less intense effort, and sampling is usually not repeated in the same area, in contrast to commercial fisheries that focus primarily on areas of fish concentrations.

4.2.1.2 Disturbance and Changes in Behavior Due to Sound Sources

Underwater sound is generated from numerous natural (biological and physical processes) and anthropogenic sources. Biological sounds include marine life (marine mammals, fish, snapping shrimp). Physical sounds in the Action Area include, but are not limited to, wind and wave activity, rain and cracking sea ice in nearshore waters. Examples of anthropogenic sound include, but are not limited to, vessel traffic, marine construction, and industrial activity (wind power installations, oil and gas exploration). Natural and anthropogenic sounds are present more or less everywhere in the ocean at any given time. Therefore, background sound in the ocean is commonly referred to as "ambient noise" (Discovery of Sound in the Sea [DOSITS] 2020).

Sound level is defined by the total acoustical energy being generated by known and unknown sources, and may be different in each region. In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can be an important component of total sound at frequencies above 500 hertz (Hz) and possibly down to 100 Hz during quiet times. Different species of fish and snapping shrimp are known to contribute significantly to ambient sound levels, as can marine mammals. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. In deep water, low-frequency ambient sound from 1-10 Hz mainly comprises turbulent pressure fluctuations from surface waves and the motion of water at the air-water interface. At these frequencies, sound levels depend only slightly on wind speed. Between 20-300 Hz, distant ships transiting dominates wind-related sounds. Above 300 Hz, the ambient sound level depends on weather conditions, with wind- and wave-related effects mostly dominating the soundscape. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

Physiological effects of noise on fish includes potential auditory distortion however, this type of effect has been associated with underwater sound sources not used during PIFSC surveys such as seismic air guns or pile driving (Lokkeborg *et al*. 2012). Schools of Atlantic mackerel have been shown to response to sound pressure levels 163.2 and 163.3 decibel (dB) peak-to-peak, respectively, approximately 50% of the time when exposed. When fish were aggregated into schools during daytime exposure, a response to sound was initiated whereas fish did not respond at night, particularly when fish schools were broken up and individual fish were dispersed (DOSITS 2020).

High frequency scientific echosounders such as the EK60 used during PIFSC research, are increasingly being used to measure top predator habitat and predator-prey relationships (Risch *et al.* 2017). Echosounders have variable source levels typically ranging between 185 dB to 230 dB re 1µPa at 1m. Most fish species do not hear in the frequencies used by echosounders, with the exception, of few species in the herring family which have been shown to respond to frequencies up to 200 kHz (DOSITS 2020). Changes in fish behavior due to sound may range from momentary awareness of the sound, to small movements, or escape responses. The degree of behavioral response would indicate how significant it may be on a particular fish species or individual and may not be biologically significant (DOSITS 2020).

Fishes with swim bladders are sensitive to particle motion due to pressure changes from underwater sounds (Normandeau 2012). Cartilaginous fish, such as sharks and rays, do not have swim bladders, so this impact would not apply to scalloped hammerheads, oceanic whitetips or giant manta rays, the only ESA-listed fish species that could be encountered during PIFSC research. Additionally, particle motion and associated impacts on fish are generally more of a concern for impulsive noise sources (i.e., pile driving), not continuous sources such as echosounders used in PIFSC research. Overall, disturbance and changes in fish behavior are expected to be short-term and not result in biologically significant changes to fish populations. Therefore, underwater sound generated by EK 60 echosounders ***may affect but is not likely to adversely affect*** ESA-listed fish in the Action Area.

Fish may also respond to approaching vessels by diving towards the seafloor or moving horizontally out of the vessel's path; however, the variable stimuli these fish may react to are not always clear (Popper *et al.* 2019). Kaplan and Mooney (2015) as cited in Popper *et al*. (2019) reported there may be some frequency overlap between vessel noise and what fish may hear, resulting in masking sounds vital to important biological functions such as feeding or territorial defense. Many studies on vessel noise and fish behavior cited in Popper *et al*. (2019) reported some evidence of changes in behavior. However, these studies were located in areas where vessel traffic was likely more frequent than where PIFSC surveys normally occur (i.e., in areas coinciding with regular recreational or commercial traffic). Kaplan *et al*. (2016) as cited in Popper *et al*. (2019) emphasized the need for both targeted and long-term acoustic monitoring studies to evaluate the potential for effects of noise on aquatic organisms, including fish.

4.2.1.3 Contamination from Discharges

Discharge from vessels, whether accidental or intentional, includes sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to fish exposed to the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (Department of Energy [DOE] 2008, NOAA 2010a).

All NOAA vessels and PIFSC vessels are subject to the regulations of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 (1973), as modified by the Protocol of 1978 (NOAA 2010b). In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and quickly contained.

Discharge of contaminants from PIFSC vessels is possible, but unlikely. If an accidental discharge does occur, it would be a rare event and the potential volume of material is likely to be small and localized. As the potential effects of discharges, regulations governing discharges and the likelihood of discharges are universal throughout the PIFSC research areas, therefore discharges ***may affect but are not likely to adversely affect*** any ESA-listed species.

4.2.2 Direct and Indirect Effects on ESA-Listed Fish and Designated Critical Habitats

4.2.2.1 Direct Mortality Due to Surveys

4.2.2.1.1 Scalloped Hammerhead Sharks

Only four scalloped hammerhead sharks have been caught by PIFSC to date, all of which belonged to the non ESA-listed Central Pacific DPS. All four of captured sharks were released alive with no obvious injury. The overall net effort of research using troll and longline would be reduced moving forward from 130 operations to 70 operations per year, further reducing the likelihood of catch of scalloped hammerhead sharks. In addition, no scalloped hammerhead sharks have been caught in PIFSC mid-water trawl surveys.

However, PIFSC is proposing to tag, track, and biologically sample scalloped hammerhead sharks that are caught as bycatch during commercial fishing operations in the western and central Pacific ocean. The research would assess post-release mortality rates and identify handling and dispatch methods that would improve survival rates for the species. Annually, approximately 50 scalloped hammerheads would be affixed with satellite tags and/or undergo tissue sampling for the next five years. PIFSC would direct the research and would conduct training fishery observers to tag, photograph, collect tissue samples and/or collect interaction data from scalloped hammerheads captured incidentally during fishing. While research tagging activities are not expected to result in mortality or serious injury, individuals would be exposed to stress resulting from handling, tagging, and tissue sampling post-capture. Therefore, PIFSC research tagging efforts on scalloped hammerheads incidentally caught in commercial fisheries ***is likely to adversely affect*** the listed Indo-West Pacific DPS. Critical habitat for scalloped hammerheads has not been designated.

4.2.2.1.2 Oceanic Whitetip Sharks

As reported in Benaka *et al*. (2019), based on 2014 data, fishery bycatch estimates were 10.94 M lbs. for the Hawai‘i Deep-Set Fishery, 604,251 lb for the Hawai‘i Shallow-Set Fishery and 752,135 lbs. for the American Samoa Deep-Set Fishery. Bycatch of oceanic whitetip sharks in commercial fisheries were rare based on the ratios of bycatch of this species in relation to the frequency of the catch (Benaka *et al*. 2019). Similar bycatch ratios were reported for 2015 (Benaka *et al*. 2019). Based on this information and considering the relatively low volume of research when compared to commercial fisheries, bycatch of oceanic whitetip sharks in PIFSC research is considered minor. In addition, no oceanic whitetip sharks have been caught in PIFSC mid-water trawl surveys.

PIFSC is proposing to tag or tissue sample oceanic whitetip sharks that are caught as bycatch in the MHI small-boat tuna fishery, as well as in the central and western Pacific commercial fisheries, to identify best practices when releasing sharks incidentally caught in these fisheries. The project would support research activities on the threatened oceanic whitetip shark to improve understanding of habitat use, movement behavior and fishery interaction rates. Up to 50 sharks (~ 30 from the MHI small boat tuna fishery and ~ 20 from commercial fisheries in the central and western Pacific) would be affixed with satellite tags or undergo tissue sampling per year for the next five years. All individuals involved with tagging efforts (fishers, fishery observers, and scientists) involved in the program would attend a training workshop and may be provided with materials such as tagging poles, electronic and identification tags, data cards and training documents. No additional oceanic whitetip sharks would be targeted beyond those incidentally caught in the fisheries as bycatch. The MHI tagging effort is currently undergoing formal ESA consultation, and a Biological Evaluation was prepared in 2020 (NMFS 2020). The same tagging methods would be used in all fisheries where oceanic whitetip sharks may be incidentally caught, and while research activities are not expected to result in mortality or serious injury, individuals will be exposed to some stress resulting from handling, tagging, and tissue sampling post-capture. Therefore, PIFSC tagging efforts on oceanic whitetip sharks incidentally caught during commercial fisheries ***is likely to adversely affect*** this ESA-listed species. Critical habitat for oceanic whitetip sharks has not been designated.

4.2.2.1.3 Giant Manta Rays

Demand for manta ray gills and other manta ray products parts in Asian markets is the most significant threat for this species. Available data reviewed by Oliver *et al*. (2015) as cited in Miller and Klimovich (2017), revealed that manta rays comprised the highest proportion of ray bycatch (specifically Giant manta rays) in purse seine fisheries in the Indian Ocean (especially the Eastern Pacific Ocean). Bycatch in longline, trawl or gillnet fisheries was not large in any ocean basin (Miller and Klimovich 2017). Bycatch of manta rays from fisheries operating primarily in the Central and Western Pacific Ocean, includes the U.S. tuna purse seine fisheries, Hawaii-based deep-set longline fisheries targeting tuna, and American Samoa pelagic longline fisheries. Considering the distribution and volume of PIFSC research is much lower than commercial fisheries, giant manta rays may be but are not are not likely to be caught incidentally during PIFSC surveys. In addition, no giant manta rays have been caught in PIFSC mid-water trawl surveys.

However, PIFSC is proposing to tag, track and biologically sample giant manta rays that are caught as bycatch during commercial fishing operations in the western and central Pacific ocean. The research would assess post-release mortality rates and identify handling and dispatch methods that would improve survival rates for the species. Annually, approximately 30 rays would be affixed with satellite tags and/or undergo tissue sampling for the next five years. PIFSC would direct the research and would conduct training fishery observers to tag, photograph, collect tissue samples and/or collect interaction data from giant manta rays captured incidentally during fishing. PIFSC prepared a Draft Biological Evaluation for this research project in 2021 (NMFS 2021). While research activities are not expected to result in mortality or serious injury, individuals will be exposed to some stress resulting from handling, tagging, and tissue sampling post-capture (NMFS 2021). Therefore, PIFSC research tagging efforts on giant manta rays incidentally caught in commercial fisheries ***is likely to adversely affect*** this ESA-listed species. Critical habitat for giant manta rays has not been designated.

4.2.2.2 Indirect Disturbance and Changes in Behavior due to Sound Sources

Fish disturbed due to acoustic sources may exhibit behavioral changes such as diving towards the seafloor or relocate from the area where vessels are approaching as a result of underwater sound or the presence of vessels. While these effects may occur due to PIFSC research, the low frequency of echosounders used during PIFSC surveys, as compared to regular shipping or commercial and recreational fishing, would not indicate that population-level effects due to behavioral changes are likely. The use of underwater equipment that may produce noise such as EK60 echosounders are not likely to cause biologically significant behavioral changes in fish given that most fish species have hearing ranges outside of the frequencies used by echosounders.

Overall, disturbance and changes in fish behavior are expected to be short-term and not result in biologically significant changes to fish populations. Therefore, underwater sound generated during PIFSC research will have ***no effect*** on ESA-listed sharks and rays in the PIFSC research areas.

4.2.2.3 Mitigation Measures

Mitigation measures for all protected species are summarized in Table 2-2. Specific handling procedures for giant manta rays are provided in Section 2.4.3.

4.3 Effects on ESA-Listed Marine Mammals

4.3.1 Mechanisms for Effects on ESA-Listed Marine Mammals

The potential effects of the fisheries and ecological research on marine mammals involve adverse interactions with research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment, including:

- Mortality/ Serious Injury (M/SI) due to ship strikes or collision or due to entanglement gear;
- Disturbance and behavioral responses due to acoustic equipment, close vessel approaches, and the physical presence of researchers;

- Changes in food availability due to research survey removal of prey and discards
- Contamination from discharges

Other unlikely, but potential effects of the activity, could include hearing impairment, masking, or non-auditory physiological effects, such as stress responses. However, PIFSC activities do not involve the use of devices such as explosives or mid-frequency active sonar that are associated with hearing impairment. Therefore, the likelihood of such an effect is very minimal. In addition, it is not expected that the anticipated effect of the activity on the species, populations or DPSs would include effects on marine mammals from ship collision or vessel strike due to the speed of the vessels relative to the speed of the animals and their ability to maneuver around the vessels (see Table 2-2 Mitigation Measures).

Future PIFSC research is evaluated in this BA using two factors, a comparison of potential take from fisheries research to the PBR of the species, population or DPS, and a comparison of the gear used in PIFSC fisheries research with the bycatch and adverse interactions of marine mammals in similar gear types used by commercial fisheries as characterized in the 'Categorization of Commercial Fisheries" and published in the List of Fisheries pursuant to the MMPA .

PBR is defined in the MMPA (16 U.S.C. § 1362(20)) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR is intended to serve as an upper limit guideline for fishery-related mortality for each species. Calculations of PBR are stock/DPS-specific and calculated as the product of the estimate of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the population stock or DPS (e.g., whether the stock is listed under the ESA or depleted under the MMPA). NMFS is required to calculate PBR (if possible) for each marine mammal stock under their jurisdiction and report PBR in annual marine mammal stock assessment reports (SARs) mandated by the MMPA. The PBR metric has been used extensively to assess anthropogenic effects on marine mammals in many situations involving M/SI. It is recognized as an acceptable metric used by NMFS OPR in the evaluation of incidental takes of marine mammals in U.S. waters.

As described in Section 4.2.1.3, contamination due to discharges from PIFSC research vessels ***may affect but is not likely to adversely affect*** ESA-listed marine mammals

4.3.1.1 Direct Mortality and Serious Injury (M/SI)

PIFSC research activities use a variety of gear that could accidentally take marine mammals by two mechanisms: 1) take by accidental entanglement or hooking that may cause M/SI; and 2) take by accidental entanglement or hooking that may cause non-serious injury. Other gears used in PIFSC fisheries research (e.g., a variety of plankton nets, CTDs, cameras, water samplers) do not have the potential for marine mammal interactions, and are not known to have been involved in any marine mammal interactions. Specifically, CTDs, plankton nets (Bongo nets), and vertically deployed or towed imaging systems are considered to be no-impact gear types. All take of ESA-listed species resulting in M/SI is considered an adverse effect.

4.3.1.2 Disturbance and Behavioral Responses Due to Acoustic Equipment

The potential sources of disturbance to marine mammals during PIFSC research activities are associated with the physical presence of human activities (i.e., vessels) and noise (i.e., underwater equipment such as echosounders). The proposed action does not include intentional approaches to marine mammals on sea or land. Any disturbance due to physical presence of humans or vessels would be incidental to research activities. Several mechanisms exist by which research activities could potentially disturb marine mammals and alter behavior, including the physical presence of human activities (i.e., vessels or field crews on land), fishing gear, underwater sound from engines, hydraulic gear, or acoustic devices (i.e., EK60) used for navigation and research.

Disturbance of an animal due to the physical presence of vessels or noise from underwater equipment does not automatically imply that harassment has occurred. There is recognition that minor and brief changes in behavior generally do not have biologically significant consequences for marine mammals and do not “rise to the level of taking” (National Research Council [NRC] 2005). Also, Southall *et al*. (2007) emphasized the need to distinguish minor, short-term changes in behavior with no lasting biological consequences from biologically significant effects on critical life functions such as growth, survival, and reproduction. The biological relevance of a behavioral response to noise exposure depends, at least in part, on how long the response persists. Southall *et al*. (2007) noted that “a reaction lasting less than 24 hours is not regarded as particularly severe unless it could directly affect survival or reproduction.”

Marine mammals rely on sound to obtain detailed information about their surroundings, communicate, navigate, reproduce, socialize and avoid predators. Thus, the surrounding soundscape is a key component of marine mammal acoustic habitat (Clark et al. 2009). Underwater sound comes from numerous natural sources (biological and physical processes) and anthropogenic sources. Biological sounds include marine life (marine mammals, fish, snapping shrimp). Physical sounds include wind and wave activity, rain, cracking sea ice, undersea earthquakes and volcano eruptions. Anthropogenic sound includes shipping and other vessel traffic, marine construction, oil and gas exploration and more. Some of these natural and anthropogenic sounds are present more or less everywhere in the ocean all of the time. Therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2020). Sound levels at a given frequency and location can vary by 10-20 dB day to day (Richardson *et al.* 1995). The result is that, depending on the source type and its intensity, sound from a specified activity may be a negligible addition to the local soundscape, or could form a distinctive signal that may affect marine mammals.

The effects of anthropogenic noise on marine mammals have been summarized in numerous articles and reports (Richardson *et al*. 1995, NRC 2005, Southall *et al*. 2007, Southall *et al.* 2019. Marine mammals use hearing and sound transmission to perform vital life functions. The distance to which anthropogenic sounds are audible depends on the level of ambient noise, anthropogenic sound source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the marine mammal (Richardson *et al.* 1995). Marine mammals exposed to high intensity sound repeatedly or for prolonged periods could experience hearing threshold shift, resulting in the loss of hearing sensitivity at certain frequency ranges (Kastak *et al*. 1999, Schlundt *et al.* 2000, Finneran *et al*. 2002, Finneran *et. al* 2005). Threshold shift results in permanent threshold shift (PTS), where loss of hearing sensitivity is unrecoverable, or temporary threshold shift (TTS), in which case an animal may recover hearing sensitivity over time (Southall *et al.* 2007).

In 2019, Southall *et al.* (2019) published an update to the 2007 Marine Mammal Noise Exposure Criteria, proposing eight discrete hearing groups including: 1) low frequency cetaceans; 2) high frequency cetaceans; 3) very high frequency cetaceans; 4) sirenians; 5) phocid carnivores in water; 6) phocid carnivores in air; 7) other marine carnivores in water; and 8) other marine carnivores in air (Southall, Finneran et al. 2019). While Southall *et al*. (2019) consider more recent studies to better understand marine mammal hearing, the 2018 revised *NMFS Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* continues to be referenced to define regulatory thresholds for calculating incidental takes of marine mammals under the MMPA. For this reason, thresholds used in this assessment are based on the 2018 revised NMFS guidance (NMFS 2018).

The *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (NMFS 2018) references marine mammal hearing groups, as defined by Southall *et al*. (2007). The groups and generalized hearing ranges are shown in Table 4-1. Also shown are marine mammals found in PIFSC research areas which fall into the following categories: low-frequency cetaceans; mid frequency cetaceans; high frequency cetaceans; phocids; and otariids. NMFS (2018) considered acoustic thresholds by hearing group to acknowledge that not all marine mammals have identical hearing ability or identical susceptibility to noise or noise-induced PTS. NMFS (2018) also used the hearing groups to establish marine mammal auditory weighting functions (Table 4-2). Acoustic threshold for Level A injury are shown in Table 4-3.

The 2018 NMFS revised guidance NMFS (2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). However, given the highly directional, e.g., narrow beam widths of acoustic equipment, NMFS does not anticipate animals would be exposed to noise levels resulting in injury.

TABLE 4-1. GENERALIZED HEARING RANGES FOR MARINE MAMMAL HEARING GROUPS IN WATER

Hearing Group	Hearing Range
Low-frequency cetaceans (e.g. baleen whales)	7 Hz to 35kHz
Mid-frequency cetaceans (e.g. sperm whales)	150 Hz to 160 kHz
High-frequency cetaceans (e.g. dolphins)	275 Hz to 160 kHz
Phocid pinnipeds	50 Hz to 86 kHz
Otariids and other non-phocid marine carnivores	60 Hz to 39 kHz

Source: NMFS (2018)

TABLE 4-2. SUMMARY OF WEIGHTING AND EXPOSURE FUNCTION PARAMETERS

Hearing Group	*a*	*b*	f_1 *(kHz)*	f_2 *(kHz)*	*K (dB)*
Low-frequency cetaceans	1.0	2	0.20	19	0.13
Mid-frequency cetaceans	1.6	2	8.8	110	1.20
High-frequency cetaceans	1.8	2	12	140	1.36
Phocids in water	1.0	2	1.9	30	0.75
Otariids in water	2.0	2	0.94	25	0.64

Source: (NMFS 2018)

TABLE 4-3. ACOUSTIC THRESHOLDS FOR LEVEL A INJURY

	PTS Onset Acoustic Thresholds (Received Level)		
	Impulsive Sources		Non-impulsive Sources
Hearing Group	Peak, L_{pk}, flat *(dB re 1 µPa)*	Cumulative weighted sound Exposure Level $(SEL)_{24}$ *(dB re 1 µPa²·s)*	Cumulative weighted SEL_{24h} *(dB re 1 µPa²·s)*
Low-frequency cetaceans	219	183	199
Mid-frequency cetaceans	230	185	198
High-frequency cetaceans	202	155	173
Phocid pinnipeds in water	218	185	201
Otariid pinnipeds in water	232	203	219

Source: NMFS (2018)
Notes: Peak sound pressure is "flat" or unweighted. Cumulative sound exposure level has a reference value of 1µPa2s. Cumulative levels should be appropriately weighted for the hearing group for assessment to the threshold.

Animals exposed to natural or anthropogenic sound may experience physical and behavioral effects, ranging in magnitude from none to severe (Southall *et al*. 2007). Watkins (1986; as reported in NRC 2003) suggests that contextual factors influence whether or not a marine mammal becomes habituated to a particular disturbance or stimuli. For example, animals may tolerate a stimulus they might otherwise avoid if the benefits in terms of feeding, mating, migrating to traditional habitat, or other factors outweigh the negative aspects of the stimulus. Conversely an animal may suffer impacts if they remain in areas with high sound levels as they lose their hearing.

As described in NMFS (2016) NMFS interprets the term harass as to…*Create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering*. Further, the annoyance must be of such extent as to *significantly disrupt normal behavior patterns* to establish a likelihood of injury. NMFS interprets the phrase *significantly disrupt normal behavioral patterns* to mean a change in the animal's behavior (breeding, feeding, sheltering, resting, migrating, etc.) that could reasonably be expected, alone or in concert with other factors, to create or increase the risk of injury. Harassment does not require that an injury actually result or is proven; only that the behavioral response creates or increases the likelihood of injury.

The active acoustic source (EK60 echo sounder) used in the surveys is likely to be inaudible to low frequency cetaceans (LFC) such as baleen whales because the relatively high frequency of the echosounder (38kHz) is outside of their hearing range (see Table 4-1). Therefore, receipt of the signal would be highly unlikely to result in any reaction considered to be harassment as defined in NMFS (2016) for ESA-listed baleen whales such as North Atlantic right, blue fin and sei whales.

The active acoustic source used in PIFSC surveys is more likely to be detected by mid-frequency cetaceans (MFC) such as sperm whales (see Table 4-1). Therefore, there is potential for temporary effects to hearing for odontocete cetaceans, but most effects would likely be limited to temporary behavioral disturbance. Effects on odontocete individuals that are taken by Level B harassment would likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring), reactions that are considered to be of low severity (e.g., Southall *et al.* 2007). There is the potential for behavioral reactions of greater severity, including displacement, but because of the directional nature of the sources considered here and because the source is itself moving, these outcomes are unlikely and would be of short duration if they did occur.

4.3.1.3 Changes in Food Availability Due to Research Survey Removals

Prey of marine mammals varies by species, season, and location and, for some marine mammals, is not well documented. There is some overlap in prey of marine mammals in the Pacific Islands Regions and the species sampled and removed during PIFSC fisheries and ecosystem research surveys although removals of species commonly eaten by marine mammals are relatively low.

Prey of sei whales and blue whales are primarily zooplankton, which are sampled in minute quantities by PIFSC fisheries research, so the likelihood of research activities changing prey availability is negligible. There may be some minor overlap with sperm whale prey (squid), but this is expected to be nil due to the very small amounts of squid removed through fisheries and ecosystem research (i.e., hundreds of lbs.). There may be some minor overlap with monk seal prey and the RAMP Survey and Insular Fish Abundance Estimation Comparison Survey removals of a variety of reef fishes. For example, in the main Hawaiian Islands, the majority of coral reef fish sampling is at the periphery of monk seal foraging habitat and is a tiny fraction of what is taken by monk seals or by apex predatory fish or non-commercial fisheries (Sprague *et al*. 2013, Kobayashi and Kawamoto 1995). In the case of false killer whale consumption of tunas, mahi, and ono, there may be some negligible overlap with research removals.

4.3.2 Direct and Indirect Effects on ESA-Listed Marine Mammals and Designated Critical Habitat

4.3.2.1 Direct Mortality or Injury Due to Surveys

4.3.2.1.1 Sperm Whales

There have been no entanglements or takes of ESA-listed marine mammals in PIFSC fisheries research from NOAA vessels or NOAA chartered vessels. Given the history of no takes and mitigation measures in place to minimize potential interactions with marine mammals (see Section 2.2.), including the use of monitoring and the move-on rule for longline research, PIFSC considers the risk of M/SI takes of sperm whales in research gear to be low. However, to be precautionary, PIFSC is requesting one MMPA Level A take over the five year authorization period. Therefore, PIFSC fisheries research ***is likely to adversely affect*** EAS-listed sperm whales.

4.3.2.1.2 All other ESA-Listed Cetaceans

False killer whales (MHI Insular DPS), and blue, fin, sei, and North Pacific right whales are not expected to interact with any PIFSC research gear and direct mortality of these due to surveys is not expected. However, because these species do rarely occur in areas where PIFSC research occurs, the research ***may affect but is not likely to adversely affect*** these species through M/SI takes.

4.3.2.1.3 Hawaiian Monk Seals

There is evidence that Hawaiian monk seals occasionally pursue fish caught on various hook-and-line gears (depredation of fishing lines) deployed in commercial and non-commercial fisheries across Hawaiʻi (Nitta and Henderson 1993). Although there are some similarities between the shoreline fishery and the bottomfishing gear used by PIFSC (e.g., circle hooks), the general size and the way the hooks are rigged (e.g., baits, leaders, weights, tackle) are typically different and probably present different risks of incidental hooking to monk seals. PIFSC research with bottomfishing gear uses pieces of fish for bait that attract bottomfish but not monk seals. The risk of monk seals getting hooked on bottomfishing gear used in PIFSC research is therefore less than the risk of getting hooked on shoreline hook-and-line gears which are identified in the marine mammal stock assessment report (Caretta *et a*l. 2015).

Given the mitigation measures described in Section 2.2, PIFSC has concluded that the risk of monk seal interactions with its research bottomfishing gear is not high enough to warrant an incidental take request for that gear. PIFSC intends to document potential depredation of its bottomfish research gear (catch loss) in the future, and increase monitoring efforts when catch loss becomes apparent, in an effort to better understand the potential risks of hooking to monk seals and other marine mammals. PIFSC research will have ***no effect*** on Hawaiian monk seals through M/SI takes.

4.3.2.2 Indirect Disturbance and Changes in Behavior Due to Sound Sources

4.3.2.2.1 Blue, Fin, Sei, and North Pacific Right Whales

The output frequencies of Category 1 active acoustic sources used by PIFSC (short range echosounders, ADCPs) are >300 kHz and are generally short duration signals with high signal directivity. The functional hearing range of baleen whales is 7 Hz-22 kHz, with highest sensitivity generally below 10 kHz, which is well below the frequency range of Category 1 sources, so they are less likely to be detected by blue, fin, sei, or North Pacific right whales. Category 2 active acoustic sources used by PIFSC (various single, dual, and multi-beam echosounder devices used to determine trawl net orientation and several current profilers) have predominant frequencies of 38-200 kHz that are of short duration and are usually highly directional. These are unlikely to be heard by most baleen whales. Due to the lack of overlap in their hearing range with operating frequencies of PIFSC acoustic sources, there would be ***no effect*** of these sources on blue, fin, sei, and North Pacific right whales.

4.3.2.2.2 Sperm and False Killer Whales

Sperm and false killer whales are in the mid-frequency hearing group with a range of 150 Hz-160 kHz, with highest sensitivity from 10-120 kHz. Category 1 sources are outside of their hearing range, but Category 2 sources are within the range of hearing for sperm and false killer whales. PIFSC estimates that 218 false killer whales from the MHI insular DPS and 1018 sperm whales from the Hawaiʻi stock would be exposed to sound levels at or above the Level B threshold over the 5-year period of 2021-2026. The potential effects from the use of active acoustic devices during research activities would be small in magnitude, short-term in duration, and dispersed over a wide geographic area. Therefore, PIFSC research ***may affect, but is not likely to adversely affect*** sperm and false killer whales though acoustic disturbance.

4.3.2.2.3 Hawaiian Monk Seals

The functional underwater hearing range of pinnipeds is 75 Hz-75 kHz, with highest sensitivity from 1-30 kHz. The functional hearing range of monk seals is below the output frequency of Category 1 acoustic sources. Most Category 2 acoustic sources are also not likely to be audible to most pinnipeds. If detected, short term avoidance is the most likely response. PIFSC estimates that 79 monk seals would be exposed to sound levels at or above the Level B threshold over the 5-year period of 2021-2026. As described above the disturbance would be short-term and small in magnitude. Therefore, PIFSC research ***may affect, but is not likely to adversely affect*** Hawaiian monk seals though acoustic disturbance.

4.3.2.3 Indirect Disturbance and Changes in Behavior due to Proximity of Researchers

Hawaiian monk seals could be disturbed in the HARA due to the physical presence of researchers near haulouts used by Hawaiian monk seals (sandy beaches, rocky outcroppings, exposed reefs). During the RAMP coral reef monitoring surveys, PIFSC research involves nearshore diving, small boat work, and shallow water sampling. There are numerous locations where Hawaiian monk seals may be resting adjacent to vegetation, or just emerging from the water onto the beach, and would not be immediately visible and where the options for alternate passage may be limited. It is essentially impossible for researchers to completely avoid disturbing monk seals as they travel around to conduct research. Given that only about one-third of the population is onshore at any particular time (Parrish *et al*. 2000) and that researchers generally do not approach any particular beach more than once per year, PIFSC conservatively estimates that no more than one-third of the Hawaiian monk seal population (1,437 animals) might be approached per year (~500 animals). Researchers would minimize interaction and disturbance would be expected to be short term. Therefore, PIFSC research ***may affect, but is not likely to adversely affect*** Hawaiian Monk seals though physical disturbance.

4.3.2.4 Indirect Effects Due to Changes in Food Availability

The removal by PIFSC fisheries and ecosystem research, regardless of season and location, is minor relative to that taken through commercial fisheries. For example, commercial fisheries catches for most pelagic species range from the hundreds to thousands of metric tons, whereas the catch in similar fisheries and ecosystem research activities typically range from the hundreds to thousands of lbs. in any particular year. PIFSC fisheries research removals of marine mammal prey are minor in magnitude, highly localized, temporary in effect, and would have ***no effect*** on unlikely to affect the availability of prey to ESA-listed marine mammals.

4.3.2.5 Effects on Designated Critical Habitat for ESA-listed Marine Mammals

Designated critical habitat for false killer whales and Hawaiian monk seals is present in PIFSC research areas. Because the research will not affect water quality (see Section 4.2.1.3), or beach geomorphology important for monk seals, critical habitat for these species would not be affected. In addition, PIFSC research is not expected to affect the availability of prey items for marine mammals. Therefore PIFSC research is ***not likely to destroy or adversely modify critical habitat*** designated for false killer whales or Hawaiian monk seals. There is no designated critical habitat for North Pacific right whales in PIFSC research areas and critical habitat has not been designated for blue, fin, and sei whales.

4.4 Effects on ESA-Listed Sea Turtles

4.4.1 Mechanisms of Effects on ESA-Listed Sea Turtles

Direct and indirect effects of PIFSC research activities on sea turtles may include:

- Disturbances and changes in sea turtle behavior due to physical presence and sound sources
- Injury or mortality due to ship or small boat strikes and gear interactions
- Changes in food availability due to survey removal of prey
- Contamination or degradation of sea turtle habitat.

There is a potential for research activities to negatively affect or disturb sea turtles and cause changes in behavior. Such effects could result from the physical presence of marine vessels and fishing gear, operational sounds from engines and hydraulic equipment, and active acoustic devices used for navigation and research. The two main mechanisms for research activities to cause injury or mortality to sea turtles are ship or small boat strikes and entanglement in fishing gear. Sea turtles come to the surface to breathe, and also to rest, making them susceptible to ship strikes. Potential mechanisms for sea turtle interactions with longline gear and mid-water trawls include entanglement in lines and being caught by hooks as a result of depredation by sea turtles on the bait or caught fish. These types of adverse interactions could potentially result in serious injuries or mortalities to sea turtles. Loggerhead and leatherback sea turtles have been identified as being at particular risk of population decline as a result of incidental take by longline pelagic fisheries (Lewison *et al*. 2004). See Table 2-3 for mitigation measures to reduce the potential for entanglement in midwater trawl gear. As described in Section 4.4.2.1, there have been no reported incidents of sea turtles being entangled in PIFSC research gear.

PIFSC research activities have the potential to remove small amounts of prey and forage species. As described in Section 4.2.1.3, contamination of habitat due to discharges from PIFSC research vessels is unlikely. As described in Section 4.2.1.3, contamination due to discharges from PIFSC research vessels ***may affect but is not likely to adversely affect*** ESA-listed sea turtles.

4.4.2 Direct and Indirect Effects on ESA-Listed Sea Turtles and Designated Critical Habitat

On December 14, 2016, PIFSC initiated informal consultation with the USFWS regarding potential effects of proposed research on ESA-listed sea turtles. The USFWS concurred with PIFSC in a response letter dated February 21, 2017 that proposed research is ***not likely to adversely affect*** the ESA-listed turtle species discussed herein (Consultation No. 01EPIF00-2017-1-0073).

4.4.2.1 Direct Mortality Due to Surveys

There have been no reported incidents of sea turtles being struck by NMFS research vessels in the HARA, MARA, ASARA, or WCPRA research areas. During nearshore small boat activities there is potential for accidentally striking a sea turtle. Green and hawksbill sea turtles generally forage close to shore around the shallow fringing reefs of the PIR. When sea turtles swim to the surface to breathe, it can be difficult to spot them, especially if the sea surface is choppy. Given the relatively slow speeds of research vessels, the presence of dedicated marine species observers during survey activities, and the relatively low density of research activities dispersed over wide areas in the HARA, MARA, ASARA, and WCPRA, collisions with sea turtles are unlikely to result from the research activities. Because the possibility of ship strikes is low, PIFSC research ***may affect but is not likely to adversely affect*** sea turtles.

There are no reported incidents of sea turtle entanglement in gear during PIFSC fisheries and ecosystem research activities conducted in the HARA, MARA, ASARA, or WCPRA. Based on the lack of previous sea turtle interactions with fisheries and ecosystem research equipment in the PIFSC research areas, and the fact that moving forward several surveys employing longline gear will be discontinued. It is not anticipated that any sea turtles would be captured during the proposed research. There would be ***no effect*** on listed sea turtles due to entanglement in gear.

4.4.2.2 Indirect Disturbance and Changes in Behavior Due to Sound Sources

Little is known about hearing in sea turtles, but the available information suggests that their underwater hearing capabilities are quite limited both in functional hearing bandwidth and in absolute hearing sensitivity. Electrophysiological studies on the acoustic sensitivity of the green sea turtle (*Chelonia mydas*) and loggerhead sea turtle (*Caretta caretta*) using auditory brainstem response techniques determined that the effective range of hearing of these species is within low frequencies (100 to 500 Hz) (Bartol and Ketten 2003). Additional data suggest that sea turtles probably have functional hearing sensitivity between about 100 Hz and 1.2 kHz (Ketten and Bartol 2005, Dow Piniak *et al.* 2012), which is well below the frequencies of active acoustic instruments used for PIFSC fisheries and ecosystem research. Active acoustic instruments used by PIFSC for fisheries and ecosystem research generally operate at frequencies in the 18 – 200 kHz range, and the sounds generated by PIFSC active acoustic instruments are unlikely to be audible to sea turtles and therefore unlikely to have adverse effects on sea turtles. Based on the auditory capabilities of sea turtles, active acoustic sources used in PIFSC fisheries research operations are unlikely to be audible to sea turtles and therefore would have ***no effect*** on sea turtles due to disturbance from sound sources used by PIFSC.

4.4.2.3 Indirect Effects due to Changes in Food Availability

PIFSC proposed fisheries and ecosystem research activities are unlikely to have substantial effects on the availability of prey and forage species for sea turtles in the HARA, MARA, ASARA, and WCPRA research areas due to the relatively low spatial density of research activities within the research areas, and the small amounts of prey removed as a result of research. Western Pacific leatherback turtles (*Dermochelys coriacea*) forage seasonally on dense aggregations of jellyfish off the west coast of the United States (Graham 2009). All life stages consume gelatinous organisms such as jellyfish and tunicates (USFWS Biological Technical Publication, BTP-R4015-2012). Several species of jellyfish are frequently caught as a result of PIFSC fisheries research activities, however, due to the extremely high densities of jellyfish encountered in leatherback foraging areas and the small amounts of biomass removed by PIFSC fisheries and ecosystem research activities, the removal of jellyfish as a result of PIFSC research would have negligible effects on the availability of jellyfish as a food source for leatherback sea turtles. Likewise, disturbance or removal of small amounts of marine plants and grasses by PIFSC research activities are unlikely to have any measurable effects on forage availability for Hawaiian green sea turtles (*Chelonia mydas*), which are known to feed on sea grasses and seaweeds (McDermid *et al*. 2015). Therefore, PIFSC research activities would have ***no effect*** on food availability for sea turtles.

4.4.2.4 Effects on Designated Critical Habitat for ESA-listed Sea Turtles

Although critical habitat has been designated for leatherback, loggerhead, green and hawksbill turtles, it does not overlap with PIFSC research activities. Therefore there will be ***no effect*** on sea turtle critical habitat.

4.5 Effects on ESA-Listed Invertebrates (Corals and Nautilus)

4.5.1 Mechanisms of Effects on ESA-Listed Invertebrates

The potential effects of research vessels, survey gear, and other associated equipment on ESA-listed invertebrates include:

- Physical damage
- Directed take of coral specimens
- Mortality from Fisheries Research Activities
- Changes in species composition
- Contamination or degradation of habitat

4.5.2 Direct and Indirect Effects on ESA-Listed Invertebrates and Designated Critical Habitat

4.5.2.1 Physical Damage to Coral

Physical damage to corals may occur during numerous PIFSC surveys through SCUBA operations, water sampling instruments, deployment of stationary bottom-contact gear, hook-and-line bottomfishing, marine debris removal, collection of coral samples, and coral coring. Fishing gear that contacts the seafloor can disturb corals by crushing them, burying them, removing them, or exposing them to predators, and thus can reduce complexity and species diversity (Collie *et al.* 2000, Morgan and Chuenpagdee 2003). For all of these gear types, physical disturbance is limited to the point of anchorage or footprint of the gear. Chambered nautilus live in the water column instead of in contact with the sea floor or reef surface[4] so would not be expected to be affected by research activities that contact the seafloor.

SCUBA operations related to surveys could potentially result in accidental contact between divers (fins or other diver gear) and ESA-listed coral species. However, the use of highly qualified divers, extensive dive training, and adherence to best practices designed to minimize unnecessary contact with live reef, diminish the likelihood of any potential incidental effects to coral.

Research fishing gear and instruments tethered to the surface can also accidentally be lost during surveys if it snags on the bottom and the line breaks. This gear (e.g., monofilament line, braided polypropylene line) can later end up getting caught on the fringing reefs that surround most of the islands. Once derelict fishing gear is caught on a reef, it begins a damaging cycle of: snagging coral colonies, dislodging pieces of coral heads during wave action, breaking free, and snagging a different part of the reef (Donohue *et al.* 2001, PIFSC 2010). The extent of adverse direct and indirect impacts will vary with the type and size of the derelict fishing gear. PIFSC does not use the most damaging types of gear (e.g., gill nets, bottom trawl nets).

During the Marine Debris Research and Removal Surveys, derelict fishing gear is cut, pulled, or both, off coral colonies. The removal activities are designed to mitigate long-term adverse impacts to coral colonies. However, during removal activities, there are short-term and temporary adverse impacts when derelict fishing gear is removed. The impacts include breaking off of pieces of coral that are sometimes impossibly entangled in nets and line, and then removing them from the marine ecosystem. The long-term beneficial impact of removing derelict fishing gear from the marine ecosystem is to provide the space and light necessary for the coral colonies to grow and avoid entangling other marine species in the future.

In conclusion, PIFSC research activities ***may affect but are not likely to adversely affect*** populations of ESA-listed invertebrates due to physical damage from gear and sampling.

4.5.2.2 Directed take of Coral Specimens

The RAMP Survey collects up to 500 samples per year of corals (including ESA-listed species), coral products, algae and algal products, and sessile invertebrates. The fewest samples needed are collected for characterization of disease and confirmation of identity. The total number cited (i.e. 500) is the maximum of all disease/invasion/ID/ESA collections. Large numbers of ESA-taxa are not proposed to be sampled, but are required to confirm a suspected ESA sighting. The smallest possible fragments of corals are collected by gloved hands or by using small tools that are cleaned between each use. Each sample is intended to act as a skeletal and genomic voucher, and typically consist of 2 cm by 2 cm pieces. This size is large enough to determine and record skeletal features. Table 2-2 describes mitigation measures for sampling all coral species during the RAMP study. The Deep Coral and Sponge Research study does not collect ESA-listed corals.

NMFS has conducted section 7 consultations related to the PIFSC RAMP Survey in the ASARA and WCPRA and issued a Biological Opinion (BiOp) on the effects of these surveys on ESA-listed corals (NMFS 2015). The BiOp concluded that directed take and voucher specimens of *Acropora jacquelineae*,

[4] https://oceana.org/marine-life/cephalopods-crustaceans-other-shellfish/chambered-nautilus

Acropora retusa, Acropora rudis, Acropora speciosa, Euphyllia paradivisa, Isopora crateriformis, and *Pavona diffluens* as part of the RAMP Survey in the ASARA and WCPRA is not likely to jeopardize the continued existence of any of these species. While this BiOp was only for RAMP surveys specifically within the ASARA and WCPRA, PIFSC will reinitiate consultations as necessary for any future research cruises in other research areas where protected corals occur (e.g. MARA). Removal of corals during the RAMP surveys ***is likely to adversely affect*** these ESA-listed corals.

4.5.2.3 Mortality from Fisheries Research Activities

During PIFSC research activities, sea water samples are collected and analyzed for water quality parameters, contamination, and microbiological communities. When sea water is collected near the reef, the possibility exists that coral and chambered nautilus in the free swimming larval stage may inadvertently be captured. However, due to the relatively low abundance of protected nautilus and coral species in the action area, the fact that high concentrations of larval coral occur only during infrequent spawning events, and the small volumes of sea water sampled, the collection of seawater samples ***may affect, but is not likely to adversely affect*** these ESA-listed invertebrates.

Chambered nautilus were listed as threatened in 2018 (83 FR 48976). While chambered nautilus may be caught as bycatch in some Indo-Pacific deep-sea fisheries (i.e., in the Philippines, India or Papua New Guinea (82 FR 48948), the likelihood of PIFSC research incidentally catching chambered nautilus is considered extremely low based on the low volume of research, short duration and disperse nature of surveys. Giant clams were petitioned to be listed under the ESA in 2016; status reviews of seven of the ten species petitioned for listed is ongoing (82 FR 28946). Byactch of this species in PIFSC research is not anticipated and therefore there would be ***no effect*** on ESA-listed chambered nautilus due to bycatch.

4.5.2.4 Changes in Species Composition

Changes in the species composition of benthic invertebrates such as corals are likely affected most by bottom trawling gear than all other gear types. Surveys conducted by PIFSC are limited to surface and midwater trawls; no fishing gear would be intentionally dragged along the sea floor. Deployments of the previously discussed stationary bottom-contact gear are not expected to alter species composition due to the small footprint created by these gear types (see Section 4.5.2.1). There would be ***no effect*** on ESA-listed species composition.

4.5.2.5 Contamination or Degradation of Habitat

The potential for research vessels to cause degradation of benthic and pelagic habitat through contamination would only be through accidental spills and discharges, which would likely be limited in magnitude, rare, and localized for the reasons described in Section 4.2.1.3. There would be ***no effect*** on ESA-listed invertebrates.

4.5.2.6 Effects on Designated Critical Habitat for ESA-Listed Invertebrates

On Nov. 27, 2020 NMFS proposed seventeen specific areas containing physical features essential to the conservation of these seven coral species in U.S. waters as critical habitat. The areas cover about 600 km^2 of marine habitat (85 FR 76262). On March 29, 2021, the public comment period on the proposed critical habitat designation for these corals was extended to May 26, 2021. Critical habitat for chambered nautilus has not been designated.

5 CUMULATIVE EFFECTS

5.1 Spatial and Temporal Scope

The cumulative effects analysis considers external actions that influence the geographic areas where PIFSC surveys occur; these areas include the HARA, MARA, ASARA, and WCPRA, as illustrated in Figure 1.1. Some actions that originate outside of the PIFSC research areas, such as discharge of pollutants, or actions that influence populations of highly migratory species, could potentially contribute to cumulative effects within the geographic areas of interest; such actions are considered in the analysis of cumulative effects. Other actions considered in the analysis of cumulative effects may be geographically widespread, such as those that could potentially result in climate change or ocean acidification. Although discussions of past actions primarily focus on the last five years, the availability of existing information and the period of time that must be considered to understand the baseline conditions vary between resource components. All analyses project five years into the future from the date this BA is finalized The temporal scope of this analysis generally covers notable events and actions that have occurred from 2016 through 2026.

5.2 Reasonably Foreseeable Future Actions

Table 5-1 summarizes the Reasonable Foreseeable Future actions (RFFAs) external to PIFSC fisheries research that are likely to occur in the next five years and the resources they are likely to affect. This information has been collected from a wide variety of sources, including NEPA documents covering the Pacific Islands marine environment, federal and state fishery agency websites and documents, U.S. Navy websites and documents, and a variety of documents concerning recreation and tourism, coastline development, and other activities. Wildlife management documents such as endangered species recovery plans and take reduction plans for sea turtles and marine mammals were also consulted.

Deciding whether to include actions that have already occurred, are ongoing, or are reasonably foreseeable in the cumulative impacts analysis depends on the resource being analyzed. Past, ongoing, and future actions must have some known or the influence on the same resources that would be affected by the research to be included in the cumulative impacts analysis. The Council on Environmental Quality (CEQ) refers to this as the cause-and-effect method of connecting human activities and resources or ecosystems. The magnitude and extent of the effect of an action on a resource or ecosystem depends on whether the cumulative impacts exceed the capacity of the resource/ecosystem to sustain itself and remain productive over the long-term.

CEQ guidelines state that “it is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.” In general, actions can be excluded from the analysis of cumulative impacts if:

- The action is outside the geographic boundaries or time frame established for the cumulative impacts analysis.
- The action will not affect resources that are the subject of the cumulative impacts analysis.
- The action is not planned or is not reasonably foreseeable (e.g., formally proposed, planned, permitted, authorized, or funded).

TABLE 5-1. REASONABLY FORESEEABLE FUTURE ACTIONS (RFFAS) RELATED TO PIFSC RESEARCH AREAS

Blank cells indicate no effects on that resource.

Action	PIFSC Research Area				Effect on ESA-Listed Fish	Effect on ESA-Listed Marine Mammals	Effect on ESA-Listed Sea Turtles	Effect on ESA-Listed Corals and Mollusk
	HARA	MARA	ASARA	WCPRA				
Other (Non-PIFSC) Scientific Research	X	X	X	X	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource	Beneficial contribution though increased understanding of resource
					Habitat disturbance	Behavioral disturbance or displacement	Loss/injury from ship or small boat strikes	Loss or displacement due to habitat disturbance
					Behavioral disruptions	Loss/injury from ship strikes		Coral reef damage
					Removal of individuals and biomass	Noise responses		Removal of individuals and biomass
Other Fishing Operations (Charter, Private, or Traditional)	X	X	X	X	Removal of managed targeted fisheries species	Loss/injury from ship strikes	Loss/injury from ship strikes	Direct loss or displacement
					By-catch removal of non-target species	Loss/injury from entanglement/hooking	Loss/injury from turtle by-catch	Indirect loss or displacement due to habitat disturbance
					Habitat disturbance	Noise responses	Loss/injury from entanglement/hooking with fishing gear	Coral reef damage
					Behavioral disruption	Alteration or reduction of prey resources		
					Loss from capture by derelict gear	Behavioral disturbance or displacement		
Recreation and Tourism	X	X	X	X	Behavioral Disruption	Noise responses	Loss/injury from ship strikes	Loss or displacement due to habitat disturbance
					Habitat disturbance	Behavioral disturbance or displacement	Noise responses	Loss/injury due to contamination
						Loss/injury from ship strikes	Displacement	Invasive species (Cruise ship ballast water)
						Loss/injury due to ingestion or entanglement in marine debris	Loss/injury due to ingestion/entanglement in marine debris	
Vessel Traffic (Shipping)	X	X	X	X	Loss due to competition or predation from invasive species	Loss/injury from ship strikes	Loss/injury from contamination	Invasive species

Action	PIFSC Research Area				Effect on ESA-Listed Fish	Effect on ESA-Listed Marine Mammals	Effect on ESA-Listed Sea Turtles	Effect on ESA-Listed Corals and Mollusk
	HARA	MARA	ASARA	WCPRA				
					Loss/injury from contamination	Displacement	Noise effects (stress, altered behavior)	Loss due to competition or predation from invasive species
					Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/injury due to ingestion/entanglement in marine debris	Loss/injury from contamination
						Behavioral disturbance		
						Loss/injury due to ingestion/entanglement in marine debris		
						Disruption of migration patterns		
Vessel Traffic (Other)	X	X	X	X	Loss due to competition or predation from invasive species	Loss/injury from ship strikes	Loss/injury from contamination	Loss due to competition or predation from invasive species
					Loss/injury from contamination	Displacement	Noise effects (stress, altered behavior)	Loss/injury from contamination
					Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/injury due to ingestion/entanglement in marine debris	
						Behavioral disturbance		
						Loss/injury due to ingestion/entanglement in marine debris		
Ocean Disposal and Discharges	X	X	X		Bioaccumulation of contaminants	Bioaccumulation of contaminants	Bioaccumulation of contaminants	Bioaccumulation of contaminants
					Loss/injury from contamination	Loss/injury from contamination	Loss/injury from contamination	Loss/injury from contamination
					Habitat disturbance	Loss/injury from ship strikes	Alteration or reduction of prey resources	Habitat disturbance
						Alteration or reduction of prey resources	Habitat disturbance	
						Habitat disturbance		
Dredging	X	X	X		Loss of habitat due to sea floor disturbance	Noise effects (stress, altered behavior)	Noise effects (stress, altered behavior)	Loss/displacement due to turbidity
					Displacement due to turbidity	Loss/injury from ship strikes	Mortality by entrainment in dredge	Indirect loss or displacement due to habitat disturbance

Action	PIFSC Research Area				Effect on ESA-Listed Fish	Effect on ESA-Listed Marine Mammals	Effect on ESA-Listed Sea Turtles	Effect on ESA-Listed Corals and Mollusk
	HARA	MARA	ASARA	WCPRA				
						Habitat disturbance/alteration	Habitat disturbance/alteration	Coral reef damage
						Alteration or reduction of prey resources	Alteration or reduction of prey resources	
Coastline Development	X	X	X		Loss/alteration of habitat due to shoreline disturbance	Loss/alteration of habitat due to shoreline disturbance	Loss/alteration of habitat due to shoreline disturbance	Coral reef damage
						Noise effects (stress, altered behavior)		Loss/displacement due to turbidity
								Indirect loss or displacement due to habitat disturbance
Geophysical/ Geotechnical Activities	X	X			Habitat disturbance	Acoustic effects from noise	Loss/injury from ship strikes	Habitat disturbance
					Acoustic effects from noise	Loss/injury from ship strikes	Behavioral disturbance	Localized benthos disturbance
						Behavioral disturbance		
Sea Turtle Conservation Measures	X	X	X				Decreased serious injury and mortality	
							Habitat protection	
Marine Mammal Conservation Measures	X	X	X			Decreased serious injury and mortality		
						Habitat protection		
Climate Change	X	X	X	X	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species
								Coral bleaching
Ocean Acidification	X	X	X	X	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Decreased calcification, shell hardening impaired
					Potential direct adverse effects on growth, reproduction, development			Potential adverse effects on prey, availability of nutritional minerals Coral bleaching
Natural Events (Tsunami, Volcano, Earthquake, Hurricane)	X	X	X	X	Habitat disturbance	Habitat disturbance	Habitat disturbance	Variable effects on different species
					Variable effects on different species	Variable effects on different species	Variable effects on different species	Coral reef damage

5.3 Cumulative Effects Analysis

5.3.1 ESA-Listed Fish Species

As discussed in Section 3.1, there are three fish species in the project area listed as threatened or endangered under the ESA: the Indo-West Pacific DPS scalloped hammerhead shark, the oceanic whitetip shark, and the giant manta ray. Only four scalloped hammerhead sharks have been caught by PIFSC, all of which belonged to the non ESA-listed Central Pacific DPS. Furthermore, all four of these captures were released alive with no resulting mortality. No takes of oceanic whitetip sharks or giant manta rays have occurred during PIFSC research.

The past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on Indo-West Pacific DPS scalloped hammerhead sharks in the PIFSC research areas external to PIFSC fisheries research are intentional and incidental takes in commercial and non-commercial fisheries. Scalloped hammerhead sharks are taken as bycatch in the Hawaiʻi-based pelagic longline fishery which targets tunas and billfish. Fishery observer data from 1995 to 2006 indicate a low catch number of scalloped hammerhead sharks (56 individuals from 26,507 total sets). More recent data from 2009 to 2011 indicates even fewer caught individuals (Miller *et al*. 2013, Walsh *et al*. 2009).

The activities external to PIFSC fisheries research potentially affecting scalloped hammerhead sharks will likely continue into the foreseeable future (see Table 5-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

When considered in conjunction with commercial and recreational fisheries and other external activities affecting ESA-listed scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays in PIFSC research areas, the contribution of PIFSC fisheries and ecosystem research to cumulative effects would be considered not likely to adversely affect these species.

5.3.2 ESA-Listed Marine Mammals

The endangered marine mammal species in the PIFSC research areas include the false killer whale - MHI insular stock, sperm whale, blue whale, fin whale, sei whale, North Pacific right whale, and Hawaiian monk seal. With the exception of the false killer whale, commercial whaling was the greatest historical source of mortality for the endangered whale species found in the PIFSC research areas (Carretta and Barlow 2011 [and citations therein], Perry *et al*. 1999). Commercial harvests of sperm whales ended worldwide in 1986. Blue and humpback whales were protected in 1966 (Perry *et al.* 1999). The International Whaling Commission (IWC) banned hunting of fin whales throughout the North Pacific in 1976 (Perry *et al*. 1999) and hunting of sei whales in the eastern North Pacific ended after 1971 and after 1975 in the western North Pacific (Perry *et al*. 1999). Although right whales received legal protection from commercial whaling in 1935 (Perry *et al*. 1999), illegal whaling by the Soviet Union continued into the 1960s and nearly extirpated North Pacific right whales in the Gulf of Alaska (Wade *et al*. 2011).

Human-related mortality has caused two major declines of the Hawaiian monk seal (Ragen and Levigne 1999). In the 1800s, this species was decimated by sealers, crews of wrecked vessels, and guano and feather hunters. Following a period of at least partial recovery in the first half of the 20th century, most subpopulations again declined. This second decline has not been fully explained, but long-term trends at several sites appear to have been driven both by variable oceanic productivity (represented by the Pacific Decadal Oscillation) and by human disturbance (Baker *et al.* 2012, Ragen and Levigne 1999). Currently, human activities in the NWHI are limited and human disturbance is relatively rare, but the intentional killing of seals in the MHI is a relatively new and alarming trend and human/seal interactions have become an important issue in the MHI (Carretta *et al.* 2015).

In 2009, three Hawaiian monk seals (including a pregnant female) were shot and killed in the MHIs (Baker *et al.* 2012). In 2010, a juvenile female seal was found dead on Kaua‘i due to multiple skull fractures caused by blunt force trauma. Whether this was an intentional killing or an accidental occurrence (e.g., boat strike) is not known. In 2011, two seals were found dead in the same general area of Moloka‘i, with skull fractures from blunt force trauma.

Other past, present, and reasonably foreseeable future conservation concerns and threats to recovery include vessel collisions, entanglement in fishing gear, anthropogenic noise, vessel/human disturbance, disease, habitat degradation, competition with fisheries for prey, climate change, and pollutants (including contaminants and oil spills) and pathogens.

Vessel collisions are a threat to endangered large whales, particularly blue and fin whales. The PIFSC research areas include numerous shipping lanes, vessel traffic and shipping ports, including six major ports, five in the Hawaiian Islands and one in Guam.. There have been more than 80 confirmed contacts between vessels and whales in Hawaiian waters over the past 40 years and three quarters of those cases have occurred in the last decade.

Entanglement in fishing gear is a common conservation concern for ESA-listed marine mammals worldwide. One sperm whale was observed either hooked or entangled in the Hawaiʿi-based deep-set longline (DSLL) fishery; the lines were cut and the whale swam away with a hook and some line still attached (Bradford and Forney 2014).

The potential effects of commercial fisheries on prey availability are not clear. Direct competition with fisheries for prey is unlikely for blue, fin, and sei whales whose diet consists of 80-100% large zooplankton, primarily krill (Barlow *et al.* 2008). Sperm whales consume about 60% large squid, and a mix of various fish, small squid, and benthic invertebrates. Krill is not commercially harvested, nor are most of the other prey items (Barlow *et al*. 2008). However, prey consumed by false killer whales include commercially valuable species, such as yellowfin tuna (*Thunnus albacares*), albacore tuna (*T. alalunga*), skipjack tuna (*Katsuwonus pelamis*), broadbill swordfish (*Xiphias gladius*), dolphin fish (or mahimahi, *Coryphaena hippurus*), wahoo (or ono, *Acanthocybium solandri*), and lustrous pomfret (or monchong, *Eumegistus illustrus*) (Baird 2009).

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. As described in Moore and Huntington (2008), certain marine mammal species may have greater ability than others to adapt to major climate shifts and ecosystem disturbances. 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 such as the proposed aquaculture program.

With the exception of the historical sources of population decline, all of the aforementioned effects are likely to continue into the foreseeable future (see Table 5-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Although ESA-listed marine mammals continue to be affected by numerous factors external to PIFSC fisheries research and the resulting cumulative effects, contribution to these effects from PIFSC fisheries research activities is small.

The direct and indirect effects of vessel collisions with marine mammals are discussed in Section 4.3.1. Although there is always risk of vessel strikes during research cruises, the volume of ship traffic generated by PIFSC fisheries and ecosystem research is miniscule compared to the number of other vessels transiting the PIR. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to ESA-listed species (or any other species of marine mammals) due to ship strikes is considered highly unlikely.

There is no documented history of marine mammals being injured or killed due to entanglement or other interactions with research gears during PIFSC research activities. However, based on documented interactions of some ESA-listed species with analogous commercial and non-commercial fisheries, PIFSC anticipates the possibility of a Level A harassment/M/SI take of a sperm whale in longline gear. A Level A take, if it occurs, would add a very small contributions to the total estimated M/SI from all anthropogenic sources relative to each stock’s PBR (Table 5-1). For the Hawaiʻi population of sperm whales, average annual M/SI from all sources is currently 6.9% of PBR (Carretta *et al.* 2020), and the PIFSC requested take, if it occurs, would add an additional 2% of PBR.

The potential effects from the use of active acoustic devices for PIFSC research activities would likely have rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from PIFSC research would affect but not be likely to adversely affect these species.

Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species, particularly the planktivorous or largely planktivorous species. There would be ***no effect*** from the proposed action.

When considered in conjunction with commercial and recreational fisheries, and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the PIFSC research areas, the contribution of PIFSC fisheries research activities to cumulative effects on ESA-listed marine mammals would not be likely to adversely affect. Additionally, ecosystem research conducted by PIFSC has beneficial effects on marine mammal populations by providing scientific information important to the conservation and management of marine mammals and their prey species.

5.3.3 ESA-Listed Sea Turtles

Sea turtles are susceptible to impacts resulting from natural and anthropogenic factors, both on land and in the water (Table 5-1). Effects on breeding beaches involve habitat degradation, habitat loss, injury, and mortality through numerous mechanisms: beach erosion, beach armoring and nourishment, rising sea levels in association with climate change, artificial lighting, increases in human presence, beach cleaning, recreational beach equipment, beach driving, coastal construction, disturbance of beach vegetation, and poaching. Increases in human presence near nesting beaches have led to the introduction of non-native predators including dogs and rats, which may feed on turtle eggs and hatchlings. Adverse impacts to sea turtles also involve habitat degradation, injury, and mortality through numerous mechanisms: coastal development and transportation, dock construction, marine pollution, dredging, underwater explosions, offshore artificial lighting, entanglement in debris (e.g., monofilament, derelict nets), ingestion of marine debris, fishery interactions, boat collisions, and poaching. Increases in diseases such as fibropapilloma tumors have also been observed on sea turtles around Hawai‘i.

Threats to sea turtles in the PIFSC research areas include incidental capture, injury, and mortality during commercial fishing operations. This conservation issue has been the subject of numerous conservation engineering studies. Use of circle hooks instead of ‘J’ hooks in commercial pelagic longline fisheries has reduced sea turtle mortalities. The implementation of time/area restrictions in commercial trawl fisheries has also reduced the level of sea turtle captures and mortality in trawl fisheries. However, capture and entanglement in several types of fishing gear continues to be a major conservation concern (NMFS 2014).

Multiple past and present actions have affected sea turtles in the PIFSC research areas and many of these impact producing factors are likely to continue for the foreseeable future. All species of sea turtles that occur in the PIFSC research areas are threatened or endangered, and have therefore been subject to major population-level cumulative effects.

Fisheries research activities conducted and funded by PIFSC have had no recorded interactions with any sea turtles and removal of potential sea turtle prey is very small and localized. The proposed research is unlikely to add to adverse effects of the cumulative effects on these species. In contrast, ecosystem research conducted by PIFSC has beneficial effects on sea turtle populations by providing scientific information important to sea turtle conservation and management. Similarly, removal of marine debris has a minor beneficial effect on sea turtles populations by reducing potential capture or entanglement. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting sea turtles in the PIFSC research areas, the contribution of PIFSC fisheries research to the cumulative effects on sea turtles in the PIFSC research would not be likely to adversely affect all species.

5.3.4 ESA-Listed Corals and Mollusk

Marine invertebrates continue to be susceptible to natural and anthropogenic effects including exploitation through commercial and recreational fishing, habitat degradation, pollution, and climate change. Because marine invertebrates do not regulate their body temperature, changes in water temperature may affect the distribution of certain species as well as affect growth rates, reproductive ability and survival (Harley *et al*. 2006, Fogarty *et al*. 2007). In addition, warmer water temperatures affect pH, dissolved oxygen and conductivity of sea water, all of which may have adverse effects on invertebrate species.

Degradation of invertebrate habitat can occur as a result of commercial and recreational fisheries that involve gear coming into contact with the sea floor. Other sources of habitat disruption identified in the RFFAs (Table 5-1) include recreation and tourism, ocean disposal, dredging, and coastline development.

In addition, pollution can negatively affect water quality and chemistry. While intentional discharges of pollutants (including fuel and oil) are relatively rare, accidental discharges may be rather common in some areas and have the potential to cause habitat degradation or direct mortality of invertebrates. Effects include decreased foraging ability and reproductive success and increased mortality (Milligan *et al.* 2009). Most accidental discharges are likely to be small and localized but some accidental discharges with large vessels or industrial activities may affect large geographic areas and impact benthic habitats for years.

Overexploitation of undersized or immature individuals can have serious implications for the sustainability of stocks, and the overall body size of individuals in a fished population may also change with intense fishing pressure on a single size class (Donaldson *et al.* 2010). Some commercially and recreationally valuable species of invertebrates (e.g., spiny and slipper lobster) have had population declines in the past due to overharvest. The NWHI lobster fishery was closed in 2000 and remains closed due to historical overfishing (50 CFR Part 665). Commercial and recreational fishing is likely to be the dominant factor in cumulative effects on these species in the future, although climate change may also have substantial effects on some species.

Extreme weather events (e.g. cyclones and hurricanes), vessel groundings, and coastal construction activities represent a chronic threat to live coral habitat. Effects of weather events include coral fragmentation, sediment deposition onto coral colonies, introduction of marine debris, and coral bleaching through hyposaline conditions caused by intense rain events. Vessel groundings physically destroy or injure corals in ways similar to cyclones. Vessel anchors can also cause similar types of damage to corals, but the effects are often smaller in scale and more frequently inflicted. Coastal construction and development can increase local turbidity levels and harm corals or slow growth (Brainard *et al.* 2011).

PIFSC research surveys remove small numbers of invertebrates from all four research areas, primarily coral fragments, and miscellaneous sessile invertebrates. Mortality resulting from PIFSC fisheries research would not add to the adverse effects of the cumulative effects on invertebrates. The contributions of PIFSC research activities to habitat contamination, climate change, and ocean acidification are expected to be insubstantial. PIFSC fisheries research would contribute to future management decisions related to invertebrate populations in all four research areas where commercial and recreational fisheries target coral and lobsters. When combined with the impacts of past, present, and reasonably foreseeable future actions, the direct contribution of PIFSC research activities may affect but would not likely adversely add to cumulative effects on invertebrates. However, research conducted by PIFSC on invertebrates in all four research areas contributes to sustainable management of certain species and this contribution to cumulative effects would be beneficial.

6 EFFECT DETERMINATIONS

In accordance with the requirements of Section 7(a) of the ESA, and consistent with ESA guidance, this document provides a synthesis of the best available scientific information to assist in the completion of formal consultation on the proposed action. This document provides updates on the current status of the ESA-listed fish, marine mammals, and sea turtles, and potential direct, indirect and cumulative effects of the proposed action on the ESA-listed species.

To assist NMFS in their review, this assessment has evaluated the potential effects of the proposed activities on ESA-listed species and has considered the extent to which these species are likely to be directly affected by proposed PIFSC research. Indirect effects such as a reduction in prey species, are not anticipated given the relatively small number of surveys that occur each year. Considering the relatively small number of research vessels and short-duration of most research cruises, indirect effects from contaminants are also not expected.

Table 6-1 summarizes the effect determinations for ESA-Listed species in the PIFSC Action Area. Details of the determinations are described in Sections 4.3 though 4.7. This BA has used the best scientific information available to evaluate the potential effects of the proposed PIFSC fisheries research activities on listed species and designated critical habitat, and has considered the required ESA determinations of the extent to which any such species or habitat are likely to be affected by these activities.

TABLE 6-1. ESA-LISTED SPECIES AND CRITICAL HABITAT DETERMINATIONS

Species	Population or DPS	ESA Status	Does Critical Habitat Occur in Action Area?	Effect Determination for Species/DPS	Effect Determination for Critical Habitat
Marine Fish					
Scalloped Hammerhead shark (*Sphyrna lewini*)	Indo-West Pacific DPS	Threatened	Not designated	Likely to adversely affect	N/A
Oceanic Whitetip shark (*Carcharhinus longimanus*)	N/A	Threatened	Not designated	Likely to adversely affect	N/A
Giant Manta ray *(Manta birostris)*	N/A	Threatened	Not designated	Likely to adversely affect	N/A
Marine Mammals					
False Killer whale (*Pseudorca crassidens*)	Main Hawaiian Islands Insular DPS	Endangered	Yes	May affect, not likely to adversely affect	Not likely to destroy or adversely modify
Sperm whale (*Physeter microcephalus*)	Hawai‘i population	Endangered	Not designated	Likely to adversely affect	N/A
Blue whale (*Balaenoptera musculus*)	Central North Pacific population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
Fin whale (*Balaenoptera physalus*)	Hawai‘i population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
Sei whale (*Balaenoptera borealis*)	Hawai‘i population	Endangered	Not designated	May affect, not likely to adversely affect	N/A
North Pacific right whale (*Eubalaena japonica*)	N/A	Endangered	No	May affect, not likely to adversely affect	No Effect

Species	Population or DPS	ESA Status	Does Critical Habitat Occur in Action Area?	Effect Determination for Species/DPS	Effect Determination for Critical Habitat
Hawaiian Monk seal (*Neomonachus schauinslandi*)	N/A	Endangered	Yes	May affect, not likely to adversely affect	No Effect
Sea Turtles[1]					
Leatherback Turtle (*Dermochelys coriacea*)	N/A	Endangered	No	May affect, not likely to adversely affect	No Effect
Loggerhead Turtle (*Caretta caretta*)	North Pacific Ocean DPS South Pacific Ocean DPS	Endangered	No	May affect, not likely to adversely affect	No Effect
Olive Ridley Turtle (*Lepidochelys olivacea*)	Mexico's Pacific coast breeding populations	Endangered	Not designated	May affect, not likely to adversely affect	N/A
Green Turtle, (*Chelonia mydas*)	Central North Pacific DPS (HARA) Central West Pacific DPS (MARA) Central South Pacific DPS (ASARA)	Threatened	No	May affect, not likely to adversely affect	No Effect
Hawksbill Turtle (*Eretmochelys imbricate*)	N/A	Endangered	No	May affect, not likely to adversely affect	No Effect
Corals[2]					
Acropora globiceps	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Acropora jacquelineae	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Acropora retusa	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Acropora speciosa	N/A	Threatened	Proposed	Likely to adversely affect	N/A

Species	Population or DPS	ESA Status	Does Critical Habitat Occur in Action Area?	Effect Determination for Species/DPS	Effect Determination for Critical Habitat
Euphyllia paradivisa	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Isopora crateriformis	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Seriatopora aculeata	N/A	Threatened	Proposed	Likely to adversely affect	N/A
Mollusks					
Chambered nautilus (*Nautilus pompilius*)	N/A	Threatened	Not designated	May affect, not likely to adversely affect	N/A

[1]USFW Consultation No. 01EPIF00-2017-1-0073 concurred that proposed research is not likely to adversely affect ESA-listed sea turtles.
[2]On Nov. 27, 2020 NMFS proposed seventeen specific areas containing physical features essential to the conservation of the seven coral species in U.S. waters as critical habitat. The areas cover about 600 km^2 of marine habitat (85 FR 76262).

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APPENDIX A

PIFSC Research Gear and Vessel Descriptions

APPENDIX

Protected Species Safe Handling Guidelines

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
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Honolulu, Hawaii 96818
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November 22, 2021

Justin Rivera
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Jolie Harrison
Chief, Permits and Conservation Division
Office of Protected Resources
NOAA, National Marine Fisheries Service
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Mr. Rivera:

This letter acknowledges the National Marine Fisheries Service's (NMFS') receipt of the Pacific Islands Fisheries Science Center's (PIFSC) September 8, 2021 request for consultation and Biological Assessment (BA) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1536(a)(2)). PIFSC determined that their proposed action is likely to adversely affect threatened scalloped hammerhead sharks (*Sphyrna lewini*), threatened oceanic whitetip sharks (*Carcharhinus longimanus*), threatened giant manta rays (*Manta birostris*), endangered sperm whales (*Physeter microcephalus*), and seven species of threatened coral (*Acropora globiceps*, *A. jacquelineae*, *A. retusa*, *A. speciosa*, *Euphyllia paradysia*, *Isopora crateriformis*, and *Seriatopora aculeata*). The PIFSC also determined the proposed action is not likely to adversely affect endangered false killer whales (*Pseudorca crassidens*), endangered Central North Pacific blue whales (*Balaenoptera musculus*), endangered fin whales (*B. physalus*), endangered sei whales (B. borealis), Eastern North Pacific right whales (*Eubalaena japonica*), endangered Hawaiian monk seals (*Neomonachus schauinslandi*), endangered leatherback sea turtles (*Dermochelys coriacea*), endangered loggerhead sea turtles (*Caretta caretta*), endangered olive ridley sea turtles (*Lepidochelys olivacea*), threatened green sea turtles (*Chelonia mydas*), endangered hawksbill sea turtles (*Eretmochelys imbricata*), and threatened chambered nautilus (*Nautilus pompilus*) in the action area from the proposed research activities.

This letter also acknowledges our receipt of NMFS' Permits and Conservation Division (PR1) request for consultation on issuing a Letter of Authorization (LOA) to PIFSC, pursuant to section 101(a)(5)(A) of the Marine Mammal Protection Act of 1972 (MMPA), as amended (16 U.S.C. 1361 et seq.), for taking marine mammals incidental to fisheries research. Under the MMPA, PR1 determined the proposed action will cause injury or mortality of sperm whales and Level B harassment of false killer whales and Hawaiian monk seals. In a November 17, 2021 email, PR1 clarified that these takings under MMPA constitute likely to adversely affect determinations under the ESA.

On June 21, 2021, PIFSC sent us a draft BA for review. Between June 21, 2021, and September 1, 2021, we held multiple meetings with PIFSC via phone conference. PIFSC sent us an updated draft BA on September 1, 2021 for review. No additional comments were given by us.

The PIFSC sent us a request for formal request for consultation on September 8, 2021. We sent comments to PIFSC on October 6, 2021, requesting clarification on the likely to adversely affect determination for sperm whales. PIFSC responded to our comments and edits on October 12, 2021. Given the preliminary information we gathered from PIFSC and PR1, we may not agree with PIFSC's not likely to adversely affect determination for listed sea turtles, false killer whales, or Hawaiian monk seals. However, as of November 17, 2021, we believe we have adequate information to initiate consultation pursuant to 50 CFR 402.14(c). Because consultation is meant to be an iterative process we may request additional data or information as the consultation progresses (50 CFR 402.14(d)).

Section 7 of the ESA allows the Services up to 90 calendar days to conclude consultation; by regulation, we have an additional 45 calendar days to prepare our Biological Opinion (unless we mutually agree to an extension). Therefore, we expect to provide our biological opinion to your not later than April 1, 2022 (135 days from initiation of consultation).

As a reminder, the ESA requires that after initiation of formal consultation, the Action Agency may not make any irreversible or irretrievable commitment of resources that would preclude the formulation or implementation of any reasonable and prudent alternatives that would avoid violating section 7(a)(2) (50 CFR 402.09). This prohibition is in force during the consultation process and continues until the requirements of section 7(a)(2) are satisfied.

If you have any questions, please contact Chuck Wheeler on my staff at chuck.wheeler@noaa.gov. Thank you for working with us to protect our nation's living marine resources.

Sincerely,

Ann M. Garrett
Assistant Regional Administrator

Cc: Amy Fowler, PR1 (amy.fowler@noaa.gov)

PIRO Reference No.: I-PI-21-1968-AG

Endangered Species Act – Section 7 Biological Opinion and Conference Report

Action Agencies: National Marine Fisheries Service, Pacific Islands Fisheries Science Center, NMFS Office of Protected Resources, Permits and Conservation Division

Activities: Pacific Islands Fisheries Science Center's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean, Office of Protected Resources' Issuance of a Letter of Authorization to Take Marine Mammals Incidental to Fisheries Research Conducted by Pacific Islands Fishery Science Center

Consultation Conducted by: National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division, Intergovernmental Coordination and Conservation Branch

NMFS File No. (ECO): PIRO-2021-03019

PIRO Reference No.: I-PI-21-1968-AG

Approved By: MALLOY.SARAH.JOAN.1262526743 Digitally signed by MALLOY.SARAH.JOAN.1262526743 Date: 2022.12.15 08:41:53 -10'00'

Sarah J. Malloy
Acting Regional Administrator, Pacific Islands Region

Date Issued: 12/15/22

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ACRONYMS

ASARA	American Samoa Archipelago Research Area
ASLL	American Samoa longline fishery
BE	Biological Evaluation
CFR	Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPUE	Catch per Unit Effort
cm	Centimeter(s)
CO_2	Carbon Dioxide
DAS	Days at Sea
dB	Decibel(s)
DPS	Distinct Population Segment
DSLL	Deep-set longline fishery
DQA	Data Quality Act
EEZ	U.S. Exclusive Economic Zone
ESA	Endangered Species Act
FAD	Fish Aggregating Devices
ft.	Feet
FR	Federal Register
FWS	US Fish and Wildlife Service
GHG	Greenhouse Gas
HARA	Hawaiian Archipelago Research Area
Hz	Hertz
IATTC	Inter-American Tropical Tuna Commission
ICCB	Intergovernmental Coordination and Conservation Branch
in	Inch(es)
ITS	Incidental Take Statement
ITP	Incidental Take Permit
IUU	Illegal, unreported and unregulated fishing
kg	Kilogram(s)
m	Meter(s)
Mara	Mariana Archipelago Research Area
mm	Millimeter(s)
nm	Nautical Mile(s)
NMFS	National Marine Fisheries Service (aka NOAA Fisheries)
NOAA	National Oceanic and Atmospheric Administration
MTBAP	Marine Turtle Biology and Assessment Program
PIFSC	Pacific Islands Fisheries Science Center
PIRO	Pacific Islands Regional Office
PSAT	Pop-off Satellite Archival Transmitting Tag
PTS	Permanent Threshold Shift
SPL	Sound Pressure Level
SSLL	Shallow-set longline fishery
TTS	Temporary Threshold Shift
U.S.	United States

WCPFC	Western and Central Pacific Fisheries Commissions
WCPO	United States Western Central Pacific Ocean
WCORA	Western and Central Pacific including the Pacific Remote Islands Research Area
ºC	Degrees Celsius
ºF	Degrees Fahrenheit

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each federal agency to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" a listed species or its designated critical habitat, that agency is required to consult formally with the National Marine Fisheries Service (NMFS) or the United States Fish and Wildlife Service (FWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR 402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species or their designated critical habitat, and NMFS or the FWS concur with that conclusion (50 CFR 402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, in accordance with the ESA Subsection 7(b)(3)(A), NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures. NMFS, by regulation has determined that an ITS must be prepared when take is "reasonably certain to occur" as a result of the proposed action. 50 C.F.R. 402.14(g)(7).

"Take" is defined by the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, any threatened or endangered species, or to attempt to engage in any such conduct. NMFS defines "harass" as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Wieting 2016). NMFS defines "harm" as "an act which actually kills or injures fish or wildlife." Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Take of species listed as endangered is prohibited at the time of listing, while take of threatened species may not be specifically prohibited unless NMFS has issued regulations prohibiting take under section 4(d) of the ESA.

Section 7(a)(4) of the ESA requires that each Federal agency confer with NMFS on any agency action that is likely to jeopardize the continued existence of any proposed species, or likely to result in the destruction or adverse modification of proposed critical habitat as per 50 CFR §402.10(d). NMFS may request to conference if, after a review of available information, it determines that a conference is required for a particular action (50 CFR §402.10(b)). If requested by the Federal agency and deemed appropriate by NMFS, the conference may be conducted in accordance with the same procedures as a formal consultation (50 CFR §402.10(d)). A conference opinion may be adopted as a biological opinion when the species is listed or critical habitat is designated as long as no significant new information is developed and no significant changes to the Federal action are made that would alter the content of the opinion. An ITS provided with a conference opinion does not become effective unless NMFS adopts the conference opinion once the listing is final or proposed critical habitat is designated as final. Federal agencies may also engage in voluntary conferencing for proposed actions that may affect proposed resources. Following an informal conference with the action agency, NMFS may issue a conference report containing recommendations for reducing adverse effects to the proposed resource.

The Pacific Islands Fisheries Science Center (PIFSC) is conducting and funding all research activities, and is the action agency for this project. The PIFSC will conduct research and provide scientific advice to manage fisheries and conserve protected species throughout the Pacific Islands Region, including the State of Hawaii, Territory of American Samoa, Territory of Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and the Pacific Remote Island Areas (PRIA). The consulting agency for this proposal is NMFS' Pacific Islands Regional Office's (PIRO) Protected Resources Division (PRD), Intergovernmental Coordination and Conservation Branch (ICCB). This document represents NMFS' final biological opinion on the effects of the proposed action on species listed in Table 4. This biological opinion has been prepared in accordance with the requirements of Section 7 of the ESA, the implementing regulations (50 CFR 402), agency policy, and guidance. It is based on information contained in PIFSC's Biological Assessment (BA) (PIFSC 2021), NMFS and FWS recovery plans and status reviews for sea turtles (NMFS and FWS 1998a, 1998b, 1998c, 1998d, 2007, 2013a, 2013b, 2014a; Seminoff et al. 2015), marine mammals (NMFS 2007, 2015, 2021b, 2021d, 2022), corals (Brainard et al. 2009), and elasmobranchs (Miller et al. 2014; Miller and Klimovich 2017; Young et al. 2017), and other sources of information as cited herein.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order and on November 14, 2022, the District Court for the Northern District of California granted the Services' motion to remand the 2019 Regulations without vacatur. As a result, the 2019 regulations are still in effect pending future agency rulemaking, and we are applying the 2019 regulations here. For purposes of this consultation, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

1.1 Consultation History

The PIFSC (formerly the Honolulu Laboratory of the Southwest Fisheries Science Center) has gathered, directed, and coordinated the collection of scientific information needed to inform fisheries management decisions for over 40 years. We completed one formal and eight informal consultations in 2015, ten informal consultations in 2016, and seven informal consultations in 2017. Copies of these consultations are available at the Pacific Island Regional Office, Honolulu, Hawaii, and the Environmental Consultation Organizer located here: https://appscloud.fisheries.noaa.gov/suite/sites/eco.

On November 30, 2015, the NMFS Office of Protected Resources, Permits and Conservation

Division (PR1) received the request from PIFSC for authorization to take marine mammals incidental to fisheries research activities. PR1 published the request for authorization for a 30-day public review on December 7, 2015.

On September 13, 2018, NMFS completed an informal consultation with PIFSC on their research program (PIR-2018-10420; I-PI-18-1653-AG) concluding that PIFSC's research was not likely to adversely affect (NLAA) the following endangered or threatened species or designated critical habitat under NMFS' jurisdiction: threatened Central North Pacific, Central West Pacific and Central South Pacific Distinct Population Segments (DPS) of green sea turtles; endangered hawksbill sea turtles; endangered leatherback sea turtles; endangered North Pacific and South Pacific loggerhead sea turtle DPSs; threatened olive ridley sea turtles; endangered Hawaiian monk seals; endangered Main Hawaiian Islands insular false killer whales; threatened Indo-West Pacific DPS scalloped hammerhead sharks; threatened oceanic whitetip sharks; threatened giant manta rays; seven threatened corals species *Acropora globiceps, Acropora jacquelineae, Acropora retusa, Acropora speciosa, Euphyllia paradivisa, Isopora crateriformis,* and *Seriatopora aculeata;* designated critical habitat for the Hawaiian monk seal and the Hawaiian Islands insular false killer whale.

On March 22, 2021, NMFS OPR PR1 submitted a proposed rule for public comment on the Taking Marine Mammals Incidental to PIFSC Fisheries Research (86 FR 15298).

On March 16, 2022, NMFS PRD completed a formal consultation with PIFSC on the tagging and releasing of oceanic whitetip sharks opportunistically caught in small boat fisheries in the Hawaiian Islands (PIRO-2021-00317; I-PI-21-1897-AG).

On June 21, 2021, PIFSC submitted a draft BA for the proposed action covered in this opinion to PRD for review.

On June 29, 2021, PR1 requested consultation under Section 7 of the ESA with NMFS PIRO PRD for the Proposed Issuance of a LOA to Take Marine Mammals Incidental to Fisheries Research Conducted by PIFSC in the Pacific Ocean.

Between June 21, 2021, and September 1, 2021, PRD and PIFSC held multiple meetings via phone conference. PIFSC provided an updated draft BA on September 1, 2021 for PRD's subsequent review.

On September 8, 2021, the PIFSC submitted an official request for formal consultation to PRD.

On October 6, 2021, PRD provided comments to PIFSC requesting clarification on the likely to adversely affect determination for sperm whales.

On October 12, 2021, PIFSC responded to PRD comments and suggested edits. Given the preliminary information PRD gathered from PIFSC and PR1, PRD noted we may not agree with PIFSC's not likely to adversely affect determination for listed sea turtles, false killer whales, or Hawaiian monk seals. However, as of November 17, 2021, PRD determined we had adequate information to initiate consultation pursuant to 50 CFR 402.14(c).

On November 22, 2021, PRD provided a memorandum to PIFSC acknowledging the receipt of the PIFSC's September 8, 2021 request for consultation and BA pursuant to Section 7(a)(2) of the ESA. This letter also acknowledged PRD's receipt of PR1's request for consultation on issuing a LOA to PIFSC, pursuant to section 101(a)(5)(A) of the MMPA of 1972, as amended (16 U.S.C. 1361 et seq.), for taking marine mammals incidental to fisheries research. Under the

MMPA, PR1 determined the proposed action would cause injury or mortality of sperm whales and Level B harassment of false killer whales and Hawaiian monk seals.

On November 17, 2021, PR1 clarified through email that these takings under MMPA constitute likely to adversely affect determinations under the ESA. PRD disagrees with PR1 and considers false killer whales and Hawaiian monk seals as not likely to be adversely affected for the purpose of this biological opinion.

On May 17, 2022, PRD requested information to determine what proportion of longline sets would replicate the SSLL and DSLL fisheries respectively, to clarify modifications in the species list, and to clarify an effects determination for Hawaiian monk seal critical habitat in the BA. PRD determined that the East Indian-West Pacific green sea turtle, East Pacific green sea turtle, Southwest Pacific green sea turtle, and Mexican breeding populations of Olive Ridley sea turtles may be affected by the proposed action. These species were not included in the BA (NMFS 2019). Genetic evidence collected in both the SSLL (NMFS 2019) and DSLL (unpublished data) fisheries have determined these species are present within the *Action Area* and may be captured by longline operations conducted by PIFSC.

Additionally, PRD described current records of ESA-listed coral species in the U.S. Pacific Islands (NMFS 2021a) for our evaluation of proposed coral critical habitat (85 FR 76262). Based on this evaluation, PRD has confirmed that *Acropora jacquelineae* and *Seriatopora aculeata* did not occur in any U.S. territorial waters (NMFS 2021a). Therefore, we suggested these two species be removed from further analysis of this proposed action. PIFSC confirmed the genetic evidence available for sea turtles in Hawaiian waters and agreed to include the additional four species of sea turtles in the analysis of the proposed action. PIFSC also agreed to remove *Acropora jacquelineae* and *Seriatopora aculeata* from further analysis and provided clarification that research longline sets will replicate the DSLL fishery only. Lastly, PISFC clarified that designated Hawaiian monk seal critical habitat would be NLAA by the proposed action.

On June 6, 2022, PIFSC confirmed that they use the existing commercial fleet to collect deep set longline samples during their regular longline fishing operations.

On October 5, 2022, PIFSC agreed to conference on proposed Pacific coral critical habitat.

On October 20, 2022, PIFSC added their Marine Turtle Biology and Assessment Program activities in this consultation.

On November 30, 2022, we corrected and updated the amount of take anticipated for this action, and re-evaluated the action's effect to listed species and their habitats, and revised the biological opinion to reflect the updated numbers.

1.2 Description of the Proposed Action

The Programmatic Environmental Analysis, the BA, and the proposed rule (86 FR 15298), provide important background information about the proposed research planned over the five year period from 2021-2026 that we considered in this biological opinion. It provided the description of the action and most of the information required to initiate section 7 consultation.

PIFSC proposes to conduct studies which include biological, physical, and chemical sampling, visual observation and other data collection. Sampling methods include using trawl gear used at various levels in the water column, hook-and-line gear (including longlines with multiple hooks, bottomfishing, and trolling), and deployed instruments (including various traps), and diver surveys. All proposed programs are listed in Table 1. All methods are described briefly in the table, and best management practices (BMP) or mitigating measures to avoid or minimize effects to ESA-listed species or designated or proposed critical habitats are listed in Table 2. PIFSC provided details in their BA and in various emails or other written transmissions to PRD. The proposed action includes PR1's issuance of a LOA to PIFSC, pursuant to section 101(a)(5)(A) of the MMPA of 1972, as amended (16 U.S.C. 1361 et seq.), for taking marine mammals incidental to fisheries research.

PIFSC proposes to use samples taken from all fisheries, including the deep set longline fishery. However, this consultation does not cover the effects (accidental hookings, entanglements, or other take associated with the longline fishing) of the deep set longline fishery, which is the subject of a separate consultation. Under 2019 regulations, effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

The deep set longline fishing will occur regardless of the proposed research sampling, and any effects of the deep set longline fishery to ESA-listed resources are part of the proposed action. Therefore, we concluded that the DSLL effects are not covered in this consultation because the fishing effort associated with PIFSC's sampling will not add to the fishing effort nor the take associated with the DSLL action.

We presented all activities that could expose potential stressors to listed species in Table 1. Proposed mitigation and monitoring measures are presented in Table 2. In the next paragraphs, we describe the activities in more detail to highlight their increased potential exposure of ESA-listed species to harmful effects.

Bottomfish Sampling

PIFSC will also use electric or hydraulic reels with sets of hooks to the bottom of the ocean to sample bottomfish populations. PIFSC proposes 175 sets, which amounts to about 2,100 hooks per year in the Hawaiian Islands, and about 1,000 sets with about 8,000 hooks in the Mariana Islands. The sets are jigged manually by personnel up to 30 minutes and retrieved. PIFSC is also proposing to sample by trolling and headlining. The proposed sample size is 28 operations throughout all of the sub-regions; using up to ten hooks per sample for no more than eight hours of troll or soak time. While the probability is low, depredation is possible.

Multi-beam, split-beam, and echosounder surveys can harm animals by emitting sounds that could cause non-auditory injury, hearing loss, or behavioral response. PIFSC also proposes to emit sounds to survey or sample cetaceans. As PR1 determined, the proposed sound effects are expected to cause harmful effects to sperm whales, Hawaiian monk seals, and Main Hawaiian Island insular false killer whales (NMFS 2021b).

Single and Multi-Frequency Narrow Beam Scientific Echosounders

Multi-beam, split-beam, and echosounder surveys can harm animals by emitting sounds that could cause non-auditory injury, hearing loss, or behavioral response. PIFSC also proposes to emit sounds to survey or sample cetaceans. As PR1 determined, the proposed sound effects are

expected to cause harmful effects to sperm whales, Hawaiian monk seals, and Main Hawaiian Island insular false killer whales (NMFS 2021b).

Echosounders and sonars work by transmitting acoustic pulses into the water that travel through the water column, reflect off the seafloor, and return to the receiver. Water depth is measured by multiplying the time elapsed by the speed of sound in water (assuming accurate sound speed measurement for the entire signal path), while the returning signal itself carries information allowing "visualization" of the seafloor. Multi-frequency split-beam echosounders are deployed from PIFSC survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering among species.

Multibeam Echosounder and Sonar

Multibeam echosounders and sonars operate similarly to the devices described above. However, the use of multiple acoustic "beams" allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior.

Acoustic Doppler Current Profiler (ADCP)

An ADCP is a type of sonar used for measuring water current velocities simultaneously at a range of depths. Whereas current depth profile measurements in the past required the use of long strings of current meters, the ADCP enables measurements of current velocities across an entire water column. The ADCP measures water currents with sound, using the Doppler effect. A sound wave has a higher frequency when it moves towards the sensor (blue shift) than when it moves away (red shift). The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument. Due to the Doppler effect, sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return. Particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Moreover, sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings.

An ADCP anchored to the seafloor can measure current speed not just at the bottom, but at equal intervals to the surface. An ADCP instrument may be anchored to the seafloor or can be mounted to a mooring or to the bottom of a boat. ADCPs that are moored need an anchor to keep them on the bottom, batteries, and a data logger. Vessel-mounted instruments need a vessel with power, a shipboard computer to receive the data, and a GPS navigation system so the ship's movements can be subtracted from the current velocity data. ADCPs operate at frequencies between 75 and 300 kHz.

Net Monitoring Systems

During trawling operations, a range of sensors may be used to assist with controlling and monitoring gear. Net sounders give information about the concentration of fish around the opening to the trawl, as well as the clearances around the opening and the bottom of the trawl; catch sensors give information about the rate at which the cod end is filling; symmetry sensors give information about the optimal geometry of the trawls; and tension sensors give information about how much tension is in the warps and sweeps.

On cetacean ecology assessments, deep coral and sponge research, PIFSC will conduct surveys to produce high-resolution bathymetry and acoustic backscatter maps, provide calibrated quantitative acoustic data useful for interpreting marine life in the water column of the ocean, and gas seeps. Most of the sounds are outside of the hearing range for sea turtles and elasmobranchs. Some of the instruments like ship-based multibeam and sub-bottom profilers produce sounds within the hearing range of all marine mammals, while some like the splitbeam EK60 and OES Netmind are outside of low frequency cetaceans' hearing range. NOAA ships generally cruise at no more than 8 knots. Ship-based profilers are intermittently pinged throughout the cruise as they gather data.

PIFSC will tow nets through the water column at various depths to 1,000 feet, which could entangle or accidentally capture listed species. To date, PIFSC has never entangled an ESA-listed species or large animal from their trawls. The details of the dimensions of each net, planned depth and duration of each tow are listed in Table 1. The largest nets are the Cobb and Isaacs-Kidd trawl and have the highest potential for entanglement. Those nets are proposed to be set for 15 to 20 tows per year resulting in 60 trawls. Sets will fish 4 hours per day/night per tow.

Throughout most of the surveys, PIFSC is proposing to drag nets through the surface and mid-water (up to 1,000 feet depth) to sample for a variety of living and non-living specimens. The total number of sets for each type of net are as follows:

- Cobb trawl, surface – 1,060 trawls
- Cobb trawl, mid-water – 60 trawls
- Plankton net, surface – 990 trawls
- Isaac-Kidd trawl, surface – 440 trawls

These nets are dragged through the water column at no more than 3.5 knots, for no more than four hours at a time.

PIFSC will also set up to 400 traps at bottomfish fishing sites to sample juvenile bottomfish data. The traps are cylindrical with dimensions up to 3 m long and 2 m diameter. Frame composed of semi-rigid plastic mesh of up to 5 cm mesh size. Folded plastic of up to 10 cm mesh is stuffed inside as settlement habitat, and cylinder ends are then pinched shut. Traps are clipped throughout the water column onto a vertical line anchored on the bottom up to 400 m, supported by a surface float.

PIFSC is proposing to set up to 400 sets of traps on sandy bottoms in the Mariana Islands to sample Kona crab (*Ranina ranina*). The traps are dropped from 60 to 210 ft. PIFSC is proposing to use two types of trap arrays; nylon open crab nets attached to a wire ring with bait, and "lobster traps" which are single-chambered, coned-entrance mesh pots. The traps use a trap door mechanism to capture the crabs.

Tagging

PIFSC is proposing to tag, photograph, collect tissue samples and/or collect interaction data from giant manta rays and Indo-West Pacific scalloped hammerhead captured incidentally during all fishing operations in the western and central Pacific Ocean. PIFSC will opportunistically tag these elasmobranchs whenever they are caught, in any of the fisheries mentioned in this opinion. Although tagging will most likely occur during longline or purse seine fisheries where the majority of the bycatch occurs and are staffed by NOAA observers. PIFSC attaches tag anchors to poles or pole spears, and if giant manta rays are within reach, they are able to tag them. PIFSC also proposes to collect tissue samples using either scissors or tissue plugs. PIFSC will collect a small sample (1 cc) of tissue using surgical scissors or a tissue plug. The tissue plug can be taken from the dorsal musculature while fin clips using surgical scissors may come from any fin (pectoral, caudal, dorsal, second dorsal, or pelvic). For all gear types, tissue sampling will occur in a very similar fashion, where fishers will be given a specialized pole with a tissue plug. PISFC will take tissue plugs from the dorsal musculature. These interactions are typically less than one minute. PIFSC may also tag and tissue sample scalloped hammerhead sharks if they are incidentally caught in various fisheries within the region. All scalloped hammerhead sharks not caught within the HARA would be within the Indo/West Pacific DPS, which is threatened. PIFSC would collect tissue samples and tag scalloped hammerhead sharks as described above. This consultation includes the effects of sampling and tagging incidentally-caught giant manta rays and Indo-West Pacific scalloped hammerhead sharks. It does not include the effects of these fisheries. An effect is caused by the proposed action if it will not occur but for the proposed action. These fisheries will occur regardless of the proposed research project.

Marine Turtle Biology and Assessment Program

PIFSC conducts research on sea turtles in the Pacific Islands Region. Their action is described in their permit (NMFS ESA 10(a)1A permit number 21260) and corresponding biological and conference opinion (NMFS 2017). All takes and effects that are expected to harm or harass sea turtles under that permit are covered under that permit and will not be evaluated in this biological opinion.

The MTBAP will employ a variety of tasks and methods to observe and collect data on sea turtles throughout the region. These tasks include visual observation, underwater and land-based captures, measurements, tagging, tissue sampling, swabbing, diet sampling, marking, ultrasound sampling, laparoscopy, photo documentation, and mark-recapture.

The MTBAP uses a variety of vessels to support their activities. PIFSC uses primarily 19- to 22-foot inflatable vessels and estimates no more than 100 vessel trips throughout the region to conduct the activities. To avoid and minimize effects such as disturbance, contact with humans or gear, vessel collision, pollutants, and other effects associated with implementation of the program, the MTBAP will adhere to all relevant BMPs identified in Table 2.

Proposed surveys per year:

- NWHI (if typical, 20 week season): 140 night, 200 basking
- MHI: 30 basking, 30 in-water
- Marianas: 20 in-water, 10 nesting
- American Samoa (Rose): 6 night, 4 in-water
- PRIA: 1 in-water

Table 1. Proposed PIFSC Research Activities in four different research areas: 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) Western and Central Pacific including the Pacific Remote Islands Research Area (WCPRA).

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
1) Sampling Pelagic Stages of Insular Fish Species	Results of sampling inform life history and stock structure studies for pelagic larval and juvenile stage specimens of insular fish. Additional habitat information is also collected. Target species are snapper, grouper, and coral reef fish species within the 0-175 meter (m) depth range. Pelagic stages sampling is conducted both at midwater depths using a “Stauffer” modified Cobb trawl (Cobb trawl) or a 10-foot (ft) Isaacs-Kidd trawl, and at the surface using a 6-ft Isaacs-Kidd trawl. Surveys may occur every year in the HARA, but approximately once every three years in the MARA, ASARA, and WCPRA.	HARA MARA ASARA WCPRA 3-200 nautical miles (nm) from shore	Year-round HARA: up to 20 DAS MARA, ASARA, WCPRA: up to 30 DAS approximately once in research area every three years Midwater Research trawls are conducted at night, Surface trawls are conducted day and night	Cobb trawl (midwater trawl) with OES Netmind or Isaacs-Kidd 10-ft midwater trawl	Tow speed: 2.5-3.5 knots (kts) Duration: 60-240 minutes (min) Depth: Deployed at various depths during same tow to target fish at different water depths, usually to 250 m	40 tows per survey per year
				Isaacs-Kidd 6-ft trawl (surface trawl) Dip net (surface)	Tow speed: 2.5-3.5 kts Duration: 60 min Depth: Surface	40 tows per survey per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
2) Spawning Dynamics of Highly Migratory Species	Early life history studies provide larval stages for population genetic studies and include the characterization of habitat for early life stages of pelagic species. Egg and larval collections are taken in surface waters using a variety of plankton gear, primarily Isaacs-Kidd 6-ft surface trawl, but also sometimes including 1-m ring net and surface neuston net.	HARA MARA ASARA WCPRA 1-25 nm from shore	Year-round HARA: up to 25 DAS MARA, ASARA, WCPRA: up to 25 DAS approximately once in research area every three years Surface trawls are conducted day and night	Isaacs-Kidd 6-ft (surface)	Tow speed: 2.5-3.5 kts Duration: 60 min Depth: Surface	140 tows per survey per year
				Neuston tows (surface) 1-m ring net (surface)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min Depth: 0-3 meters (m)	140 tows per survey per year
3) Cetacean Ecology Assessment	Survey transects conducted in conjunction with cetacean visual and acoustic surveys within the Hawaii Exclusive Economic Zone (EEZ) to develop ecosystem models for cetaceans. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.	HARA MARA ASARA WCPRA	Variable, up to 180 DAS depending on area surveyed Midwater trawls are conducted at night, surface trawls are conducted day and night All other gear and instruments are conducted day and night	Cobb midwater trawl	Tow speed: 3 kts Duration: 60-240 min	180 trawls per research area
				Small-mesh towed net (surface trawl)	Tow Speed: 2.5-3.5 kts Duration: 30-60 min	180 tows total per year
				Active acoustics (splitbeam Simrad EK60, OES Netmind)	38-200 kilohertz (kHz)	Intermittent continuous during surveys
				Acoustic Doppler Current Profiler (ADCP) (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
				CTD profiler	90 min Profiles from surface down to 1000 m depth	Up to 180 per survey per year
				Expendable bathythermograph (XBT)	10 min duration. Profiles from surface down to1000 m depth	Maximum 900 per survey per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	Passive Acoustics Calibration - Transmit sound (synthetic pings, dolphin whistles or echolocation clicks, etc.) to passive acoustic recording devices for purposes of in-situ calibration, needed to understand detection distances and received level or frequency-dependent variation in the device performance.	HARA MARA ASARA WCPRA		Underwater sound playback system (Lubell LL916 piezoelectric underwater speaker)	Includes underwater projector and amplifier suspended from small boat or ship. Projection depth may vary from near surface to 100 m.	Intermittent
	Stationary Passive Acoustic Recording - Placement of long-term acoustic listening devices for the purposes of recording cetacean occurrence and distribution, ambient and anthropogenic noise levels, and presence of other natural sounds. Recorders are typically deployed and retrieved once or twice per year at each monitoring location.	HARA MARA ASARA WCPRA		High-frequency acoustic recording package (HARP), ecological acoustic recorder (EAR), or similar device	Deployed in seafloor package or mooring configuration consisting of recorder, acoustic releases, anchor and flotation	Up to ten long-term monitoring sites
	Passive Acoustic Monitoring - Deployment of passive acoustic monitoring devices in conjunction with other sampling measures, such as on fishing gear or free-floating.	HARA MARA ASARA WCPRA		Miniature HARPs, sonobuoys, or similar platforms	Autonomous recorder package modified for attachment to longline gear, oceanographic mooring, or free-floating. Various configurations may have surface buoys with recorder up to 1000 feet (ft) below, or may have smaller form factor with entire package not exceeding 1m length.	Continuous

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	Passive Acoustic or Oceanographic Gliders - Autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods. Passive acoustic device integrated into the vehicle provide measure of cetacean occurrence and background noise. CTD, pH, fluorometer, and other sensors provide oceanographic measures over several months duration.	HARA MARA ASARA WCPRA		Seaglider; WaveGlider; or similar platform	AUV.	Continuous
	Collection of Environmental DNA (eDNA) samples – Shipboard eDNA samples would be collected via the ship's CTD to identify cryptic cetaceans.	HARA MARA ASARA WCPRA	Casts would generally occur during night	eDNA water samples collected via Niskin bottles on CTD frame	Water samples collected at depths ranging from 10 – 1000 m. Water would be collected in Niskin bottles and decanted into 10 liter carboys for processing.	200 casts per research area

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
4) Marine Debris Research and Removal	These surveys: (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. Team members systematically survey reefs using shoreline walks, swim surveys, and towed-diver surveys to locate submerged derelict fishing gear in shallow water. Debris type, size, fouling level, water depth, GPS coordinates, and substrate of the adjacent habitat are recorded. Nets are evaluated before removal actions to determine appropriate removal strategies. Attempts to remove marine debris encountered at sea are variable and can be unfeasible because of operational, vessel, or safety constraints. However, by attaching a satellite-tracked marker to debris, it will be possible to locate that debris in the future and to track and analyze its	HARA MARA ASARA WCPRA	HARA: annually or on an as needed basis, up to 30 DAS ASARA: Occurred once in 2009 after a tsunami Surface trawls are conducted day and night Unmanned Aerial systems (UAS) are conducted during the day or night In-water and beach activities are conducted during the day	Knives, lift bags, scissors, shovels, cargo nets Helicopters (Main Hawaiian Islands [MHI] only)	Gear used to a depth of 30 m in around islands and atolls.	HARA: average of 48 metric tons (mt) per survey per year 1996 - 2013 ASARA: 4 mt per survey per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	drifting patterns.					
	Surface and midwater plankton tows to quantify floating microplastic in seawater	HARA MARA ASARA WCPRA	Annually, or on an as-needed basis, up to 30 DAS Surface trawls are conducted day and night UAS are conducted during the day or night In-water and beach activities are conducted during the day	Neuston, or similar, plankton nets surface towed alongside ship and/or small boats	Tow Speed: varied Duration: < 1 hour	Up to 250 tows per survey per year
	The use of UAS platforms can aid in efficiency during survey and removal operations by directing efforts to high density areas	HARA		UASs (e.g., NOAA PUMA or NASA Ikhana systems, hexacopter)	Deployed from shore, small boat, or ship. Operate along shoreline or over water around atoll.	Less than 20 operations per island or atoll per year
	Adding more frequent marine debris research and removal activities to other research areas.	MARA WCPRA	Additional 30 DAS	Same as above	Same as above	Same as above

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	Collection and sieving of mesoplastics from beach sand located between the low and high tide lines. Plastics are removed for sampling and further study.	HARA		Sieves	Sieving of mesoplastics (> 500 microns in size) from sand.	100 samples per atoll
	Structure-from-Motion (SfM) surveys consist of marking off plots on the seafloor (1-3 m depth) with cable ties and/or stainless steel pins, collecting photographs of the plots and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images.	HARA MARA ASARA WCPRA	Annually, or on an as-needed basis, up to 30 DAS.	Cable ties, stainless steel pins, camera	Temporarily deployed on the seafloor to mark off plots, removed once photos are taken.	
5) Coral Reef Benthic Habitat Mapping	Produces comprehensive digital maps of coral reef ecosystems using multibeam sonar surveys and optical validation data collected using towed vehicles and AUVs.	HARA MARA ASARA WCPRA	Year-round, up to 30 DAS Day and night	Active acoustics (will vary by vessel): Multibeam Simrad EM3002 D and EM300, multibeam Reson 8101 ER, Imagenex 837 DeltaT, split-beam Simrad EK60	38-300 kHz	Continuous

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
6) Deep Coral and Sponge Research	Research includes opportunistic surveys on distribution, life history, ecology, abundance, and size structure of deep corals and sponges using ROV, divers, and submersibles. Besides visual surveys, sampling protocols include collection of coral and sponges for genetic, growth and reproductive work and an array of data loggers (temperature, currents, particulate load) placed on the bottom for recovery in future years.	HARA MARA ASARA WCPRA	Opportunistically, depending on ship availability Year-round, 50 DAS	Remotely operated vessel (ROV), divers, submersibles, AUV, landers, instrument packages, Ship-based multibeam echosounders (SeaBeam 3012 multibeam, EK-60 18kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz)	ROVs include the Super Phantom S2 ROV system operated by the Undersea Vehicles Program at the University of North Carolina at Wilmington. Subs include Pices V and Pices IV and similar Human Occupied Vehicles (HOV) AUV includes Seabed and other unmanned systems Hull-mounted 3.5-30 kHz multibeam	HARA: 200 MARA: 200 ASARA: 200 WCPRA: 200 DNA specimens N=100, mean weight (wt) = 10 grams (g) Voucher specimens N=60 wt = 10-500 g Paleo-specimens N=40, wt=500-2000 g
7) Insular Fish Life History Survey and Studies	Provide size ranges of deepwater eteline snappers, groupers, and large carangids to determine sex-specific length-at-age growth curves, longevity estimates, length and age at 50% reproductive maturity within the Bottomfish Management Unit Species (BMUS) in Hawaii and the other Pacific Islands Regions. Specimens are collected in the field and sampled at markets.	HARA: (0.2 - 5 nm from shore) every year. MARA ASARA WCPRA	HARA: July-September, up to 15 DAS/yr. Other areas: Year-round, up to 30 DAS for each research area once every three years Day and night	Hook-and-line	Hand line, Electric or hydraulic Reel: Each operation involves 1-3 lines with.4-6 hooks per line; soaked 1-30 min. Squid bait on circle hooks (typically 10/0 to 12/0).	HARA: 350 operations per survey per year Other areas: 240 operations per survey per year for each research area
8) Pacific Reef Assessment and Monitoring	Ecosystem surveys that include rapid ecological assessments; towed-	HARA MARA ASARA	Year-round; Annual (each research area is surveyed triennially) 30-120 DAS depending on which area is surveyed	Hand gear used by SCUBA and free divers.	Spear gun, slurp gun (a clear plastic tube designed to catch small fish by sliding a plunger backwards	MARA: Ad hoc fish collections from 2009, less

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
Program (RAMP)	diver surveys; coral disease, invertebrates, fish, and algae surveys; and oceanographic characterization of coral reef ecosystems. Surveys also include training to conduct surveys which occur between 0-3nm from shore, year-round, using small boats, Self-Contained Underwater Breathing Apparatus (SCUBA) or closed circuit rebreathers (CCR) diver surveys, sampling, and deployment of various equipment. Samples and specimens collected in the field would be analyzed in the laboratory.	WCPRA; 0-20 nm from shore	In-water activities with divers are conducted during the day, all other activities are conducted day and night	EARs, Water samplers (programmable Under water Collection Units [PUCs], Remote Access Samplers [RAS], Surface Temperature Recorders [STRs], Water Temperature Recorders [WTRs], and hand collecting devices) Carbonate sensing instruments [SEAFET (pH), SAMI (pH), SAMI (pCO_2)] Calcium Acidification Units (CAUs) Bioerosion Monitoring Units (BMUs)	out of the tube), hand net, including small boat operations with SCUBA Hammer, chisel, bone cutter, shears, scissors, clippers, scraping, syringe, core-punch, hand snipping Temporary transect line, surface marker buoy, 1 m long plastic spacer pole with camera. Sensors are deployed by use of ~ 70 pound (lb.) anchors guided into place by divers. CTD sized instruments are anchored to a dead portion of the reef with coated weights and cable ties typically deployed at 5-30 m depth.	than 20 specimens. Up to 500 samples per year including corals, coral products, algae and algal products, and sessile invertebrates, fragments to entire individuals/colonies 25 EARs per year, typically deployed for 1-3 years 500 water samples per year, deployed 1-7 days 150 deployments per year, deployed for approximately 1-3 years Up to 500 BMUs and CAU per year Collection of 1900 cm^3 of live rock (e.g., dead Porites sp.) to provide clean

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
						coral skeletons to generate new BMUs to measure bio erosion rates, and study bio erosion.
				Pneumatic/hydraulic drill for coral coring	Approx. 4 cm masonry drill bit used to extract a 2.5 x 5-70 centimeter (cm) sample	30 coral cores per survey per year
				Active acoustics: will vary by vessel (Multi-beam: Reson8101 ER; split-beam: Simrad EK60)	38-200 kHz	Continuous
				BMUs	1 x 2 x 5 cm pieces of relic calcium carbonate, placed next to the reef and deployed at 0-40 m	150 deployments per survey per year, deployed for approximately 1-3 years.
				Autonomous reef monitoring structures (ARMS)	36 x 46 x 20 cm structure placed on pavement or rubble (secured to bottom by stainless steel stakes and weights) in proximity to coral reef structures	150 deployments for a duration of typically1-3 yr. each
				Sea Bird Electronics SBE56 temperature recorders	Instrument and mounting brackets are 10 x 5 x 30 cm, anchored to a dead portion of the reef with two coated 3 lb. dive weights and cable ties, typically deployed at 5-25 m, but may reach 30 m	Typically deployed for 1-3 years
				ADCP	Nortek Aquadopp Sideseeing Profiler, 2 megahertz (MHz) down to 30 m	Continuous during transects
				CTD profiler (shallow-water and deep-water)	Shallow-water CTDs will be conducted from small boats to a depth of 30 meters Deep-water CTDs will be conducted from larger vessels to a maximum depth of 500 m.	Hundreds to thousands of casts per survey per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
				Baited remote underwater video system (BRUVS)	35 kg system weight with 1 kilogram (kg) of bait Deployed down to100 m to the seafloor	Up to 600 deployments per survey per year Deployed for approx. 1 hour
				CAUs	Each CAU consists of 2 PVC plates (10 x 10 cm) separated by a 1 cm spacer and mounted on a stainless steel rod which is installed by divers into the bottom (avoiding corals) down to 30 m	150 deployments per survey per year Deployed for approximately 1-3 years
	UAS would be used to collect coral reef ecosystem mapping & monitoring data. Initially testing and field trials would be conducted using multispectral, hyperspectral, or IR sensors. Surveys would be conducted around the MHI.	HARA MARA ASARA WCPRA		UASs (e.g., NOAA PUMA or NASA Ikhana systems, hexacopter)	Deployed from shore, small boat, or ship. Operate along shoreline or over water around atoll.	Less than 20 operations per island or atoll per year
	USV – Unmanned Surface Vehicles	HARA MARA ASARA WCPRA Nearshore areas		*Emily* Unmanned Survey Vehicle (USV) will be used to conduct nearshore sampling of surface and bottom variables, as well as ambient atmospheric conditions near the USV.		
	Visual reef fish surveys	HARA MARA ASARA WCPRA	Year-round, additional 21 DAS	SCUBA and free divers	Visual fish identification and abundance surveys, benthic photo-transect	None
	Photomosaics to collect coral community composition data.	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed.	SCUBA, digital cameras and video camera	Camera system with two SLR digital cameras and a single video camera mounted to a custom frame.	None

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	Carbonate budget assessments to assess reef material production rates	HARA MARA ASARA WCPRA	Year-round, 30-120 DAS depending on area surveyed.	SCUBA divers	Visual benthic, fish, and urchin identification, size, and abundance surveys	None
9) Surface Night-Light Sampling	Conducted opportunistically for decades aboard PIFSC research vessels. Sampling goals: collect larval or juvenile stages of pelagic or reef fish species that accumulate within surface slicks during daylight hours and those attracted to surface and submerged lights from research vessels at night.	HARA; primarily 1-25 nm from shore; adjacent to the Kona coast, but also out to 200 nm and beyond in the WCPRA	Year-round Up to 30 DAS Along with scheduled NOAA research cruises or opportunistically aboard other vessels. Conducted during the night	Net (dip)	Scoop nets (0.5 m diameter sometimes attached to 3-4 m long poles) used while vessel is drifting	30 night-light operations on all vessels combined. Total catch (all species) ≤ 1,500 specimens of larval or juvenile fish per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
10) Pelagic Troll and Handline Sampling	Surveys would be conducted to collect life history and molecular samples from pelagic species. Other target species would be tagged-and-released. Different tags would be used depending upon the species and study, but could include: passive, archival, ultrasonic, and satellite tags. Fishery observers or NOAA scientists conduct on-board documentation of catch and survival.	HARA, MARA, ASARA, 0 to 24 nm from shore (excluding any special resource areas)	Variable, up to 14 DAS Day and night	Pelagic troll and handline (hook-and-line) fishing. NOAA research vessels or the equivalent, or contracted fishing vessels.	Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook trolling lures at 4-10 kts. Pelagic handline (hook-and-line) fishing at primarily 10-100 m midwater depths and down to bottomfish depths of 600 m, with hand, electric, or hydraulic reels. Up to 4 lines. Each line is baited with 4 hooks.	A total of up to 2 operations of any of these gear types per DAS, totaling 28 operations (all types combined) for the survey.
11) West Hawaii Integrated Ecosystem Assessment Cruise	Survey transects conducted off the Kona coast and Kohala Shelf area to develop ecosystem models for coral reefs, socioeconomic indicators, circulation patterns, larval fish transport and settlement. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations;	HARA; 2-10 nm from shore	Variable timing, depending on ship availability, up to 10 DAS Day and night	Large-mesh midwater Cobb trawl	Tow speed: 3 kts Duration: 60-240 min Depths: Deployed at various depths during same tow to target fish at different water depths, usually to 200 m	15-20 tows per survey per year
				Hook-and-line	Electric or hydraulic reel: Each operation involves 1-3 lines, with squid lures, soaked 10-60 min at depths between 200m to 600m.	No more than 50 hours of effort. Approximately 10 mesopelagic squid caught per year
				Small-mesh surface and midwater trawl nets (Isaacs-Kidd 6-ft and 10-ft, neuston, ring, bongo nets, 1-m plankton drop net)	Tow speed: 3 kts Duration: up to 60 min Depth: 0-200 m	15-20 tows per survey per year (any combination of the nets described)

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	surface and water column oceanographic measurements and water sample collection. This survey is usually performed along with passive acoustic surveys as described under the Cetacean Ecological Surveys			Active acoustics (split-beam: Simrad EK60; trawl mounted OES Netmind; Didson 303)	Hull mounted: 38-200 kHz Surveys typically from surface to 1000 m depth Didson is usually operated between 400 m and 700 m depth. Range is 30 m	Intermittent continuous during surveys Up to 12 Didson casts for up to 120 min per survey.
				ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
				CTD profiler	90 min/cast	50 tows per survey per year, alternating with Oceanography Cruise
12) Sampling of Juvenile-stage Bottomfish via Settlement Traps	Sampling activity to capture juvenile recruits of eteline snappers and grouper that have recently transitioned from the pelagic to demersal habitat. The specimens will provide estimates of birthdate, pelagic duration, settlement date, and pre- and post-recruitment growth rates derived from the analysis of otoliths. The target species include Deep-7 bottomfish and the settlement habitats these stages are associated with.	MHI; 0.2-5 nm from shore	July-September Up to 25 DAS Day and night	Trap (Settlement)	Cylindrical with dimensions up to 3 m long and 2 m diameter. Frame composed of semi-rigid plastic mesh of up to 5 cm mesh size. Folded plastic of up to 10 cm mesh is stuffed inside as settlement habitat, and cylinder ends are then pinched shut. Traps are clipped throughout the water column onto a vertical line anchored on bottom at up to 400 m, supported by a surface float.	10 traps per line set; up to 4 line sets soaked per day, from overnight up to 3 days. Up to 100 lines of traps set per year. Catch of 2500 juvenile stage bottomfish per year
13) Barbless Hook Donation	Donations of barbless circle hooks are made primarily at shore-based fishing tournaments or	HARA	Year round, no DAS Conducted during the day	Barbless circle hooks	Hooks have the barbs crimped flat (barbs effectively removed)	Up to 35 events (days of donating hooks) per year. Up to 35,000

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	other outreach events to encourage replacement of barbed hooks in normal (legal) use. PIFSC has no control over the use of the hooks after the donation.					hooks donated per yr
14) Insular fish Abundance Estimation Comparison Surveys	Comparison of Fishery-Independent Methods to Survey Bottomfish Assemblages in the MHI: Coordinated research between PIFSC ESD and FRMD, State of Hawaii Department of Land and Natural Resources, University of Hawaii at Manoa, University of Miami. Day and night* surveys are used to develop fishery-independent methods to assess stocks of economically important insular fish. Methods include: active acoustics, stereo baited underwater video camera systems (BotCam, Modular Optical Underwater Survey System [MOUSS], BRUVS), AUV equipped with stereo video cameras, towed optical assessment device (TOAD), and hook-and-line fishing.	HARA MARA ASARA WCPRA	Variable, up to 30 DAS per research area per year, HARA surveyed annually, ASARA, WCPRA surveyed every 3 years	Hook-and-line	Hand, Electric, Hydraulic reels. Each vessel fishes 2 lines. Each line is baited with 4-6 hooks. 1-30 minutes per fishing operation.	HARA: 7,680 operations per year MARA: 1.920 every 3rd year (average 640 operations per year) ASARA: 1,920 every 3rd year (average 640 per year) WCPRA: 1,920 every 3rd year (average 640 per year)
				Active acoustics (split multi-beam: Reson8101 ER; deep water: Simrad EK60; trawl mounted OES Netmind), various fish finder devices	Hull mounted 38-240 kHz	Intermittent continuous during surveys
				Underwater Video Camera (BotCam BRUVS, MOUSS)	Duration: deployed 30-60 min. Depth: 350m	HARA: 7,680 drops per year MARA: 1.920 every 3rd year (average 640 per year) ASARA: 1,920 every 3rd year (average 640 per year) WCPRA: 1,920

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
						every 3rd year (average 640 per year)
				AUV	Speed: 0.5 kts Duration: 3 hours/deployment	HARA: 480 deployments per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average 27 per year) WCPRA: 80 every 3rd year (average 27 per year)
				ROV	Duration: 1 hr	HARA: 480 deployments per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average27 per year) WCPRA: 80 every 3rd year (average 27 per year)
				TOAD	Tow speed: 6 kts Duration: 1 hr	HARA: 480 per year MARA: 80 every 3rd year (average 27 per year) ASARA: 80 every 3rd year (average 27 per year)

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
						WCPRA: 80 every 3rd year (average 27 per year)
				Niskin bottles attached to ship's CTD, MOUSS frame (aboard small boats), or equivalent	Bottles attached to frame would be triggered at different depths (10 – 1000 m). Water would be stored and processed upon conclusion of the cruise.	250 casts / 250 L of water per research area per year
				Ship-based multibeam echosounders (SeaBeam 3012 multibeam, EK-60 18kHz, Knudsen 3260 sub-bottom profiler 3.5 kHz)	Hull mounted	Intermittent continuous during surveys
15) Gear and Instrument Development and Field Trials	Field trials to test the functionality of the gear prior to the field season or to test new gear or instruments described elsewhere in this table, but outside the geographic scope specified for other surveys.	HARA (Primarily in the waters south of Pearl Harbor on the Island of O'ahu)	Year-round, up to 15 DAS Day and night	Nets, lines, instruments Calibration of Simrad EK60	38-200 kHz	Intermittent for 24-48 hours
16) Mariana Resource Survey	Sampling activity to quantify baseline bottomfish and reef fish resources in the MARA. Various artificial habitat designs will be developed, enclosed in mesh to retain captures, and evaluated. Cobb trawl and Isaacs-Kidd trawls will collect pelagic-stage specimens of reef fish and bottomfish species.	MARA 0-25 nm from shore	May - August Up to 102 DAS (once every three years) Midwater trawls are conducted at night, surface trawls are conducted day and night In-water activities are conducted during the day All other activities are day or night	Large-mesh midwater Cobb trawl	Tow speed: 3 kts Duration: 60-240 min trawls; 2 tows per night Depth(s): Deployed at various depths during same tow to target fish at different water depths, usually between 100 m and 200 m	15-20 tows per survey per year
				Small-mesh surface and midwater trawl nets (Isaacs-Kidd, neuston, ring, bongo nets)	Tow speed: 3 kts Duration: up to 60 min Depth: 0-200 m	15-20 tows (any combination of the nets described) per survey per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	Large fish traps (1m x 1m x 2m) will be deployed overnight to assess bottomfish composition relative to hook-and-line fishing and the quality of each habitat for recent recruits. Traps will be set along or perpendicular to the bottom contour primarily in mesophotic habitats (50-200 m depths) and in deep-slope bottomfish habitats (200-500 m).			Traps (Kona crab, enclosure)	Nylon nets, meshing 2 1/2 inches attached to a wire ring with bait. Up to ten nets can be tied together with a buoy on the end. Soak for about 20 min. Enclosure traps are Fathoms Plus shellfish "lobster" traps or similar. dome-shaped, single-chambered, two entrance cones with inside mesh dimensions of 45mm x 45mm. Weighted and baited with the remains of life history samples and attached to two surface floats. Two strings of six traps deployed at night on not coral substrate, and retrieved the next morning. Up to 20 traps per string, separated by 20 fathoms of ground line; two depths 10-35 fathoms. Up to 2 strings per DAS. Trap dimensions up to 1m high, 1 m wide, and 2 m long. Traps have outer mesh covering from 0.5-3.0 inch mesh and 1-2 funnel entrances. Trap is baited with fish using an inside baiter. Trap door swings open to retrieve catch and baiter.	25 gear sets per cruise Up to 400 strings set per survey per year
				Simrad split-beam EK60, OES Netmind	38-200 kHz	Intermittent continuous during surveys
				Hook-and-line	Electric or hydraulic reel: Each operation involves 1-3 lines, with squid lures, soaked 10-60 min at depths between 200 m to 600 m.	1000 sets per survey per year
				Divers (spear)	Speargun	1000 reef fish

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
17) Pelagic Oceanographic Cruise	Investigate physical (e.g., fronts) and biological features that define the habitats for important commercial and protected species of the North Pacific Ocean, especially tuna and billfishes, which are targeted by longline fishers. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; surface and water column oceanographic measurements and water sample collection.	Pacific Ocean; Western and Central tropical and subtropical Pacific 25-1000 nm from shore in any direction	Annual (season variable) Up to 30 DAS Midwater trawls are conducted at night, surface trawls are conducted day and night All other activities are conducted day and night	Large-mesh midwater Cobb trawl Plankton drop net (stationary surface sampling)	Tow speed: 3 kts Duration: 60-240 min 1-meter diameter plankton drop net would be deployed down to 100 m	20 tows per year, alternating with West Hawai‘i IEA cruise 4 liters of micronekton per tow 20 drops per year (collections would be less than one liter of plankton)
				Small-mesh surface and midwater trawl nets (Isaacs-Kidd, neuston, ring, bongo nets)	Duration: up to 60 min Depth: 0-200 m	15-20 tows (any combination of the nets described) <1 liter of organisms per tow
				Active acoustics (split multi-beam: Reson8101 ER; deep water: Simrad EK60, OES Netmind)	38-200 kHz	Intermittent continuous during surveys
				ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
				CTD profiler	45-90 min cast duration	60 casts per year, alternating with West Hawai‘i IEA cruise 60 tows/year
18) Lagoon Ecosystem Characterization	Measure the abundance and distribution of reef fish (including juvenile bumphead parrotfish) in any of the lagoons in the WCPRA over a two-week-long period by	Throughout WCPRA	Up to 14 DAS Conducted during the day	Divers with Hand Net or speargun	SCUBA, snorkel, 12-inch diameter small mesh hand net	10 dives per survey 10 fin clips collected for genetic analyses

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	employing standardized transect and photo-quadrant techniques using SCUBA and snorkeling gear. A collection net may also be used to non-lethally sample fish species inhabiting the lagoon to determine genetic identity. Hook-and–line and spear may also be used to lethally collect specimens.					
				Hook-and-line	Standard rod and reel using lures or fish bait from shoreline or small boat	1-30 min casts 60 casts per survey
19) Pelagic Longline, Troll, and Handline Gear Trials	Investigate effectiveness of various types of hooks, hook guards, gear configurations, or other modified fishing practices for reducing the bycatch of non-target species and retaining or increasing target catch. Data collected on catch efficacy, fish size, species selectivity, and survival upon haul-back Investigate the vertical distribution of pelagic species catch and capture time with TDRs and hook-timers. Investigate behavior of catch and bycatch in	25 to 500 nm from shore (excluding any special resource areas).		Trolling and handline (hook-and-line)	Troll fishing with up to 4 troll lines each with 1-2 baited hooks or 1-2 hook troll lures at 4-10 kts Pelagic handline (hook-and-line) fishing at 10-100 m midwater depths, with hand, electric, or hydraulic reels. Up to 4 lines. Each line is baited with 4 hooks. Up to 4 hrs per troll or handline operation	Up to 21 troll or handline (combined) operations per survey per year

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	relation to fishing operations using cameras, hydrophones, or other sensors. Catch may be tagged and released and specimens may be kept for genetic, physiological, and ecological studies. Troll and handline fishing for pelagic species may also be investigated, with tag and release of catch and collection of specimens.					
		HARA MARA ASARA WCPRA	Up to 60 DAS per year	Tags (SPOT, SPAT, miniPAT, dart tags, Coded 69 kHz acoustic transmitters (V16 Vemco).	SPOT = up to 87 x 37 x 23 millimeter (mm) and 57 g fin mounted tags SPAT = 124 x 38 mm and 60 g attached by tether and anchor miniPAT = 124 x 38 mm and 60 g attached by tether and anchor Dart tags = 160 x 1.6 mm attached at base of dorsal fin Acoustic transmitters = 90 x 9 mm, surgically implanted into abdominal wall	50 sharks/year per species (Bigeye thresher, silky, whale, Blue, pelagic thresher, mako spp., mobulid spp.), 3 milliliter (ml) blood samples from the same sharks
20) Fishing Impacts of Non-Target Species	Bycatch reduction research, post release survival and ecological research on sharks commonly encountered in recreational, commercial purse seine and longline fisheries in the Pacific Ocean. Research would include post-release survival studies to identify and develop best handling	HARA MARA ASARA WCPRA	Up to 60 DAS per year	Microwave Telemetry Inc. Pop-off Satellite Archival Transmitting Tags (PSATs,), acoustic tags or conventional identification tags. From small boats used in the tuna fisheryTags (SPOT, SPAT, miniPAT, dart tags, Coded 69 kHz acoustic transmitters (V16 Vemco).	Fishing techniques that might interact with these sharks include: nighttime handline fishing, trolling, jigging, bottom-fishing and spearfishing. SPOT = up to 87 x 37 x 23 millimeter (mm) and 57 g fin mounted tags SPAT = 124 x 38 mm and 60 g attached by tether and anchor miniPAT = 124 x 38 mm and 60 g attached by tether and anchor Dart tags = 160 x 1.6 mm attached at base of dorsal fin	About 27 individuals may be captured and tagged in a given year 50 sharks/year per species (Bigeye thresher, silky, whale, Blue, pelagic thresher, mako spp., mobulid spp.), 3 milliliter (ml)

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
	methods in recreational, purse seine and longline fisheries for improved post-release survival rates and ensuring crew safety. The deployment and analysis of electronic tags would generate robust post-release survival estimates which would improve the rigor of stock assessments and aid in the development of best handling practices for fisheries impacting shark populations.				Acoustic transmitters = 90 x 9 mm, surgically implanted into abdominal wall	blood samples from the same sharks
22) Giant Manta Ray Tagging	Tagging, tracking and biological sampling of giant manta rays incidentally caught in Pacific longline and purse seine fisheries. Research activities would be directed by PIFSC and include training fishery observers to tag, photograph, collect tissue samples and/or collect interaction data from giant manta rays captured incidentally during fishing operations in the western and central Pacific ocean	HARA	Annual (season variable) Up to 20 DAS, daytime operations	Plankton drop net (stationary surface sampling)	1-meter diameter plankton drop net would be deployed down to 100 m	200 drops per year (collection total would be less than five liters of plankton)
23) Coastal Pelagic Ecology,	Investigate physical and			Small-mesh surface nets (neuston, ring, bongo nets)	Duration: up to 60 min Depth: 0-100 m	15-20 tows (any combination of

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
Coastal Fishery Oceanography, Opelu Koas	biological features that define the key habitats for important coastal pelagic species around Hawaiian Islands, especially the mackerel scad locally called opelu, *Decapterus macarellus*, which are targeted by fishers and an important forage fish for the coastal pelagic ecosystem. Sampling includes using 360-degree video cameras in the water column; scientific fishing operations; plankton nets; surface and water column oceanographic measurements; water sample collection for biogeochemical properties, physical properties, and eDNA. These surveys will be conducted in waters within and adjacent to these key habitats.					the nets described) <1 liter of organisms per tow
				CTD profiler (portable unit)	15-30 min cast duration	60 casts per year
				360 degree video camera	Less than 1 hour duration	Up to 20 deployments per year
				Hook-and-line	Standard rod and reel using jigging lures from small boat at ~ 25 meters depth	2 lines used at daytime only. 10-20 small boat trips per year. Less than one hour per trip.

Survey Name	Survey Description	General Area of Operation*	Season, Frequency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
				Water sample collection	Duration: 15-30 min; Depth:0-100m; Water samples collected at depths ranging from 0 – 100 m. Water would be collected in Niskin bottles and decanted into 10 L carboys for processing.	60 casts per year
				Water sample collection	Duration: 15-30 min; Depth:0-100m; Water samples collected at depths ranging from 0 – 100 m. Water would be collected in Niskin bottles and decanted into 10 L carboys for processing.	60 casts per year

Table 2. Proposed Mitigation and Monitoring Measures.

Proposed Activities	Mitigation and Monitoring Measures
Midwater Trawl Surveys	Visual Monitoring Measures • The officer on watch, Chief Scientist (or other designee), and crew standing watch visually scan for marine mammals, sea turtles, and other ESA-listed species (protected species) using binoculars. The monitor should have no other duties while monitoring and should be trained in species identification methods. Because trawling is typically conducted at night, sight distance is generally limited to no more than 20 m beyond the ship. If trawling is conducted during the day, an approximately 1-km radius is scanned. Operational Procedures • "Move-on" Rule: When trawling is conducted during the day, if any marine mammals are sighted by the Chief Scientist or designee within a 1 km radius of the vessel in the 30 minutes before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear at the discretion of the officer on watch in consultation with the Chief Scientist. When trawling is conducted at night, the visible distance would be limited to 20 m. Small moves within the sampling area can be accomplished without leaving the sample station. After moving on, if marine mammals are still visible from the vessel and appear to be at risk, the officer on watch

Proposed Activities	Mitigation and Monitoring Measures
	may decide, in consultation with the Chief Scientist, to move again or to skip the station. The officer on watch will first consult with the Chief Scientist or other designated scientist and other experienced crew as necessary to determine the best strategy to avoid potential takes of these species based on those encountered, their numbers and behavior, position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel might not require any move or only require a short move from the initial sampling site while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if they follow the vessel. In most cases, trawl gear is not deployed if marine mammals have been sighted from the ship in the previous 30 minutes unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the Chief Scientist and officer on watch. The efficacy of the "move-on" rule is limited during nighttime or other periods of limited visibility; although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval. • Trawl operations are usually the first activity undertaken upon arrival at a new station in order to reduce the opportunity to attract marine mammals and other protected species to the vessel. However, in some cases, CTD casts may immediately precede trawl deployment. The order of gear deployment is determined on a case-by-case basis by the Chief Scientist based on environmental conditions and other available information at the sampling site. Other activities, such as water sampling or plankton tows, are conducted in conjunction with, or upon completion of, trawl activities. • Once the trawl net is in the water, the officer on watch, the Chief Scientist or other designated scientist, or crew standing watch continue to monitor the waters around the vessel and maintain a lookout for marine mammal presence as far away as environmental conditions allow (as noted previously, visibility is very limited during night trawls). If these species are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. Generally, if a marine mammal is incidentally caught, it would happen during haul-back operations, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. The risk of catching an animal may be reduced if the trawling continues and the haul-back is delayed until after the marine mammal has lost interest in gear, or left the area. In other situations, swift retrieval of the net or cutting the cables may be the best course of action. The appropriate course of action to minimize the risk of incidental take of protected species is determined by the professional judgment of the officer on watch and appropriate crew based on all situation variables, even if the choices compromise the value of the data collected at the station.

	Mitigation and Monitoring Measures
	• If trawling operations have been delayed because of the presence of marine mammals, the vessel resumes trawl operations (when practicable) only when these species have not been sighted within 30 minutes or else otherwise determined to no longer be at risk. This decision is at the discretion of the officer on watch and will depend upon the circumstances of the situation. • Care is taken when emptying the trawl, including opening the cod end, as close to the deck as possible in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. The gear is emptied as quickly as possible after retrieval in order to determine whether or not protected species are present. It may be necessary to cut the net to remove the protected species. Tow Duration • Standard tow durations for midwater Cobb trawls are between two and four hours as target species are relatively rare, and longer haul times are necessary to acquire the appropriate scientific samples. However, trawl hauls will be terminated and the trawl retrieved upon the determination and professional judgment of the officer on watch, in consultation with the Chief Scientist or other designated scientist and other experienced crew as necessary, that this action is warranted in order to avoid an incidental take. Marine mammal excluder devices • PIFSC currently uses two types of midwater trawl nets; the Cobb trawl and the Isaacs-Kidd trawl. The Cobb trawl and the Isaacs-Kidd trawl have been used throughout the Pacific Islands Region (PIR) with no interactions with protected species. There are no plans to develop or install marine mammal excluder devices for these types of trawls in this region. Speed limits and course alterations • Vessel speeds are restricted on research cruises in part to reduce the risk of ship strikes with marine mammals. Transit speeds vary from six to ten knots, but average nine knots. The vessel's speed during active Cobb trawl operations and active acoustic surveys is typically two to four knots due to trawl net and sea-state constraints. Thus, these much slower speeds greatly reduce the risk of ship strikes. In addition, PIFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them. • At any time during a survey or while in transit, any crew member that sights marine mammals that may intersect with the vessel course immediately communicates their presence to the bridge for appropriate course alteration or speed reduction as possible to avoid incidental collisions, particularly with large whales.

Proposed Activities	Mitigation and Monitoring Measures
	<u>Gear modifications</u> • As applicable, sinking line would be used for approximately the top 1/3 of the line. The other approximately lower 2/3 would still be floating line. This configuration would allow any excess scope in the line to sink to a depth where it would be below where most whales and dolphins commonly occur. Specific line lengths, and ratios of floating line to sinking line, would vary with actual depth and the total line length. This mitigation measure would not preclude the risk of whales or dolphins swimming into the submerged line, but this risk is believed to be lower relative to line floating on the surface.
Longline Gear	<u>Operational Procedures</u> Longline research is currently conducted in conjunction with commercial fisheries, and operational characteristics of the longline gear follows the requirements specified in 50 Code of Federal Regulations (CFR) 229, 300, 404, 600, and 665. PIFSC will generally follow the following procedures when setting and retrieving longline gear: • When shallow-setting anywhere and setting longline gear from the stern: Completely thawed and blue-dyed bait will be used (two 1-lb. containers of blue-dye will be kept on the boat for backup). Fish parts and spent bait with all hooks removed will be kept for strategic offal discard. Retained swordfish will be cut in half at the head; used heads and livers will also be used for strategic offal discard. Setting will only occur at night and begin 1 hour after local sunset and finish 1 hour before next sunrise, with lighting kept to a minimum. • When deep-setting north of 23°N and setting longline gear from the stern: 45 g or heavier weights will be attached within 1 m of each hook. A line shooter will be used to set the mainline. Completely thawed and blue-dyed bait will be used (two 1-lb. containers of blue-dye will be kept on the boat for backup). Fish parts and spent bait with all hooks removed will be kept for strategic offal discard. Retained swordfish will be cut in half at the head; used heads and livers will also be used for strategic offal discard. • When shallow-setting anywhere and setting longline gear from the side: Mainline will be deployed from the port or starboard side at least 1 m forward of the stern corner. If a line shooter is used, it will be mounted at least 1 m forward from the stern corner. A specified bird curtain will be used aft of the setting station during the set. Gear will be deployed so that hooks do not resurface. 45 g or heavier weights will be attached within 1 m of each hook. • When deep-setting north of 23°N and setting longline gear from the side: Mainline will be deployed from the port or starboard side at least 1 m forward of the stern corner. If a line shooter is used, it will be mounted at least 1 m forward from the stern corner. A specified bird curtain will be used

Proposed Activities	Mitigation and Monitoring Measures
	aft of the setting station during the set. Gear will be deployed so that hooks do not resurface. 45 g or heavier weights will be attached within 1 m of each hook. • The "move-on" rule may be implemented if any protected species are present near the vessel and appear to be at risk of interactions with the longline gear; longline sets are not made if marine mammals or sea turtles have been seen within in 1km from the vessel within the past 30 min and represent a potential for interaction with the longline gear, as determined by the professional judgment of the Chief Scientist or officer on watch. Longline gear is always the first equipment or fishing gear to be deployed when the vessel arrives on station. Longline gear is set immediately upon arrival at each station provided the conditions requiring the move-on rule have not been met. • If marine mammals are detected while longline gear is in the water, the officer on watch exercises similar judgments and discretion to avoid incidental take of these species with longline gear as described for trawl gear. The species, number, and behavior of the protected species are considered along with the status of the ship and gear, weather and sea conditions, and crew safety factors. The officer on watch uses professional judgment and discretion to minimize risk of potentially adverse interactions with protected species during all aspects of longline survey activities. • If marine mammals are detected during setting operations and are considered to be at risk, immediate retrieval or halting the setting operations may be warranted. If setting operations have been halted due to the presence of these species, setting does not resume until no marine mammals have been observed for at least 30 min. • If marine mammals are detected while longline gear is in the water and are considered to be at risk, haul-back is postponed until the officer on watch determines that it is safe to proceed. Marine mammals caught during longline fishing are typically only caught during retrieval, so extra caution must be taken during this phase of sampling. <u>Gear Modifications</u> • Use of sinking line as described above for trawl surveys.

Proposed Activities	Mitigation and Monitoring Measures
Plankton Nets, Small-mesh Towed Nets, Oceanographic Sampling Devices, Active Acoustics, Video Cameras, AUV, and Remotely Operated Vessel (ROV) Deployments	• PIFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises, such as plankton nets, oceanographic sampling devices, video cameras, low-power high-frequency active acoustics directed underneath the ship as a beam, AUVs and ROVs. It is not anticipated that these types of gear or equipment would interact with protected species and are therefore not subject to specific mitigation measures. However, the officer on watch and crew visually monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to protected species during deployment of all research equipment (e.g., reduced boat speed). Often these types of gear are deployed from small boats, not ships, and therefore visual monitoring is the best measures to avoid interactions with protected species.
Reef Assessment and Monitoring Program and Marine Debris Research and Removal Activities	The following measures are carried out when working in and around shallow water coral reef habitats. These measures are intended to avoid and minimize impacts to protected species and benthic habitats, as well as avoid introducing non-native invasive species. These activities generally include small boat operations and divers in the water. <u>Small Boat and Diver Operations</u> • Transit from the open ocean to shallow-reef survey regions (depths of < 35 m) of atolls and islands should be no more than 3 nm, dependent upon prevailing weather conditions and regulations. Each team conducts surveys and in-water operations with at least 2 divers observing for the proximity of protected species sightings, a coxswain driving the small boat, and a topside spotter working in tandem. Topside spotters may also work as coxswains, depending on team assignment and boat layout. Spotters and coxswains will be tasked with specifically looking out for divers, protected species, and environmental hazards. • Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species. Scientists, divers, and coxswains follow the Best Management Practices (BMPs) for boat operations and diving activities. These practices include but are not limited to the following precepts: 1. Constant vigilance shall be kept for the presence of protected species 2. When piloting vessels, vessel operators shall alter course to remain at least 100 m from marine mammals and at least 50 m from sea turtles 3. Reduce vessel speed to 10 km or less when piloting vessels in the proximity of marine mammals 4. Reduce vessel speed to 5 km or less when piloting vessels in areas of known or suspected turtle activity

Proposed Activities	Mitigation and Monitoring Measures
	5. Marine mammals and sea turtles should not be encircled or trapped between multiple vessels or between vessels and the shore 6. If approached by a marine mammal or turtle, put the engine in neutral and allow the animal to pass 7. Unless specifically covered under a separate permit that allows activity in proximity to protected species, all in-water work will be postponed until whales are within 100 yards or other protected species are within 50 yards. Activity will commence only after the animal(s) depart the area 8. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s) 9. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any protected species <u>Protocol for Minimizing Benthic Disturbance (including coral reefs)</u> • Research dives, using scuba, will focus on the goal of data collection for research and monitoring purposes. All care will be taken during anchoring small boats, with sand or rubble substrate targeted for anchorage to minimize benthic disturbance or coral damage. The operational area will be continuously monitored for protected species, with dive surveys being altered, postponed, or canceled and small boats on standby, neutral, or relocating to minimize disturbances or interactions. The anchor will be lowered rather than thrown, and a diver will check the anchor to make sure it does not drag or entangle any benthos or listed species. • ESA coral taxa would be collected as sparingly as possible and would never exceed more than 10 samples per taxon per cruise. Voucher samples would be small (2 cm by 2 cm) and would only be collected from well-established colonies using gloved hands or hammer and chisel with tools bleached between uses. <u>Protocol for Minimizing the Spread of Disease and Invasive Species</u> The following actions are routinely required to minimize the spread of diseases to coral reef organisms and spreading invasive species on equipment and vessels. *Equipment and Gear*

Proposed Activities	Mitigation and Monitoring Measures
	• Equipment (e.g., gloves, forceps, shears, transect lines, photographic spacer poles, surface marker buoys) in direct contact with potential invasive species, diseased coral tissues, or diseased organisms are soaked in a freshwater 1:32 dilution with commercial bleach for at least 10 min and only a disinfected set of equipment is used at each dive site. • All samples of potentially invasive species, diseased coral tissues, or diseased organisms are collected and sealed in at least 2 of a combination of bags or jars underwater on-site and secured into a holding container until processing. • Dive gear (e.g., wetsuit, mask, fins, snorkel, buoyancy compensator, regulator, weight belt, booties) is disinfected by one of the following ways: a 1:52 dilution of commercial bleach in freshwater, a 3 percent free chlorine solution, or a manufacturer's recommended disinfectant-strength dilution of a quaternary ammonium compound in "soft" (low concentration of calcium or magnesium ions) freshwater. Used dive gear is disinfected daily by performing the following steps: (1) physical removal of any organic matter and (2) submersion for a minimum of 10 min in an acceptable disinfection solution, followed by a thorough freshwater rinse and hanging to air dry. All gear in close proximity to the face or skin, such as masks, regulators, and gloves, are additionally rinsed thoroughly with potable water following disinfection. *Small Boats* • Small boats that have been deployed in the field are cleaned and inspected daily for organic material, including any algal fragments or other organisms. Organic material, if found, is physically removed and disposed of according to the ship's solid-waste disposal protocol or in approved secure holding systems. The internal and external surfaces of vessels are rinsed daily with freshwater and always rinsed between islands before transits. Vessels are allowed to dry before redeployment the following day. <u>Sea Turtles and Hawaiian Monk Seals</u> • To avoid interactions with listed species during surveys and operations, team members and small boat coxswains will monitor areas while in transit to and from work sites. If a listed species is sited, the vessel will alter course in the opposite direction. If unable to change course, the vessel will slow or come to a stop awaiting the animal to be clear of the boat as long as passenger safety is not compromised. Currently, there are no known strikes or incidental takes of a listed protected species from a vessel or propeller of a Pacific RAMP vessel in the Northwestern Hawaiian Islands (NWHI), or other surveyed areas around the Pacific. • As part of due diligence, protected species monitoring will continue throughout all dive operations by at least one team member aboard each boat and two divers working underwater. Operations will be altered and modified as previously listed.

Proposed Activities	Mitigation and Monitoring Measures
	• Mechanical equipment will also be monitored to ensure no accidental entanglements occur with protected species (e.g., with Passive Acoustic Monitoring [PAM] float lines, transect lines, and oceanographic equipment stabilization lines). Team members will immediately respond to an entangled animal, halting operations and providing an onsite response assessment (allowing the animal to disentangle itself, assisting with disentanglement, etc.), unless doing so would put divers, coxswains, or other staff at risk of injury or death. • Before approaching any shoreline or exposed reef, all observers will examine the beach, shoreline, reef areas, and any other visible land areas within the line of sight for marine mammals and sea turtles. The Pacific RAMP teams typically do not participate during terrestrial surveys and operations as part of their mandate, and, therefore, minimize the potential for disturbances of resting animals along shorelines. • Land vehicle (trucks) operations will occur in areas of marine debris where vehicle access is possible from highways or rural/dirt roads adjacent to coastal resources. Prior to initiating any marine debris removal operations, marine debris personnel (marine ecosystem specialists) will thoroughly examine the beaches and nearshore environments/waters for Hawaiian monk seals, false killer whales, green sea turtles, and hawksbill sea turtles before approaching marine debris sites and initiating removal activities. Debris will be retrieved by personnel who are knowledgeable of and act in compliance with all federal laws, rules and regulations governing wildlife in the Papahānaumokuākea Marine National Monument and Main Hawaiian Islands (MHI). This includes, but is not limited to: 1. Decontamination of clothing/soft gear taken ashore by prior freezing for 48 hours, or use of new clothing/soft gear as indicated by U.S. Fish and Wildlife Service (USFWS) regulations; 2. Avoidance of seabird colonies; and 3. Avoidance of marine turtles and Hawaiian monk seals, maintaining a minimum distance of 50 yards from all monk seals and turtles, and a minimum of 100 yards from female seals with pups.
Autonomous Underwater Vehicles (AUVs) and Unmanned Aircraft Systems (UAS)	• In order to minimize malfunction of the AUV's during operations, a pre-deployment test of all operating systems will be run to ensure that the AUV is operating correctly and there are no visually apparent physical defects in the AUV. • All AUV deployment missions will have a deployment and retrieval plan to minimize lag time in water and ensure that the AUV is properly retrieved. • In order to minimize the spread of invasive species, all AUV's will be inspected and cleaned of any organic material including algae and other organisms prior to deployment.

Proposed Activities	Mitigation and Monitoring Measures
	• All UAS will undergo a pre-flight test prior to deployment to ensure that the equipment is working properly and weather conditions are conducive to flying a mission. • All UAS operations will be conducted with a pilot and a spotter to ensure that the UAS is monitored at all times. • Should any UAS make an emergency landing in the water, small boats will be deployed immediately to retrieve the equipment to minimize potential for pollution (e.g. loss of gas or batteries into the marine environment). • A submersible dive plan will be in place for each dive that details each mission, locations, and deployment/recovery times to minimize the potential for collision with the substrate or groundings. • Each submersible will be inspected and cleaned of any organic material including algae other organisms, and chemicals, oils or other pollutants prior to deployment, in order to minimize the spread of invasive species and ensure no pollutants are released into the ocean.
Bottom Fishing Hook and Line Research Gear	• Researchers and contracted fishers will use pre-existing mapping data to avoid sensitive areas (areas of high coral cover) when conducting bottomfishing operations Visual monitoring for marine mammals before gear is set and implementation of the "move-on" rule as described for longline gear. • To avoid attracting any marine mammals to a bottom fishing operation, dead fish and bait will not be discarded from the vessel while actively fishing. Dead fish and bait may be discarded after gear is retrieved and immediately before the vessel leaves the sampling location for a new area. • If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity of a bottom fishing operation, then the gear would be retrieved immediately and the vessel would move to another sampling location where marine mammals are not present. • If a hooked fish is retrieved and it appears to the fisher that it has been damaged by a monk seal, then visual monitoring will be enhanced around the vessel for the next ten minutes. Fishing may continue during this time. If a shark is sighted, then visual monitoring would be returned to normal. If a monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity of a bottom fishing operation, then the gear would be retrieved immediately and the vessel would be moved to another sampling location where marine mammals are not present. Catch loss would be tallied on the data sheet, as would a "move-on" for a marine mammal. • If bottom fishing gear is lost while fishing, then visual monitoring will be enhanced around the vessel for the next ten minutes. Fishing may continue during this time. If a protected shark or ray, monk seal, bottlenose dolphin, or other marine mammal is seen in the vicinity, it would be observed until

Proposed Activities	Mitigation and Monitoring Measures
	a determination can be made of whether gear is sighted attached to the animal, gear is suspected to be on the animal (i.e., it demonstrates uncharacteristic behavior such as thrashing), or gear is not observed on the animal and it behaves normally. If a cetacean or monk seal is sighted with the gear attached or suspected to be attached, then the procedures and actions for incidental takes would be initiated. Gear loss would be tallied on the data sheet, as would a "move-on" because of a marine mammal.
Unknown Future PIFSC Research Activities	In addition to the activities identified above, PIFSC may propose additional surveys or modify existing research activities within the timeframe covered by this BA. Over the next five years advancements in technology may lead to new and better sampling instruments and gear, such as video equipment and UAS. Evaluation of proposed future research activity would: • Determine if the activity would be conducted within the geographic scope of the region evaluated • Evaluate the seasonal distribution of the activity and the gear types proposed to determine if coverage is present.

1.3 Requirements Implemented under the False Killer Whale Take Reduction Plan

Under the proposed action, PIFSC may replicate or test gear configurations for the Hawaii DSLL fishery which is also subject to regulations implemented under the authority of the MMPA to conserve false killer whales (50 CFR 229). NMFS implemented the False Killer Whale Take Reduction Plan (FKWTRP) regulations on December 31, 2012 (77 FR 71260). Because the FFKWTRP includes measures that affect the main Hawaiian Islands (MHI) IFKW, we discuss it here.

The FKWTRP implemented the following regulatory measures for the Hawaii DSLL fishery, which would be applicable to deep-set longline sets made by PIFSC during research and testing activities. All were effective on December 31, 2012, with the exception of the gear requirements, which went into effect on February 27, 2013:

- Requires circle hooks with 4.5 mm maximum wire diameter, sufficient round wire in the shank to be measured with a caliper, and 10 degree offset or less.
- Established a minimum 2.0 mm diameter for monofilament used in leaders or branch lines, and a minimum breaking strength of 400 pounds for any line used in the construction of a branch line if any other material is used.
- Established a year-round MHI longline fishing prohibited area in FKWTRP regulations, bounded by the same coordinates as the existing February-September boundary of the MHI longline exclusion zone. The net effect is to prohibit longline fishing year-round in the area north of the MHI that is currently closed to longlining only seasonally. NMFS also revised existing Magnuson-Steven Act regulations defining the MHI longline exclusion zone, to eliminate the seasonal boundary change and make the current February-September boundary permanent year-round, to bring the MSA regulations into accordance with the FKWTRP regulations.
- Requires annual certification in marine mammal interaction mitigation techniques for longline vessel owners and operators.
- Requires posting of a marine mammal handling and release informational placard on longline vessels.
- Requires captains' supervision of marine mammal handling and release.
- Requires posting of a placard instructing crew to notify the captain of marine mammal interactions.
- Established a Southern Exclusion Zone (SEZ) and specific bycatch triggers for closure of this zone to the Hawaii-based deep-set longline fishery (Figure 1).

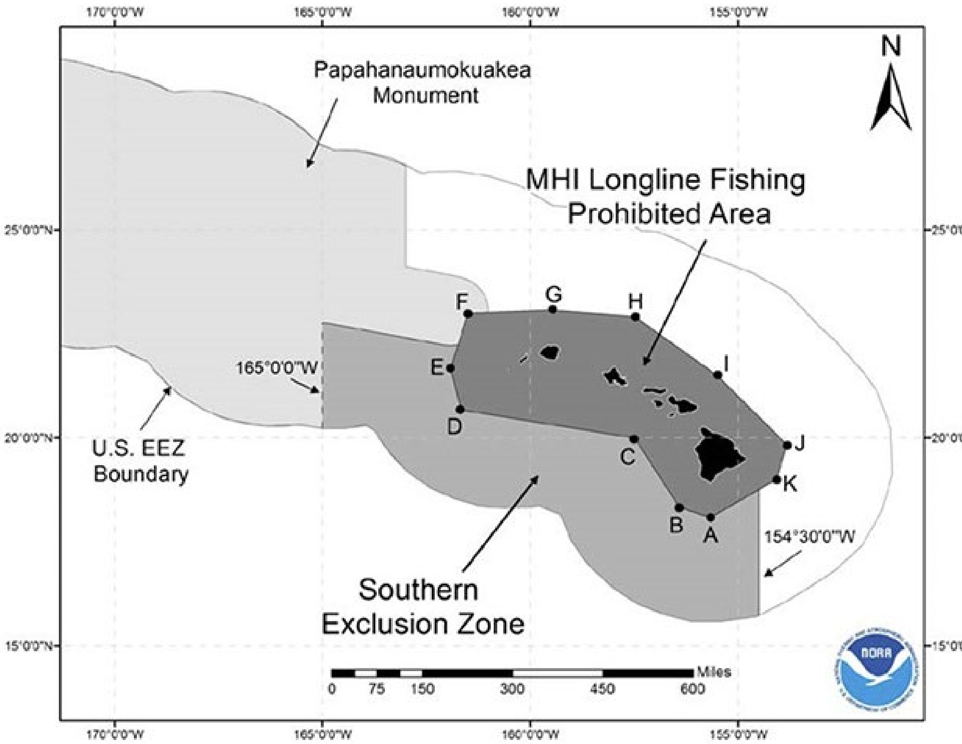

Figure 1. Map of the MHI longline fishing prohibited area, the FKWTRP southern exclusion zone, and the Papahanaumokuakea Monument.

The trigger for closing the SEZ is calculated based on observed false killer whale mortalities or serious injuries in the DSLL fishery that occur in the EEZ around Hawaii. The trigger is calculated as the larger of these two values: (i) Two; or (ii) The smallest number of observed false killer whale mortalities or serious injuries that, when extrapolated based on the percentage observer coverage in the deep-set longline fishery for that year, exceeds the Hawaii Pelagic false killer whale stock's potential biological removal level. The SEZ has been closed twice since implementation of the FKWTRP. The first closure of the SEZ occurred on July 24, 2018, and the SEZ was reopened on January 1, 2019. The SEZ was closed again on February 22, 2019, and reopened on August 25, 2020. In 2020, a new trigger was published to revise the trigger to four observed M/SI of false killer whales (85 FR 81184). In 2021, four observed mortalities or serious injuries of false killer whales occurred incidental to the Hawaii DSLL within the U.S. EEZ around Hawaii on January 18, 2021, March 26, 2021, April 17, 2021, and November 19, 2021. Because the injury determination of the fourth interaction meeting the trigger was not available until January 2022, the timeframe for closing the SEZ in 2021 had passed, and the SEZ was not closed.

1.4 Overview of NMFS Assessment Framework

Biological opinions address two central questions: (1) has a Federal agency insured that an action it proposes to authorize, fund, or carry out is not likely to jeopardize the continued existence of endangered or threatened species; and (2) has a Federal agency insured that an action it proposes to authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat that has been designated for such species. Every section of a biological opinion from its opening page and its conclusion and all of the information, evidence, reasoning, and analyses presented in between is designed to help answer these two questions. What follows summarizes how NMFS' generally answers these two questions; that is followed by a description of how this biological opinion will apply this general approach to the proposed research activities.

Before we introduce the assessment methodology, we want to define the word "effect." An effect is a change or departure from a prior state or condition of a system caused by an action or exposure (Figure 2). Although Figure 2 depicts a negative effect, the definition itself is neutral: it applies it to activities that benefit endangered and threatened species as well as to activities that harm them. Whether the effect is positive (beneficial) or negative (adverse), an "effect" represents a change or departure from a prior condition (a in Figure 2); in consultations, the prior global condition of species and designated critical habitat is summarized in the *Status of the Listed Resources* narratives while their prior condition in a particular geographic area (the *Action Area*) is summarized in the *Environmental Baseline* section of this opinion. Extending this baseline condition over time to form a future without the project condition (line b in Figure 2); this is alternatively called a counterfactual because it describes the world as it might exist if a particular action did not occur. Although consultations do not address it explicitly, the future without project is implicit in almost every effects analysis.

As Figure 2 illustrates, effects have several attributes: polarity (positive, negative, or both), magnitude (how much a proposed action causes individuals, populations, species, and habitat to depart from their prior state or condition) and duration (how long any departure persists). The last of these attributes—duration—implies the possibility of recovery which has the additional attributes recovery rate (how quickly recovery occurs over time; the slope of line **c** in the figure) and degree of recovery (complete or partial). The recovery rate allows us to estimate how long it would take for a coral reef and associated benthic communities would take to recover.

As described in the following narratives, biological opinions apply this concept of effects to endangered and threatened species and designated critical habitat. Jeopardy analyses are designed to identify probable departures from the prior state or condition of individual members of listed species, populations of those individuals, and the species themselves. Destruction or adverse modification analyses are designed to identify departures in the area, quantity, quality, and availability of the physical and biological features that represent habitat for these species.

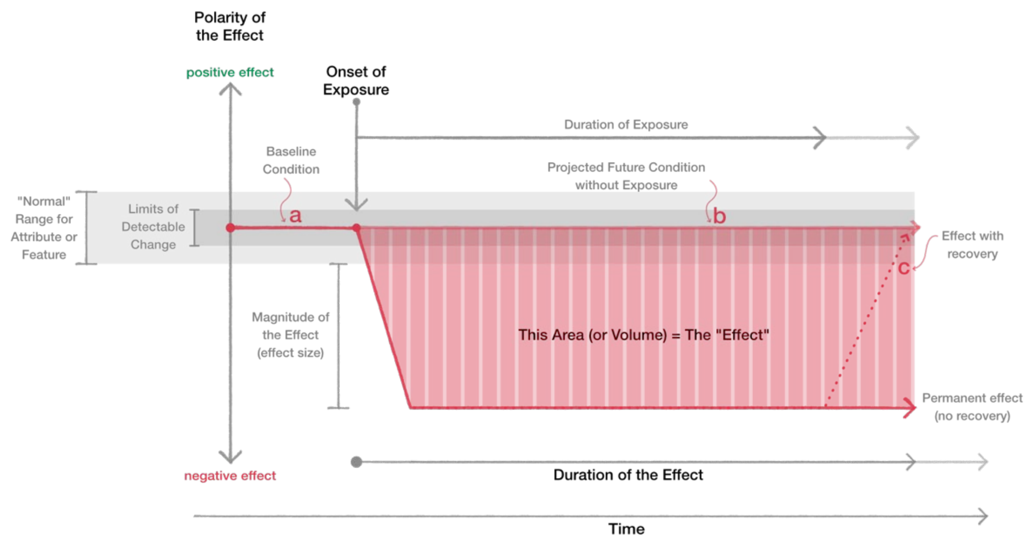

Figure 2. A schematic of the various elements encompassed by the word "effect." The vertical bars in the figure depict a series of annual "effects" (negative changes from a pre-existing or "baseline" condition) that are summed over time to estimate the action's full effect. See text for a more complete explanation of this figure.

1.4.1 Jeopardy Analysis

The Section 7 regulations define "jeopardize the continued existence of " as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02, emphasis added). The jeopardy standard is focused on the effects of the action when considered together with the species' status and all other threats acting on it. A federal action that adversely affects a declining population does not necessarily jeopardize that species unless the action itself is the cause of some active change of the species' status for the worse. *See National Wildlife Federation v. NMFS*, 524 F.3d 917, 930 (9th Cir. 2008). Minor reductions in the reproduction, numbers, or distribution of a species that are inconsequential at the species level will not be sufficient to jeopardize that species. In other words, a jeopardizing action requires that any reduction in the likelihood of survival or recovery be appreciable; i.e., material or meaningful from a biological perspective. *See Oceana v. Pritzker*, 75 F.Supp. 3d 469, 481-84 (DDC 2014) (holding that NMFS was within the bounds of its discretion to construe the word "appreciably" as entailing more than a bare reduction in the likelihood of survival and recovery, but rather "a considerable or material reduction in the likelihood of survival and recovery"). We note, however, that for a species that has a particularly dire -pre-action condition, an action's even slight impacts may rise to the level of appreciable reduction. This definition requires our assessments to address four primary variables:

1. Reproduction
2. Numbers

3. Distribution
4. The probability of the proposed action will cause one or more of these variables to change in a way that represents an appreciable reduction in a species' likelihood of surviving and recovering in the wild.

Reproduction leads this list because it is "the most important determinant of population dynamics and growth" (Carey and Roach 2020). Reproduction encompasses the reproductive ecology of endangered and threatened species; specifically, the abundance of adults in their populations, the fertility or maternity (the number of live births rather than the number of eggs they produce) of those adults, the number of live young adults produce over their reproductive lifespans, how they rear their young (if they do), and the influence of habitat on their reproductive success, among others. Reducing one or more of these components of a population's reproductive ecology can alter its dynamics so reproduction is a central consideration of jeopardy analyses.

The second of these variables—numbers—receives the most attention in the majority of risk assessments and that is true for jeopardy analyses as well. Numbers or abundance usually represents the total number of individuals that comprise the species, a population, or a sub-population; it can also refer to the number of breeding adults or the number of individuals that become adults. For species faced with extinction or endangerment several numbers matter: the number of populations that comprise the species, the number of individuals in those populations, the proportion of reproductively active adults in those populations, the proportion of sub-adults that can be expected to recruit into the adult population in any time interval, the proportion of younger individuals that can be expected to become sub-adults, the proportion of individuals in the different genders (where applicable) in the different populations, and the number of individuals that move between populations over time (immigration and emigration). Reducing these numbers or proportions can alter the dynamics of wild populations in ways that can reinforce their tendency to decline, their rate of decline, or both. Conversely, increasing these numbers or proportions can help reverse a wild population's tendency to decline or cause the population to increase in abundance.

The third of these variables—distribution— refers to the number and geographic arrangement of the populations that comprise a species. Jeopardy analyses must focus on populations because the fate of species is determined by the fate of the populations that comprise them: species become extinct with the death of the last individual of the last population. For that reason, jeopardy analyses focus on changes in the number of populations, which provides the strongest evidence of a species' extinction risks or its probability of recovery. Jeopardy analyses also focus on changes in the spatial distribution of the populations that comprise a species because such changes provide insight into how a species is responding to long-term changes in its environment (for example, to climate change). The spatial distribution of a species' populations also determines, among other things, whether all of a species' populations are affected by the same natural and anthropogenic stressors and whether some populations occur in protected areas or are at least protected from stressors that afflict other populations.

To assess whether reductions in a species' reproduction, numbers, or distribution that are caused by an action appreciably reduce the species' likelihood of surviving and recovering in the wild, NMFS' first assesses the status of the endangered or threatened species that may be affected by an action. That is the primary purpose of the narratives in the *Status of the Listed Resources* sections of biological opinions. Those sections of biological opinions also present descriptions of the number of populations that comprise the species and their geographic distribution. Then NMFS' assessments focus on the status of those populations in a particular *Action Area* based on how prior activities in the *Action Area* have affected them. The *Environmental Baseline* sections of biological opinions contain these analyses; the baseline condition of the populations and individuals in an *Action Area* determines their probable responses to future actions.

To assess the effects of actions considered in biological opinions, NMFS' consultations use an exposure–response–risk assessment framework. The assessments that result from this framework begin by identifying the physical, chemical, or biotic aspects of proposed actions that are known or are likely to have individual, interactive, or cumulative direct and indirect effects on the environment (we use the term "potential stressors" for these aspects of an action). As part of this step, we identify the spatial extent of any potential stressors and recognize that the spatial extent of those stressors may change with time. The area that results from this step of our analyses is the *Action Area* for a consultation.

After they identify the *Action Area* for a consultation, jeopardy analyses then identify the listed species and designated critical habitat (collectively, "listed resources"); critical habitat is discussed further below) that are likely to occur in that *Action Area*. If we conclude that one or more species is likely to occur in an *Action Area* when the action would occur, jeopardy analyses try to estimate the number of individuals that are likely to be exposed to stressors caused the action: the intensity, duration, and frequency of any exposure (these represent our exposure analyses). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an action's effects and the populations or subpopulations those individuals represent.

Once we identify the individuals of listed species that are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those individuals are likely to respond given their exposure (these represent our response analyses). Our individual-level assessments conclude with an estimate of the probable consequences of these responses for the "fitness" of the individuals exposed to the action. Specifically, we estimate the probability that exposed individuals will experience changes in their growth, development, longevity, and the number of living young they produce over their lifetime. These estimates consider life history tradeoffs, which occur because individuals must allocate finite resources to growth, maintenance and surviving or producing offspring; energy that is diverted to recover from disease or injury is not available for reproduction.

If we conclude that an action can be expected to reduce the fitness of at least some individuals of threatened or endangered species, our jeopardy analyses then estimate the consequences of those changes on the viability of the population(s) those individuals represent. This step of our jeopardy analyses considers the abundance of the populations whose individuals are exposed to an action; their prior pattern of growth and decline over time in the face of other stressors; the proportion of individuals in different ages and stages; gender ratios; whether the populations are "open" or "closed" (how much they are influenced by immigration and emigration); and their ecology (for example, whether they mature early or late, whether they produce many young or a small number of them, etc.). Because the fate of species is determined by the fate of the populations that comprise them, this is a critical step in our jeopardy analyses.

Our risk analyses normally conclude by assessing how changes in the viability of populations of threatened or endangered species affect the viability of the species those populations comprise (measured using probability of demographic, ecological, or genetic extinction in 10, 25, 50 or 100 years). This step of our analyses considers data available on the particular populations and species affected by an action. However, this step of our analyses is also informed by empirical information on (1) species that have become extinct—they became endangered but did not "survive" endangerment and, therefore, could not "recover" from it; (2) species whose abundance and distribution has declined and collapsed but whose future—their likelihood of continuing to persist over time (survive) or recovering them from endangerment—remains uncertain; (3) species that have declined and collapsed, but have begun the process of recovering from endangerment although they have not yet "recovered" in the wild; and (4) species that have survived endangered and subsequently recovered from it. The second of these categories includes species that have been extinct in the wild, but "survive" in captivity.

Section 7(a)(2) requires us to insure that threatened or endangered species are not likely to become extinct in the wild and, instead, insure that they are likely to end up in the fourth category (survived and recovered). We fulfill that mandate, by studying data and other information on how and why species ended up in these four categories, identifying common patterns in the data, and using the knowledge, those studies produce to inform our jeopardy determinations.

1.4.2 Destruction or Adverse Modification Analyses

The Section 7 regulations define "destruction or adverse modification" as "a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species." (50 CFR 402.02). This definition focuses on how federal actions affect the quantity, quality, and availability of the physical or biological features of the designated critical habitat.

NMFS uses the same exposure–response–risk assessment framework for designated critical habitat that it uses for jeopardy analyses. Exposure analyses first determine if designated critical habitat occurs in the *Action Area* for a consultation. If it does, those analyses identify the physical or biological features of critical habitat that are likely to be exposed to an action's effects.

Our analyses then consider how those features are likely to respond to that exposure, which requires us to consider the habitat's probable condition when the exposure occurs (that is, the impact of the *Environmental Baseline* on the value of the habitat); the ecology of the habitat at the time of exposure; where the exposure is likely to occur; and when the exposure is likely to occur; and the intensity, duration, and frequency of exposure.

If our analyses lead us to expect the quantity, quality, or availability of the physical or biological features of an area of designated critical habitat to decline because of a proposed action, we ask initially if those reductions are likely to be sufficient to reduce the value of the designated critical habitat for the conservation of listed species in the *Action Area*. By value, we mean the probability that the habitat designated in the *Action Area* will be occupied by and provide utility to individuals of the endangered or threatened species it was designated to help conserve. In this case, occupancy only means that individuals of the species are likely to use the habitat, even if they only use it intermittently; utility means that the individuals that occupy the habitat receive measurable improvement in their fitness (as defined earlier) as a result of using the habitat.

NMFS' destruction or adverse modification analyses are based on whether any reductions in the value of designated critical habitat in an *Action Area* is likely to be sufficient to reduce the value of the entire critical habitat designation. In this final step of our assessment, we combine information about the essential features of critical habitat that are likely to experience changes in quantity, quality, and availability given exposure to an action with information on the physical, chemical, biotic, and ecological processes that produce and maintain those constituent elements in the *Action Area*. We use the conservation value of the entire designated critical habitat (as described in the *Status of the Listed Resources* and *Designated Critical Habitat* subsections of biological opinions) as our point of reference for this comparison.

1.5 Application of this Approach in this Consultation

NMFS has identified several aspects of the PIFSC's Fishery and Ecosystem Research Activities that represent potential stressors to threatened or endangered species or designated or proposed critical habitat. The term stressor means any physical, chemical, or biological entity that can induce a direct or indirect effect on the environment (*Action Area*) or that can induce an adverse response on threatened or endangered species and their critical habitat. Sources of the stressors are primarily vessels and vessel operations, and gear use. The specific stressors addressed in this consultation include:

1. Tagging and genetic sampling
2. Entanglement
3. Direct take of coral specimens
4. Acoustic disturbance
5. Interaction with, including capture of non-target species, such as listed species, or their prey
6. Derelict gear
7. Introduction of oily discharges, cardboard, plastics, and other waste into marine waters
8. Collisions with vessels
9. Vessel groundings
10. Vessel emissions

1.6 Action Area

The *Action Area* is defined by regulation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The *Action Area* includes all areas affected by the action physically, chemically, or biologically. PIFSC's fisheries research activities take place in the nearshore and offshore areas of the HARA, MARA, ASARA, and the WCPRA; Figure 3. The HARA includes waters surrounding the Hawaiian Islands to a seaward extent of approximately 24 nautical miles (nm). PIFSC conducts research surveys in the HARA, primarily inside the Insular Pacific-Hawaiian Large Marine Ecosystem boundary. The Insular Pacific-Hawaiian Large Marine Ecosystem has a surface area of approximately one million km², extending 1,500 miles from the MHI to the outer northwest islands, including a range of islands, atolls, islets, reefs and banks (WPRFMC 2019). The MARA includes waters surrounding the CNMI and the Territory of Guam to a seaward extent of approximately 24 nm. The ASARA includes waters surrounding the American Samoa archipelago to a seaward extent of approximately 24 nm. The WCPRA includes part of the high seas (i.e., international ocean waters) considered under the jurisdiction of the Western and Central Pacific Fisheries Commissions (WCPFC). The WCPRA also includes the PRIA comprised of Baker Island, Howland Island, Jarvis Island, Johnston Atoll, Kingman Reef, Wake Atoll, and Palmyra Atoll. This large area essentially captures all future PIFSC high seas research surveys (e.g. oceanography, longline gear research) that occur outside of the HARA, MARA, and ASARA, while also approximately aligning with various other geopolitical boundaries.

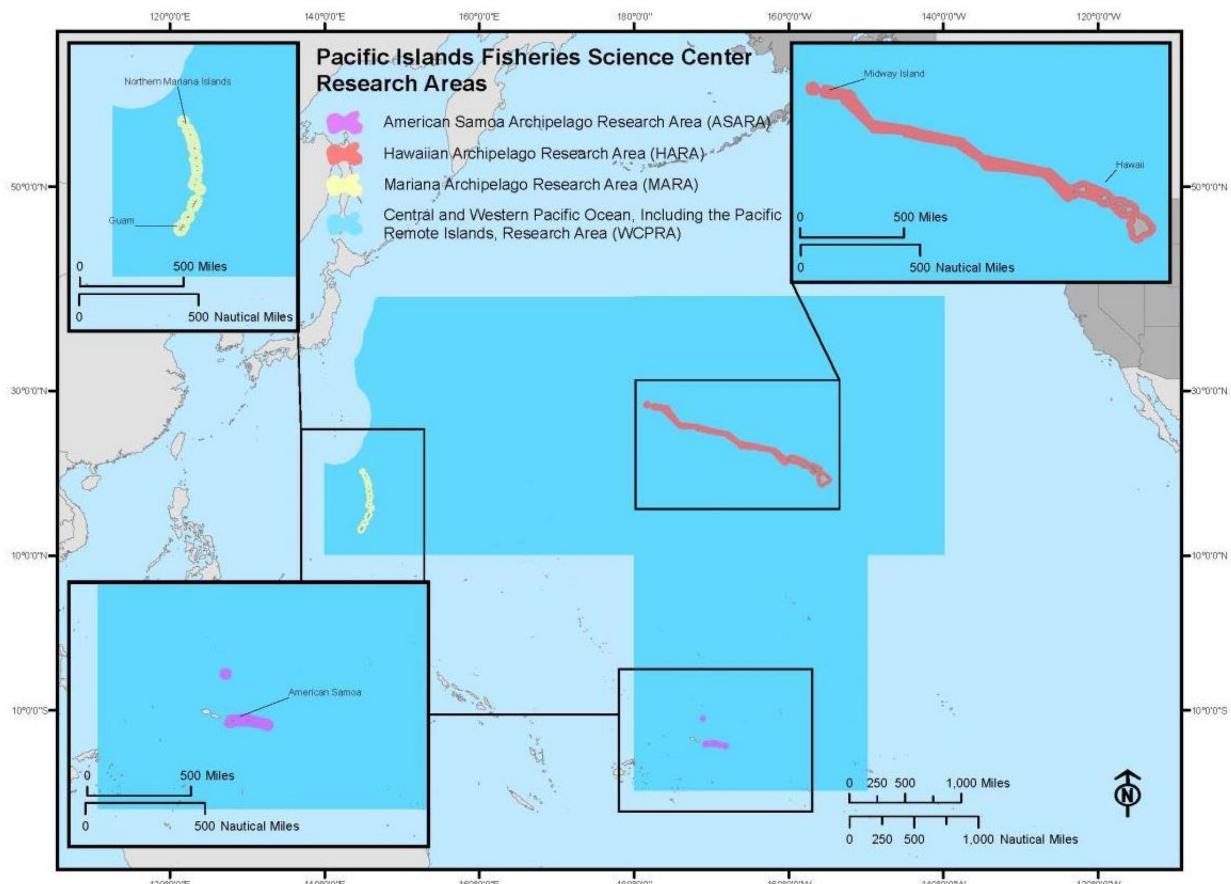

Figure 3. Pacific Islands Fisheries Science Center Research Areas.

1.7 Approach to Evaluating Effects

After identifying the *Action Area* for this consultation, we identified those activities and associated stressors that are likely to co-occur with (a) individuals of endangered or threatened species or areas designated as critical habitat for threatened or endangered species; (b) species that are food for endangered or threatened species; or (c) species that prey on or compete with endangered or threatened species. The latter step represents our exposure analyses, which are designed to identify:

- The exposure pathway (the course the stressor takes from the source to the listed resource or its prey);
- The exposed listed resource (what life history forms or stages of listed species are exposed; the number of individuals that are exposed; which populations the individuals represent); and
- The timing, duration, frequency, and severity of exposure.

We also describe how the exposure might vary depending on the characteristics of the environment (for example, the occurrence of oceanic fronts or eddies) and seasonal differences in those characteristics, behavior of individual animals, etc. Our exposure analyses require knowledge of the action, and a species' population structure and distribution, migratory behaviors, life history strategy, and abundance.

Next, we identified how listed species and their designated critical habitat are likely to respond once exposed to the action's stressors. These analyses evaluated whether the species responses were expected to be immediate or later in time, and considered the severity, frequency, and duration of those responses.

We lay the foundation for our risk assessment and our understanding of the animal's pre-existing physical, physiological, or behavioral state in the Status of Listed Resources and the Environmental Baseline using qualitative and quantitative analytical methods

1.8 Climate Change

Future climate will depend on warming caused by past anthropogenic emissions, future anthropogenic emissions and natural climate variability. NMFS' policy (NMFS 2016) is to use climate indicator values projected under the Intergovernmental Panel on Climate Change (IPCC)'s Representative Concentration Pathway (RCP) 8.5 when data are available or best available science that is as consistent as possible with RCP 8.5. RCP 8.5, like the other RCPs, were produced from integrated assessment models and the published literature; RCP 8.5 is a high pathway for which radiative forcing reaches >8.5 W/m2 by 2100 (relative to pre-industrial values) and continues to rise for some amount of time. A few projected global values under RCP 8.5 are noted in Table 3**.**

Presently, the IPCC predicts that climate-related risks for natural and humans systems are higher for global warming of 1.5 ºC but lower than the 2ºC presented in Table 3 (IPCC 2018). Changes in parameters will not be uniform, and IPCC projects that areas like the equatorial Pacific will likely experience an increase in annual mean precipitation under scenario 8.5, whereas other mid-latitude and subtropical dry regions will likely experience decreases in mean precipitation. Sea level rise is expected to continue to rise well beyond 2100 and while the magnitude and rate depends upon emissions pathways, low-lying coastal areas, deltas, and small islands will be at greater risk (IPCC 2018).

Table 3. Projections for certain climate parameters under Representative Concentration Pathway 8.5 (values from IPCC 2014).

Projections	**Scenarios (Mean and likely range)**	
	Years 2046-2065	**Years 2081-2100**
Global mean surface temperature change (ºC)	2.0 (1.4-2.6)	3.7 (2.6-4.8)
Global mean sea level increase (m)	0.30 (0.22-0.38)	0.63 (0.45-0.82)

Given the limited data available on sea turtle populations, and other listed species like whales, sharks, and rays that are adversely affected by the proposed action, and the inherent challenges with creating population models to predict extinction risks of these species, we are not inclined to add more uncertainty into our assessment by creating climate models with little data to parameterize such models. Since trying to apply a climate based model in 2012 to the SSLL, we've learned a few key important lessons: the climate based model incorporating fixed age (lag) is unrealistic given variability ages at sexual maturity for loggerhead and leatherback sea turtles, and fails to consider variation in age of the nesting cohort; studies have shown juvenile loggerhead sea turtles are distributing more widely than thought, and thus are likely impacted in ways not considered under the previous model; a new dispersion model on leatherback sea turtles suggest they too may be dispersing more broadly, and affected differently than previously considered; the model did not account for impacts to more than two life-stages; and arguably, most importantly, the models did not perform as expected because the predictions were wrong for leatherback sea turtles the majority of the time, and predictions for loggerhead sea turtles were wrong half the time (Kobayashi et al. 2008, 2011; Van Houtan 2011; Van Houtan and Halley 2011; Allen et al. 2013; Briscoe 2016a, 2016b; Jones et al. 2018; see also Jones memo 2018).

We address the effects of climate, including changes in climate, in multiple sections of this assessment: *Status of Listed Resources*, *Environmental Baseline*, and *Integration and Synthesis of Effects*. In the *Status of Listed Resources* and the *Environmental Baseline* we present an extensive review of the best scientific and commercial data available to describe how the listed species and its designated critical habitat is affected by climate change—the status of individuals, and its demographically independent units (subpopulations, populations), and critical habitat in the *Action Area* and range wide.

We do this by identifying species sensitivities to climate parameters and variability, and focusing on specific parameters that influence a species health and fitness, and the conservation value of their habitat. We examine habitat variables that are affected by climate change such as sea level rise, temperatures (water and air), and changes in weather patterns (precipitation), and we try to assess how species have coped with these stressors to date, and how they are likely to cope in a changing environment. We look for information to evaluate whether climate changes effects the species' ability to feed, reproduce, and carry out normal life functions, including movements and migrations.

We review existing studies and information on climate change and the local patterns of change to characterize the *Environmental Baseline* and *Action Area* changes to environmental conditions that would likely occur under RCP 8.5, and where available we use changing climatic parameters (magnitude, distribution, and rate of changes) information to inform our assessment. In our exposure analyses, we try to examine whether changes in climate related phenomena will alter the timing, location, or intensity of exposure to the action. In our response analyses we ask, whether and to what degree a species' responses to anthropogenic stressors would change as they are forced to cope with higher background levels of stress cause by climate-related phenomena.

1.9 Evidence Available for this Consultation

Section 7(a)(2) of the ESA and its implementing regulations require NMFS to use the best scientific and commercial data available during consultations. We used the following procedure to ensure that this consultation complies with NMFS' requirement to consider and use the best scientific and commercial data available. We started with the data and other information contained in the NMFS PIFSC 2021 Biological Evaluation, NMFS' proposed rule to designated critical habitat for seven Indo-Pacific corals (85 FR 76262), relevant Letters of Concurrence and biological opinions, and available recovery plans for affected species.

We supplemented these sources with electronic searches of literature published in English or with English abstracts to cross search multiple databases for relevant scientific journals, open access resources, proceedings, web sites, doctoral dissertations and master's theses. Particular databases we searched for this consultation included Google Scholar, Bielefeld Academic Search Engine (BASE), CORE, Bing, Microsoft Academic, Science Direct, Web of Science, Science.gov, and JStor (to identify older studies) with targeted searches of websites for the journals Copeia, Marine Biology, Marine Ecology Progress Series, Marine Pollution Bulletin, Public Library of Science - Biology (PLoS Biology), and Public Library of Science - One (PLoS One).

Electronic searches have important limitations. First, often they only contain articles from a limited time span (e.g., First Search only provides access to master's theses and doctoral dissertations completed since 1980 and Aquatic Sciences and Fisheries Abstracts only provide access to articles published since 1964). Second, electronic databases commonly do not include articles published in small or obscure journals or magazines that contain credible and relevant scientific and commercial data. Third electronic databases do not include unpublished reports from government agencies, consulting firms, and non-governmental organizations that also contain credible and relevant scientific and commercial data. To overcome these limitations, we supplemented our electronic searches by searching the literature cited sections and bibliographies of references we retrieved to identify additional papers that had not been captured in our electronic searches. We acquired references that, based on a reading of their titles and abstracts, appeared to comply with our keywords. If a references' title and abstract did not allow us to eliminate it as irrelevant to this inquiry, we acquired the reference.

To supplement our searches, we examined the literature that was cited in documents and any articles we collected through our electronic searches. If a reference's title did not allow us to eliminate it as irrelevant to this inquiry, we acquired it. We continued this process until we identified all of the relevant references cited by the introduction and discussion sections of the relevant papers, articles, books, modeling results, and, reports and all of the references cited in the materials and methods, and results sections of those documents. We did not conduct hand searches of published journals for this consultation.

These procedures allowed us to identify relevant data and other information that was available for our analyses. In many cases, the data available were limited to a small number of datasets that either did not overlap or did not conflict. In those cases, none of these sources were "better' than the alternatives and we used all of these data.

2 STATUS OF LISTED RESOURCES

NMFS has determined that the action may affect the threatened and endangered species listed in Table 4, and designated critical habitats in Table 5. These species occur in the *Action Area* and may be affected by the proposed action and they are included in this biological opinion. These listed resources are provided protections under the ESA.

Table 4. Listed resources within the *Action Area* that are likely to be adversely affected by the proposed action.

Species	Scientific Name	ESA Status	Listing Date	Federal Register Reference
Giant Manta Ray	*Manta birostris*	Threatened	02/21/2018	83 FR 2916
Indo-West Pacific Scalloped Hammerhead Shark	*Sphyrna lewini*	Threatened	09/02/2014	79 FR 38213
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened	03/01/2018	83 FR 4153
Coral (no common name)	*Acropora globiceps*	Threatened	10/10/2014	79 FR 53852
Coral (no common name)	*Acropora retusa*	Threatened	10/10/2014	79 FR 53852
Coral (no common name)	*Acropora speciosa*	Threatened	10/10/2014	79 FR 53852
Coral (no common name)	*Euphyllia paradivisa*	Threatened	10/10/2014	79 FR 53852

Species	Scientific Name	ESA Status	Listing Date	Federal Register Reference
Coral (no common name)	*Isopora crateriformis*	Threatened	10/10/2014	79 FR 53852

Table 5. Designated critical habitat within the *Action Area* that may be affected by the proposed action.

Species	Scientific Name	Critical Habitat Effective Date	Federal Register Reference
Hawaiian monk seal	*Neomonachus schauinslandi*	5/26/1988 revised on 8/21/2015	53 FR 18990 80 FR 50925
False killer whale Main Hawaiian Island Insular	*Pseudorca crassidens*	7/24/2018	83 FR 35062
Pacific corals	*Acropora globiceps, Acropora retusa, Acropora speciosa, Euphyllia paradivisa, and Isopora crateriformis*	Proposed on 11/27/2020	85 FR 76262

2.1 Listed Resources Not Considered Further

As described in the *Approach to the Assessment* section of this biological opinion, NMFS uses two criteria to identify endangered or threatened species or critical habitat that are not likely to be adversely affected by PIFSC's research activities. The first criterion is exposure or some reasonable expectation of a co-occurrence between one or more potential stressor associated with the PIFSC's research activities and a particular listed species or designated critical habitat. If we conclude that a listed species or designated critical habitat is not likely to be exposed to PIFSC's research activities, we must also conclude that the species and critical habitat is not likely to be adversely affected by those activities. The second criterion is the probability of a response given exposure, which considers susceptibility: for example, species that may be exposed to vessel noise from fishing vessels operating near them but are not likely to respond to that noise (at noise levels they are likely exposed to) are also not likely to be adversely affected by vessel operations.

Based on the general exposure profiles that we developed during the course of this consultation, and described in Appendix A of this biological opinion, the threatened and endangered species that are not likely to be adversely affected by PIFSC's Fishery and Ecosystem Research

Activities in the Western and Central Pacific Ocean are listed in Table 6. We discuss the basis of these determinations in Appendix A.

Table 6. Listed resources within the *Action Area* that are not likely to be adversely affected by the proposed action.

Species	Scientific Name	ESA Status	Listing Date	Federal Register Reference
Central North Pacific Green Sea Turtles, Central South Pacific, Green Sea Turtle Central West Pacific Green Sea Turtle	*Chelonia mydas*	Threatened	05/06/2016	81 FR 20057
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	06/03/1970	35 FR 8491
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/03/1970	35 FR 8491
North Pacific Loggerhead Sea Turtle	*Caretta caretta*	Endangered	10/24/2011	76 FR 58868
Olive Ridley Sea Turtle (all other populations)	*Lepidochelys olivacea*	Threatened	08/27/1978	43 FR 32800
Hawaiian Monk Seal[1]	*Neomonachus schauinslandi*	Endangered	11/23/1976	41 FR 51612
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970	35 FR 18319
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970	35 FR 18319
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970	35 FR 18319
Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970	35 FR 18319

Species	Scientific Name	ESA Status	Listing Date	Federal Register Reference
Main Hawaiian Island Insular[2] False Killer Whale	*Pseudorca crassidens*	Endangered	12/28/2012	77 FR 70915
North Pacific right whale	*Eubalaena japonica*	Endangered	04/07/2008	73 FR 12024
Chambered Nautilus	*Nautilus pompilius*	Threatened	10/29/2018	83 FR 48976

2.2 Introduction to the Status of Listed Species

The rest of this section of NMFS biological opinion consists of a narrative for each of the threatened and endangered species, and designated critical habitat that occur in the *Action Area* and that may be adversely affected by the PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean. To fulfill that purpose, the species' narrative presents a summary of: (1) the species' distribution and population structure (which are relevant to the distribution criterion of the jeopardy standard); (2) the status and trend of the abundance of those different populations (which are relevant to the numbers criterion of the jeopardy standard); (3) information on the dynamics of those populations where it is available (which is a representation of the reproduction criterion of the jeopardy standard); and (4) natural and anthropogenic threats to the species, which helps explain our assessment of a species' likelihood of surviving and recovering in the wild. This information is integrated and synthesized in a summary of the status of the species.

Following the narratives that summarize information on these topics, the species' narrative provides information on the diving and social behavior of the different species because that behavior helps assess a species' probability of being captured by fishing gear. A more detailed background information on the general biology and ecology of these species can be found in status reviews and recovery plans for the various species[1] as well as the public scientific literature.

2.2.1 Giant Manta Ray

Distribution and Population Structure

The giant manta ray occurs across the globe in tropical and warm temperate bodies of water from 36°S to 40°N (Mourier 2012). The documented range for this species within the Northern hemisphere includes: Mutsu Bay, Aomori, Japan; the Sinai Peninsula and Arabian Sea, Egypt; the Azores Islands, Portugal; and as far north as southern California (west coast) and New Jersey (east coast), U.S. (Kashiwagi et al. 2010; Moore 2012; CITES 2013). In the southern

[1] Status reviews and recovery plans are generally accessible through NMFS' endangered species conservation website: https://www.fisheries.noaa.gov/topic/endangered-species-conservation#conservation-&-management and NatureServe Explorer: http://explorer.natureserve.org/servlet/NatureServe?init=Species

hemisphere, the giant manta has been documented as far south as Peru, Uruguay, South Africa, French Polynesia, New Zealand, and most recently, photographed in eastern Australia off Montague Island and Tasmania at 40° S (Mourier 2012; CITES 2013; Couturier et al. 2015). Couturier et al. (2015) documented the presence of the species for the first time in waters off eastern Australia and off the northeast coast of Tasmania. In addition, the giant manta ray has been observed in a predictable seasonal pattern in estuarine waters of Florida, Uruguay, and Brazil suggesting that they may use estuaries as nursery areas during summer months (Adams and Amesbury 1998; Milessi and Oddone 2003; Medeiros et al. 2015).

Previously considered to be monospecific, Marshall et al. (2009) presented new data to support the splitting of the *Manta* genus into two species: giant manta ray (*Manta birostris*) and reef manta ray (*M. alfredi*). Prior to 2009, all *Manta* species were categorized as giant manta ray (*Manta birostris*). The reef manta ray inhabits tropical coastal areas while the giant manta ray's habitat is more offshore and extends to sub-tropical regions; however, there is overlap in the habitats of the two species. Furthermore, while there are distinct morphological differences between the two species, they can be difficult to distinguish without adequate training and identification keys (Stevens et al. 2018). Therefore, correct identification to the species level is likely an issue in fisheries observer data.

Area of occupancy for giant manta rays was estimated from observations and expert opinion by Lawson et al. (2017; Figure 4). The environmental variables that drive or are correlated with giant manta ray habitat use in the ocean are largely unknown (Jaine et al. 2014). Giant manta rays are found offshore in oceanic waters near productive coastlines, continental shelves, offshore pinnacles, seamounts, and oceanic islands. In a satellite tracking study off of Mexico, Graham et al. (2012) found that 95% of locations occurred in waters warmer than 21.6° C and that most locations were correlated with high surface chlorophyll concentrations.

Stewart et al. (2016a) also reported that giant manta ray off Mexico tend to occur near the upper limit of the pelagic thermocline where zooplankton aggregate. Burgess (2017) suggested that giant manta ray specifically feed on mesopelagic plankton, which would place them at depths as deep as 1,000 meters (also see Marshall et al. 2018). Giant manta ray are also observed at cleaning sites at offshore reefs where they are cleaned of parasites by smaller organisms.

The population structure of giant manta rays — the number of populations and sub-populations that comprise the species, whether they are linked by immigration and emigration, and the strength of those links — is largely unknown. At a minimum, the evidence suggests that giant manta rays in the Atlantic and giant manta rays in the Indo-Pacific represent separate populations because this species does not appear to migrate to the Pacific through Drake Passage (or vice versa) and they do not appear to migrate around the Cape of Good Hope to the Indian Ocean (Lawson et al. 2017, Marshall et al. 2018; Figure 4).

Figure 4. Distribution map for the giant manta ray. Extent of occurrence is depicted by light blue and the area of occupancy is noted in darker blue. (Figure 3 from Lawson et al. 2017).

Several authors have reported that giant manta ray likely occur in small regional subpopulations (Lewis et al. 2015; Stewart et al. 2016a; Marshall et al. 2018; Beale et al. 2019) and may have distinct home ranges (Stewart et al. 2016a). The degree to which subpopulations are connected by migration is unclear but is assumed to be low (Stewart et al. 2016a; Marshall et al. 2018) so regional or local populations are not likely to be connected through immigration and emigration (Marshall et al. 2018), making them effectively demographically independent. While NMFS' concluded that the species is likely to become endangered within the foreseeable future throughout a significant portion of its range (the Indo Pacific and eastern Pacific), NMFS did not find the species met the criteria to list as a DPS (83 FR 2916, and 82 FR 3694). This decision is unique to the listing process, and does not mean that NMFS should not or would not consider the potential role that populations play in evaluating whether a proposed action is likely to result in appreciable reduction in numbers, distribution or reproduction, or whether such reductions may affect the viability of the putative populations that comprise the listed species. The preponderance of current evidence, combined with expert opinion suggest the species likely has a complex population structure, and while it may occasionally be observed making long distance movements, it likely occurs in small spatially separated populations, though to be viable the abundance of each subpopulation likely needs to be at least 1,000 individuals. This structure is further supported by studies described by Beale et al. (2019) that have documented fisheries-induced declines in several isolated subpopulations (Lewis et al. 2015; Stewart et al. 2016; Moazzam 2018).

Several studies have tracked individual giant manta rays and provide information on the spatial extent of giant manta ray populations. Stewart et al. (2016a) studied four subpopulations of giant manta ray using genetics, stable isotopes, and satellite tags. They found that these subpopulations appeared to be discrete with no evidence of movement between them. The home ranges for three of these subpopulations (all of which are outside of the *Action Area*), defined as the areas where tagged animals were expected to spend 95% of their time encompassed areas of 79,293 km^2 (Raja Ampat, Indonesia), 70,926 km^2 (Revillagigedo Islands, Mexico), and 66,680 km^2 (Bahia de Banderas, Mexico). They suggest that their findings indicate that giant manta rays form discrete subpopulations that exhibit a high degree of residency. Stewart et al. (2016a) state that this does not preclude occasional long-distance migrations, but that these migrations are likely rare and do not generate substantial gene flow or immigration of individuals into these subpopulations. One instance of a long-distance migration has been noted in the literature. Hearn et al. (2014) tracked nine giant manta rays at Isla de la Plata, Ecuador. Eight of the nine tagged giant manta rays remained in an area of 162,500 km^2, while the ninth traveled a straight-line distance of 1,500 km to the Galapagos Islands, however, Stewart and Hearn later believed it may have been from a floating tag (J. Stewart pers. comm. to J. Rudolph, October 7, 2020).

The Status Review (Miller and Klimovich 2017), notes only four instances of individual tagged giant manta rays making long-distance migrations. Of those, one animal was noted to travel a maximum distance of 1,151 km but that was a cumulative distance made up of shorter movements within a core area (Graham et al. 2012). No giant manta ray in that study moved further than 116 km from its tagging location and the results of Graham et al. (2012) support site fidelity leading to subpopulation structure. The remaining references to long distance migrations include Mozambique to South Africa (1,100 km), Ecuador to Peru (190 km), and the Yucatan into the Gulf of Mexico (448 km). The last two distances are well within core areas of subpopulation habitat use as specified in Stewart et al. (2016a) and may only represent movements between coastal aggregation sites and offshore habitats as discussed in Stewart et al. (2016a). In contrast with these few individuals making long-distance movements, most tracked individuals (Hearn et al. 2014 [8 out of 9 individuals]) or all tracked individuals (Graham et al. 2012 [6 individuals]; Stewart et al. 2016a [18 individuals]) from other studies remained within defined core areas, supporting subpopulation structure. Marshall et al. (2018) summarizes that current satellite tracking studies and international photo-identification matching projects suggest a low degree of interchange between subpopulations.

To date there have been limited genetics studies on giant manta ray; however, Stewart et al. (2016a) found genetic discreteness between giant manta ray populations in Mexico suggesting isolated subpopulations with distinct home ranges within 500 km of each other. In addition to genetics, differentiation was discovered through isotope analysis between those two Mexican populations (nearshore and offshore) and between two others (Indonesia and Sri Lanka). Using satellite tagging, stable isotopes and genetics, Stewart et al. (2016a) concluded that, in combination, the data strongly suggest that giant manta rays in these regions are well-structured subpopulations that exhibit a high degree of residency.

A vulnerability analysis conducted by Dulvy et al. (2014) indicates that mobulid populations can only tolerate very low levels of fishing mortality and have a limited capacity to recover once their numbers have been depleted (Couturier et al. 2012; Lewis et al. 2015). Furthermore, Lewis et al. (2015) suggests local populations in multiple areas in Indonesia have been extirpated due to fishing pressure noting that *Manta birostris* was the most common species previously caught in these areas. Additionally, White et al. (2015) documented an 89% decline in the observed *Manta birostris* population in Cocos Island National Park over a 20-year period and is believed to be from overfishing outside of the park.

A population structure described by small, isolated subpopulations does not conflict with seasonal sightings of giant manta ray as described for a number of the subpopulations studies with photo-identification or acoustic arrays (in contrast with those using satellite tagging; Dewar et al. 2008; Marshall et al. 2009; Rohner et al. 2013). Stewart et al. (2016a) suggest that habitats used by giant manta rays include both nearshore and offshore locations, and that the core spatial distribution of giant manta ray subpopulations encompass both types of habitats, leading to seasonal observations of giant manta rays in the nearshore habitats in many areas. Water temperature and productivity may dictate giant manta ray movements (Freedman and Roy 2012; Beale et al. 2019). In a subpopulation off the coast of North Carolina (U.S.), Freedman and Roy (2012) found that in the cooler winter months, giant manta ray distribution was extremely limited with a tight clustering in an area associated with the Gulf Stream and warmer waters, while in summer giant manta ray were distributed across a larger area, and individuals were more spread out, yet still in a discrete area.

Not all giant manta ray subpopulations are defined by seasonal sightings. Studied subpopulations that have more regular sightings include the Similan Islands (Thailand); Raja Ampat (Indonesia); northeast North Island (New Zealand); Kona, Hawaii (USA); Laje de Santos Marine Park (Brazil); Isla de la Plata (Ecuador); Ogasawara Islands (Japan); Isla Margarita and Puerto la Cruz (Venezuela); Isla Holbox, Revillagigedo Islands, and Bahia de Banderas, Mexico (Notarbartolo-di-Sciara and Hillyer 1989; Homma et al. 1999; Duffy and Abbott 2003; Luiz et al. 2009; Clark 2010; Kashiwagi et al. 2010; Marshall et al. 2011; Stewart et al. 2016a).

Given the current understanding of giant manta ray population structure, for the remainder of this biological opinion, we will use the terms 'giant manta ray' or 'species' to refer to the giant manta ray as they were listed, the term 'population' to refer to the Indo-Pacific population as a whole, and 'subpopulation' to refer to independent subunits considered in this biological opinion. We note that for some of the study areas where only small numbers of individuals have been identified, these may not represent regionally defined subpopulations and we consider them aggregations until further data can be collected.

Status and Trends

NMFS listed giant manta rays globally as threatened in 2018. The IUCN lists them as vulnerable (the category that immediately precedes endangered in the IUCN classification system), with a decreasing population trend. Although the number of regional subpopulations is unknown, the sizes of those identified as regional subpopulations tends to be small, ranging from 600 to 25,250 (CITES 2013; Marshall et al. 2018; Beale et al. 2019; Table 7). CITES (2013) highlights three giant manta ray subpopulations that have been studied and population estimates provided, and counts for more than ten aggregations (Table 7). CITES (2013) also discusses an additional approximately 25 aggregations where species-level information (i.e., *Manta birostris* vs *M. alfredi*) does not exist and, while actual abundance estimates are not available, it is assumed they consist of very small number of individuals. This information was compiled from O'Malley et al. (2013), Heinrichs et al. (2011), Lewis et al. (2015), and Fernando and Stevens (2011). The most comprehensive of these is O'Malley et al. (2013) that presents an overview of the economic value of manta ray watching tourism. They highlight 23 sites globally, and within the *Action Area* of the U.S., these areas include nine sites: Indonesia, Papua New Guinea, Federated States of Micronesia, Palau, Solomon Islands, Kiribati, New Caledonia, Fiji and French Polynesia.

Overall, giant manta ray subpopulations appear to be regionally distinct (Lewis et al. 2015; Stewart et al. 2016a; Moazzam 2018; Beale et al. 2019) and may have distinct home ranges (Stewart et al. 2016a).

Table 7. Numbers of recorded individuals and subpopulation estimates of giant manta ray at identified locations adapted from CITES (2013) and updated with supplementary references as specified.

Location	**Recorded Individuals**	**Subpopulation Estimate**	**Reference**
Mozambique	180 - 254	600	Marshall et al. (2009) and pers. comm. cited in CITES (2013); MantaMatcher (2016)
Egypt	60	-	Marine Megafauna (2011) as cited in CITES (2013)
Republic of Maldives	716	-	J. Stewart pers. comm. to A. Garrett citing S. Hilbourne pers. comm. (2021)
Republic of Maldives	378	-	Nicholson-Jack (2020)
Kona, Hawaii (U.S.)	29	-	Clark (2010)
Thailand	365	-	J. Stewart pers. comm. to A. Garrett citing Manta Trust data (2021)
Raja Ampat, Indonesia	588	1,875	Beale et al. (2019)
Isla de la Plata, Ecuador	~650	1,500	M. Harding, pers. comm. cited in CITES (2013); Sanchez (2016)
Isla de la Plata, Ecuador	2,464	25,250	MantaMatch (2016); Burgess (2017); Marshall and Holmberg 2011as cited in Burgess (2017); Subpopulation estimate from J. Stewart pers. comm. to A. Garrett (2021)

Location	Recorded Individuals	Subpopulation Estimate	Reference
Brazil	60	-	Laje Viva Institute unpubl. cited in CITES (2013), Luiz et al. (2009)
Mexico (Revillagigedos Is.)	916	-	J. Stewart pers. comm. to A. Garrett citing pers. comm to R. Rubin and K. Kumli (2021)
Mexico (Isla Holbox)	> 200	-	R. Graham, pers. comm. cited in CITES (2013)
Jupiter, Florida (U.S.)	59	-	Pate and Marshall (2020)
Flower Garden Banks (U.S. EEZ)	>70	-	Graham and Witt (2008) cited in CITES (2013)
Flower Garden Banks (U.S. EEZ)	95 (52 proposed *M. cf. birostris*)	-	Stewart et al. (2018)
Japan (Ogasawara Islands)	42	-	Kashiwagi et al. (2010)
Azores, Portugal	31	-	J. Stewart pers. comm. to A. Garrett citing A. Sobral pers. comm. (2021).
Myanmar	201	-	J. Stewart pers. comm. to A. Garrett citing Manta Trust data (2021)
Costa Rica	52	-	J. Stewart pers. comm. to A. Garrett citing Manta Trust data (2021)

Population Dynamics

Most documented giant manta ray subpopulations appear to be composed of relatively small population sizes. Photo-identification studies for giant manta ray subpopulations in southern Mozambique (*n*= 180-254; Marshall et al. 2009); southern Brazil (*n*= 60; Luiz et al. 2009); Revillagigedo Islands, Mexico (*n*= 916; J. Stewart pers. comm. to A. Garrett citing pers. comm to R. Rubin and K. Kumli [2021])); the Ogasawara Islands, Japan (*n*= 42; Kashiwagi et al.

2010); the Maldives (*n*= 716; J. Stewart pers. comm. to A. Garrett citing S. Hilbourne pers. comm. 2021)); Isla Holbox, Mexico (*n*= 200; S. Hinojosa-Alvarez unpubl. data 2010 cited in Marshall et al. 2018); with many of these studies having been conducted for the last 10–20 years. A study of Japan-wide photographic records confirmed that the known main aggregation in Ogasawara Islands (42 known individuals during 1995–1998 study) represents a part of a fairly isolated population (Kashiwagi et al. 2010). A mark-recapture population study in southern Mozambique over five years from 2003 to 2008 estimated the local population during that time to be 600 individuals (Marshall et al. 2009). Flight surveys and re-sightings data of individuals at Isla Holbox, Mexico have estimated that roughly 100 manta rays use this area during every season (S. Hinojosa-Alvarez unpubl. data 2010 cited in Marshall et al. 2018). However, 'recorded individuals' may not be indicative of population size.

The number of individually identified giant manta ray for each studied aggregation ranges from less than 50 in regions with low survey effort or infrequent sightings to more than 1,000 in some regions with targeted, long-term studies. However, ongoing research including mark-recapture analyses suggests that typical subpopulation abundances are more likely in the low thousands (e.g., Beale et al. 2019) and in rare cases may exceed 10,000 in areas with extremely high productivity (pers. comm. Joshua Stewart, citing Manta Trust to A. Garrett 2021). Of the 12 studied subpopulations, statistical analyses of sightings/photo-identification data to estimate total population size has only been conducted for three of them. For Raja Ampat, CITES (2013) indicated that there were 72 identified individuals. After additional research and an analysis of resightings data, Beale et al. (2019) estimated the total population size to be approximately 1,875 individuals. Isla de la Plata, Ecuador had approximately 650 identified individuals reported in CITES (2013), in this case, Burgess (2017) conducted further analyses and estimates the total population size to be 2,464 individuals. Similar, for the Republic of Maldives, as of 2013, 63 individuals had been identified (CITES 2013), Nicholson-Jack (2020) reported 378, and further study indicates a more than 10-fold increase over the initial number of identified individuals (n = 716; J. Stewart pers. comm. to A. Garrett citing S. Hilbourne pers. comm. 2021). Thus, while some subpopulations may have been reduced to very small population sizes due to fisheries (direct harvest or bycatch), in general, stable giant manta ray subpopulations are likely to be larger, potentially greater than 1,000 individuals, which would be in keeping with the literature that suggests subpopulations are isolated with limited movement. The current understanding of effective population sizes necessary for the genetic diversity needed to maintain evolutionary fitness in isolated populations is greater than 1,000 (Frankham et al. 2014).

More importantly, the size of some of these subpopulations has declined significantly in regions subject to fishing (Marshall et al. 2018). Fisheries catch and bycatch have caused giant manta rays to decline by at least 30% globally and by up to 80% in significant portions of its range (i.e., Indonesia, Philippines, Sri Lanka, Thailand, Madagascar; Marshall et al. 2018). Lewis et al. 2015 collected data on daily landings of *Manta* and *Mobula* species from 2002 to 2014 for eight locations in Indonesia. For Manta species, *Manta birostris* was the primary target of these fisheries. Total annual landings were estimated by multiplying the number of recorded or observed daily landings by the number of fishing days per year. For the three locations with the most complete data, landings of *Manta* species declined by 71% to 95%. Reports from fishermen suggest that these data are representative of declines in abundance rather than shifts in effort.

Within the *Action Area*, Tremblay-Boyer and Brouwer (2016) present catch per unit effort (CPUE) data for giant manta ray observed captures in the WCPO longline and purse seine fisheries. Giant manta ray were not reliably identified to species by observers in the WCPO purse seine fishery until about 2011 (NMFS 2021c). In their analysis, Tremblay-Boyer and Brouwer (2016) found increasing trends in CPUE from 2005 to 2016 for giant manta rays but they caution that these trends represent increases in compliance with reporting the species and does not represent an index of abundance. CPUE trends in the longline fisheries indicate that giant manta rays are observed less frequently in recent years compared to 2000-2005, suggesting a decline in abundance.

Giant manta rays are a long-lived, late maturing species with productivity that is among the lowest of all elasmobranchs. Rambahiniarison et al. (2018) estimated that giant manta ray off the Philippine Islands matured at about 9 years and had their first pregnancy at about 13 years of age. Overall, age at maturity estimates range from three to more than 15 years. Giant manta rays typically give birth to only one pup every two to three years, but this can range from annual to 5 years (Notarbartolo-Di-Sciara 1989; Marshall and Bennett 2010; Dulvy et al. 2014; Rambahiniarison et al. 2018). Rambahiniarison et al. (2018) reported that the proportion of pregnant females in subpopulations of giant manta ray in the Philippine Islands averaged about 9 out of every 100 females (9%), but they suggested this might depend on the length of the inter-pregnancy period which could depend on the availability of resources. Additionally, sex ratios may differ between populations. Beale et al. (2019) noted a statistically significant female-biased sex ratio of 2.62(f):1 in Raja Ampat. However, Pate and Marshall (2020) did not find a statistical difference in Florida with a sex ratio of 1:1 and Stewart et al. (2018) noted a ratio of 1.3(f):1 in the Flower Garden Banks of the Gulf of Mexico. Differences between locations may be due to unique threats to each population.

Gestation is thought to last around a year. Although manta rays have been reported to live at least 40 years (Dulvy et al. 2014), not much is known about their growth, development, and population dynamics, although generation time is estimated at 25 years. Nevertheless, the combination of long-lives, late-maturation, and low productivity would make this species particularly vulnerable to harvests that target adults (Dulvy et al. 2014; Croll et al. 2016; Miller and Klimovich 2017), which would limit their ability to recover from over-exploitation (Crouse 1999). To illustrate this point, Rambahiniarison et al. (2018) estimated that giant manta ray subpopulations would require about 36.5 to 86.6 years to double in size (the former based on estimated age to maturity; the latter based on estimated age of first pregnancy). A population that requires about 4 to almost 9 decades to double in size has limited ability to recover from exploitation and disturbance, particularly when the exploitation is constant.

In order to determine how changes in survival may affect populations, Smallegange et al. (2016) modeled the demographics of reef manta rays (*M. alfredi*), which have similar life history characteristics to giant manta rays, therefore we chose this species as a proxy and assume their results are relevant to giant manta rays. In their own observations of the population off the southern coast of Mozambique, the authors estimated an adult survival rate of 0.67 (± 0.16 SE). Results from the population modeling showed that, at this adult survival rate and yearling survival rates greater than 0.75, population growth rate was most sensitive to changes in juvenile survival, while if yearling survival rates were less than 0.75, population growth rates were most sensitive to adult survival rates. They contrasted these results to a population model based on an estimated survival rate of 0.95 for a stable reef manta ray population in Japan. Based on the elasticity analysis, population growth rate was most sensitive to changes in the survival rate of adults regardless of yearling and juvenile survival rates (Smallegange et al. 2016). In other words, in order to prevent populations from declining further, Smallegange et al. (2016) found that increases in adult survival rates would have the greatest impact, such as through protection of adult aggregation sites or a reduction in fishing of adult manta rays (Smallegange et al. 2016). However, their results also show that low yearling and juvenile survival can result in declining populations even if adult survival remains high, so increased mortality of those life stages are also important.

Behavior

Although giant manta rays are considered more oceanic and solitary than the reef manta, they have been observed congregating at cleaning sites at offshore reefs and feeding in shallow waters during the day at depths <10 m (O'Shea et al. 2010; Marshall et al. 2011; Rohner et al. 2013). Unlike the reef manta ray, the giant manta ray does not appear in large schools (<30 individuals; Marshall et al. 2018) and despite having a larger distribution when compared to the reef manta, they are encountered with far less frequency.

Giant manta rays appear to exhibit a high degree of plasticity in terms of their use of depths within their habitat. Tagging studies have shown that the species conducts night descents to 200-450 m depths (Rubin et al. 2008 as cited in Miller and Klimovich 2017; Stewart et al. 2016b) but is capable of diving to depths exceeding 1,000 m (A. Marshall et al. unpubl. data 2011 cited in Marshall et al. 2011).

Threats to the Species

Giant manta rays are reportedly targeted in fisheries in Indonesia, Philippines, India, Thailand, Mozambique, Tonga, Micronesia, Peru, Ghana, and previously in Mexico and possibly the Republic of Maldives. Indonesia is reported to be one of the top countries that catch mobulid rays (Heinrichs et al. 2011). Manta and devil ray fisheries span the majority of the Indonesian archipelago, with most landing sites along the Indian Ocean coast of East and West Nusa Tenggara and Java (Lewis et al. 2015). Although fishing for manta rays was banned within the Indonesian exclusive economic zone (EEZ) in February 2014, in May 2014, manta rays were still being caught and processed at Lamakera, with the giant manta the most commonly targeted species (Marshall and Conradie 2014). It is unlikely that fishing effort and associated utilization of the species will significantly decrease in the foreseeable future as interviews with fishermen indicate that many are excited for the new prohibition on manta rays in Indonesian waters because it is expected to drive up the price of manta ray products, significantly increasing the current income of current resident fishermen (Marshall and Conradie 2014).

Giant manta rays are also frequently caught as bycatch in a number of commercial and artisanal fisheries worldwide, particularly commercial longline, trawl, purse-seine and gillnet fisheries off Europe, western Africa, the Atlantic coast of the U.S., Australia, and the Pacific and Indian Oceans.

In regions outside of the *Action Area* considered in this biological opinion (captures in fisheries that overlap the *Action Area* are considered in the *Environmental Baseline* section), giant manta rays are caught in the U.S. WCPO purse seine fishery and the ASLL fishery. The U.S. WCPO purse seine fishery captured 1,523 giant manta rays from 2010-2018 and an estimated 3,676 (95% CI: [3,119, 4,467]) interactions accounting for unidentified *Manta* species and unavailable observer data (NMFS unpublished data). However, it is also considered highly likely that a large portion (~75%) of those individuals identified as giant manta ray were misidentified by observers. In contrast the ASLL fishery captured 12 giant manta rays from 2010-2017 (based on 19 - 25% observer coverage), resulting in an estimated 122 interactions accounting for unobserved sets and individuals not identified to species (NMFS unpublished data).

Conservation

Domestic fishery regulations prohibit the retention of manta rays by persons under U.S. jurisdiction. Additionally, as noted in the final status review report (Miller and Klimovich 2017), established Marine Protected Areas (MPAs) that limit or prohibit fishing also exist that cover areas with observed giant manta ray presence, including the waters off Guam (Tumon Bay Marine Preserve), within the Gulf of Mexico (Flower Garden Banks National Marine Sanctuary), and in the Central Pacific Ocean (Pacific Remote Islands Marine National Monument).

Internationally, the giant manta ray is protected in the Maldives, Philippines, Mexico, Brazil, Ecuador, Yap, Indonesia, Western Australia, and New Zealand (Miller and Klimovich 2017). These protections range from restrictions on knowingly capturing or killing rays, to bans on exportation of ray species and their body parts from established Marine Protection Areas of known giant manta ray aggregations. However, many of these restrictions are difficult and rarely enforced; in Indonesia, restrictions have driven the price of manta ray products up (Marshall and Conradie 2014), which has likely increased demand and had the opposite effect intended.

Manta rays were included on Appendix II of CITES at the 16 Conference of the CITES Parties in March 2013. Export of manta rays and manta ray products, such as gill plates, require CITES permits that ensure the products were legally acquired and that the Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species (after taking into account factors such as its population status and trends, distribution, harvest, and other biological and ecological elements). Although this CITES protection was not considered to be an action that decreased the current listing status of the threatened giant manta ray, it may help address the threat of foreign overutilization for the gill plate trade by ensuring that international trade of this threatened species is sustainable (Miller and Klimovich 2017).

In November 2014, the Convention on the Conservation of Migratory Species of Wild Animals listed the giant manta ray on Appendix I and II of the Convention (CMS 2014). Under this designation, Conservation of Migratory Species Parties strive to protect these animals, conserve and restore habitat, mitigate obstacles to migration and engage in international and regional agreements.

There are many conservation efforts presently ongoing to collect research on manta ray life history, ecology, and biology, and to raise awareness of threats to manta rays. Some of these efforts are spearheaded by non-profit organizations specifically dedicated to manta ray conservation, such as the Manta Trust (Stevens et al. 2018), the Marine Megafuna Foundation, the Manta Pacific Research Foundation and MantaWatch. Others are driven by the countries whose economies largely depend on manta ray tourism (Erdmann 2014). In addition, guidelines for best practices for the safe release of manta rays caught in purse seine and longline fisheries have been developed (Hutchinson et al. 2017) and, as discussed in the *Description of the Proposed Action* section, went into effect as a WCPFCIA January 1, 2021. CMM 2019-05 prohibits vessels from targeted fishing or intentional setting on mobulid rays; from retaining on board, transshipping, or landing any part or whole carcass of mobulid rays; fishing vessels must promptly release animals alive and unharmed that will result in the least possible harm to the individuals captured. The U.S. has issued a proposed rule to put the handling practices in CMM 2019-05 into regulation for U.S. fisheries (86 FR 55790).

Summary of the Status

In this section of this biological opinion, we explained that the giant manta ray is highly fragmented and sparsely distributed, which contributes to the lack of information on this species. It is one of the least understood of the marine mega vertebrates. Many of the studied giant manta ray populations' have declined significantly in areas subject to fishing (Marshall et al. 2018). Fisheries catch and bycatch have caused giant manta rays to decline by at least 30% globally and by up to 80% in significant portions of its range (i.e., Indonesia, Philippines, Sri Lanka, Thailand, Madagascar; Marshall et al. 2018). In Indonesia, manta ray landings are estimated to have declined by 71% to 95%, with potential extirpations noted in certain areas (Lewis et al. 2015).

As mentioned above, in the early stages of development as an embryo, the giant manta ray is susceptible to toxins that may be passively transferred from its mother through milk production (Lyons et al. 2013). Species like the giant manta ray with delayed sexual maturity increase their potential to accumulate toxins and therefore, are expected to offload higher levels of contaminants to their offspring. Once the giant manta ray grows beyond a neonate, it is vulnerable to the same threats throughout its juvenile and adult life stages. Targeted capture and bycatch in fisheries is arguably the most significant threat to the giant manta ray (Croll et al. 2016).

Due to their particular life-history characteristics (e.g., slow growth, late maturity, and low fecundity), elasmobranchs, and specifically, the giant manta ray, have little potential to withstand high and sustained levels of fishing exploitation (Hoenig and Gruber 1990; Stevens et al. 2000; Couturier et al. 2012; Dulvy et al. 2014). Despite the best efforts of protections and conservation measures, the overall trend of the giant manta ray continues to decline.

2.2.2 Indo-West Pacific Scalloped Hammerhead Shark

Distribution and Population Structure

In 2014, the scalloped hammerhead shark was determined to consist of six DPSs and of those, four were listed as either threatened or endangered including the Indo-West Pacific scalloped hammerhead shark (Figure 5; 79 FR 38213). The majority of the *Action Area* overlaps with the range of the Central Pacific scalloped hammerhead shark which is not listed under the ESA. While most observed scalloped hammerhead shark captures have occurred within the range of the Central Pacific scalloped hammerhead shark, there have been a smaller number of captures overlapping with the range of the Indo-West Pacific scalloped hammerhead shark. Our assessment is limited to analyzing the effect of the Hawaii DSLL fishery on threatened Indo-West Pacific scalloped hammerhead sharks.

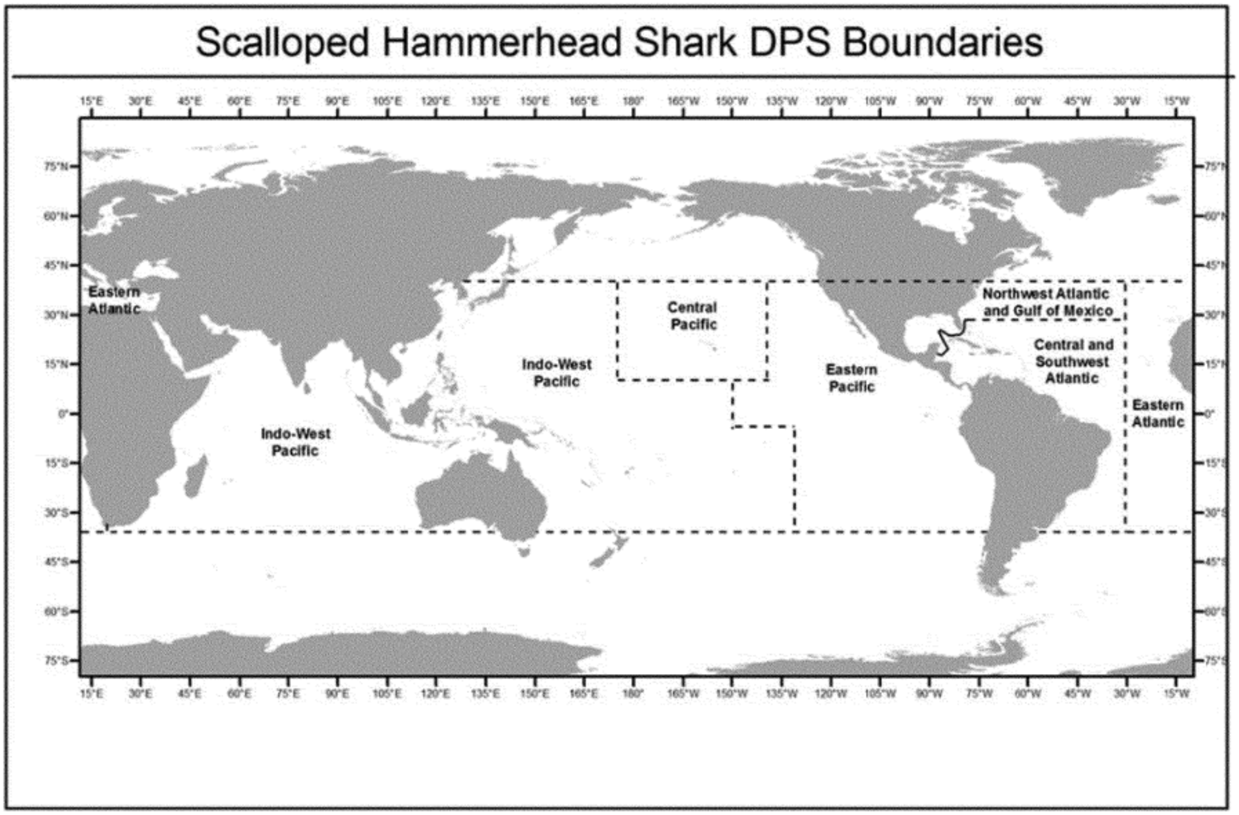

Figure 5. DPS boundaries of the scalloped hammerhead shark (79 FR 38213).

Scalloped hammerhead sharks (*Sphyrna lewini*) can be found in coastal warm temperate and tropical seas worldwide. Indo-west Pacific scalloped hammerhead sharks can be found throughout the entire Indian Ocean and in the western Pacific from Japan and China to New Caledonia, including throughout the Philippines, Indonesia, and off Australia. The scalloped hammerhead shark occurs over continental and insular shelves, as well as adjacent deep waters, but is seldom found in waters cooler than 22°C (Compagno 1984).

These sharks have been observed making migrations along continental margins as well as between oceanic islands in tropical waters (Kohler and Turner 2001; Duncan and Holland 2006; Bessudo et al. 2011; Diemer et al. 2011). Tagging studies reveal the tendency for scalloped hammerhead sharks to aggregate around and travel to and from core areas or "hot spots" within locations (Holland et al. 1993; Duncan and Holland 2006; Hearn et al. 2010; Bessudo et al. 2011), however they are also capable of traveling long distances (1671 km, Kohler and Turner 2001; 1941 km, Bessudo et al. 2011; 629 km, Diemer et al. 2011).

Status and Trends

Indo-west Pacific scalloped hammerhead sharks are listed as threatened because of overharvesting. Although range-wide trends in the abundance of this species are unknown, CPUE data suggest that local populations throughout the range of the species have declined significantly (Miller et al. 2014). For example, the hammerhead population in Australia's northwest marine region has been estimated to have declined between 58-76% between 1996 and 2005 (Miller et al. 2014). Similarly, catch rates of *Sphyrna lewini* in beach mesh programs in South Africa have declined by 99%, 86%, and 64% from 1952-1972, 1961-1972, and 1978-2003, respectively (Dudley and Simpfendorfer 2006; Ferretti et al. 2010). Estimates of the decline in Australian hammerhead abundance range from 58-85% (Heupel and McAuley 2007; CITES 2010). Data from protective shark meshing programs off beaches in New South Wales (NSW) and Queensland also suggest significant declines in hammerhead populations off the east coast of Australia. From 1973 to 2008, the number of hammerheads caught per year in NSW beach nets decreased by more than 90% from over 300 individuals to fewer than 30 (Reid and Krogh 1992; Williamson 2011; Miller et al. 2014). Similarly, data from the Queensland shark control program indicate declines of around 79% in hammerhead shark abundance between the years of 1986 and 2010, with *Sphyrna lewini* abundance fluctuating over the years but showing a recent decline of 63% between 2005 and 2010 (QLD DEEDI 2011 as cited in Miller et al. 2014).

Current effective population sizes are available for the scalloped hammerhead shark, but are considered qualitative indicators rather than precise estimates given their reliance on mutation rates and generation times (Duncan et al. 2006). Using two generation times (5.7 and 16.7 years), Duncan et al. (2006) calculated the effective female population (Nf) size of *Sphyrna lewini* for the major ocean basins. Based on a 1:1 sex-ratio (Clarke 1971; Chen et al. 1988; Stevens and Lyle 1989; Ulrich et al. 2007; White et al. 2008; Noriega et al. 2011), these calculations have been converted into total (both females and males) effective population size (Ne) by using the formula Ne = 2(Nf). Results of Ne greatly varied within and between ocean basins, with the global Ne estimated at 280,000 using a generation time of 5.7 years, and 94,000 using a generation time of 16.7 years (Miller et al. 2014). There are no estimates of abundance for the Indo-West Pacific scalloped hammerhead sharks but we can assume it is less than the global abundance of 280,000.

Pacoureau et al. (2021) indicates a 67% global decline from 1970 to 2018 equating to a 2.31% decline per year. However, Figure 5 of Pacoureau et al. (2021) suggests populations in the South Pacific and Indian Oceans (i.e., Indo West Pacific scalloped hammerheads) have stabilized at a depressed level.

Population Dynamics

Like the other elasmobranchs included in this biological opinion, scalloped hammerhead sharks are long lived, late maturing, and with low productivity (Branstetter 1990). Although their age at maturity varies geographically, scalloped hammerhead sharks are generally considered mature at about 200-250 cm total length (females) while males reach maturity at smaller sizes (range 128 – 200 cm). These lengths correspond to ages from 3.8 to 15.2 years. They are estimated to live for at least 20 to 30 years, have gestation periods of 9 to 12 months (Branstetter 1987; Stevens and Lyle 1989), give birth to live young, and females may rest for about 12 months between births (Liu and Chen 1999).

Behavior

Both juvenile and adult scalloped hammerhead sharks occur as solitary individuals, pairs, or in schools. The schooling behavior has been documented during summer migrations off the coast of South Africa as well as in permanent resident populations, like those in the East China Sea

(Compagno 1984). Adult aggregations are most common offshore over seamounts and near islands, especially near the Galapagos, Malpelo, Cocos and Revillagigedo Islands, and within the Gulf of California (Compagno 1984; CITES 2010; Hearn et al. 2010; Bessudo et al. 2011). Neonate and juvenile aggregations are more common in nearshore nursery habitats, such as Kaneohe Bay in Oahu, Hawaii, coastal waters off Oaxaca, Mexico, and Guam's inner Apra Harbor (Duncan and Holland 2006; Bejarano-Alvarez et al. 2011). It has been suggested that juveniles inhabit these nursery areas for up to or more than a year, as they provide valuable refuges from predation (Duncan and Holland 2006).

Threats to the Species

Overharvest in commercial and artisanal fisheries and illegal fishing are the most serious threats to Indo-west Pacific scalloped hammerhead sharks. Scalloped hammerhead sharks in general are captured in targeted fisheries and captured as bycatch in pelagic longline fisheries and purse seine fisheries. Miller et al. (2014) noted that significant catches of scalloped hammerheads have and continue to go unrecorded or underreported in many countries outside the U.S. Furthermore, Miller et al. (2014), discussed that data on catches of scalloped hammerheads are suspected to underestimate the true catch because many records do not account for discards (example: where the fins are kept but the carcass is discarded) or reflect dressed weights instead of live weights. In addition, many catch records do not differentiate between hammerhead species, or sharks in general, and thus species-specific population trends for scalloped hammerheads are not readily available (Miller et al. 2014). Contributing to the scalloped hammerhead shark's biological vulnerability is the fact that these sharks are obligate ram ventilators and suffer very high at-vessel fishing mortality from fisheries where they are not able to continually swim forward (Morgan and Burgess 2007; Macbeth et al. 2009; Miller et al. 2014; Dapp et al. 2016). For example, between 92 to 94% of the hammerhead sharks captured in bottom longline fisheries die at vessel and this does not include post release mortality (Morgan and Burgress 2007). Considering purse seine fisheries, while Hutchinson's (2015) study focused on silky sharks, the study showed that sharks confined in the sack portion of the net just prior to loading suffered much higher mortality with only a 6.67% chance of survival after brailing. This highlights the consequences of restricting the movement of hammerhead shark species given their respiratory mode (i.e., obligate ram ventilation). Compared to other chondrichthyans, scalloped hammerhead sharks appear to sustain a higher level of fishing mortality (Miller et al. 2014). Miller et al. (2014) further ranked high at-vessel mortality as the most serious threat to the species.

Catches of Indo-West Pacific scalloped hammerhead sharks from foreign fisheries have decreased since reaching a maximum of 798 t in 2002 (see Figure 2 in Miller et al. 2014). According to shark fin traders, hammerheads are one of the sources for the best quality fin needles for consumption and fetch a high commercial value in the Asian shark fin trade (Abercrombie et al. 2005). In Hong Kong, the world's largest fin trade market, scalloped hammerhead, and smooth hammerhead sharks are found under the "Chun chi" market category, the second most traded fin category in the market (Clarke et al. 2006a). Applying a Bayesian statistical method to the Hong Kong shark fin trade data, Clarke et al. (2006) estimated that between 1 and 3 million hammerhead sharks, with an equivalent biomass of 60 – 70 thousand metric tonnes, are traded per year.

U.S. fisheries appear to have less influence on this species status when compared to foreign fisheries. U.S. fisheries in Alaska and California, and the Hawaii SSLL do not overlap with the species range. Thus these fisheries do not interact with Indo-West Pacific scalloped hammerhead sharks. However, the U.S. WCPO purse seine and ASLL fisheries do interact with the Indo-West Pacific scalloped hammerhead.

A total of 14 Indo-West Pacific scalloped hammerhead sharks were caught and positively identified in the U.S. WCPO purse seine fishery between 2008 and 2018. However, NMFS estimates a total of 41 (95% CI: [31, 51]) Indo-West Pacific scalloped hammerhead sharks were captured between 2008 and 2018 using the Bayesian model approach and is expected to interact with 5 individuals a year with 100% mortality (NMFS 2021c).

Lastly, the ASLL fishery is expected to have interacted with approximately 60 Indo-West Pacific scalloped hammerhead sharks over a 9-year period from 2010 to 2019 (2nd quarter; McCracken 2019c). Most confirmed Indo-West Pacific hammerhead sharks were released alive (73%) and no sharks were recorded as retained. Average at-vessel mortality of Indo-West Pacific hammerhead sharks is 27% in the ASLL fishery. However, the publicly available data compiled by Dapp et al. (2016), estimate 37.6% at-vessel mortality based on the gear type (longline) and the respiratory mode of the animals (i.e., obligate ram-ventilation). Thus the greatest influence on the decline of this species is from foreign fisheries throughout the species range in the western Pacific.

Conservation

Within the WCPO, finning bans have been implemented by Australia, Cook Islands, Micronesia New Zealand, Palau, Republic of the Marshall Islands and Tokelau, as well as by the Inter-American Tropical Tuna Commission (IATTC) and the WCPFC. These finning bans range from requiring fins remain attached to the body to allowing fishermen to remove shark fins provided that the weight of the fins does not exceed 5% of the total weight of shark carcasses landed or found onboard. The WCPFC has implemented several conservation and management measures for sharks with the following objectives (Clarke 2013): (1) promote full utilization and reduce waste of sharks by controlling finning (perhaps as a means to indirectly reduce fishing mortality for sharks); (2) increase the number of sharks that are released alive (in order to reduce shark mortality); and (3) increase the amount of scientific data that is collected for use in shark stock assessments. Also, specific to oceanic whitetip sharks, CMM 2011-04 prohibits WCPFC vessels from retaining onboard, transshipping, storing on a fishing vessel, or landing any Indo-West Pacific scalloped hammerhead shark, in whole or in part, in the fisheries covered by the Convention. This CMM was later replaced in 2019 by CMM-2019-04 for all sharks, which retains the retention prohibition for oceanic whitetip sharks, and includes additional measures on minimizing bycatch (including some gear restrictions) and implementing safe release practices.

Also of relevance is the FAO International Plan of Action for the Conservation and Management of Sharks which recommends that RFMOs carry out regular shark population assessments and that member States cooperate on joint and regional shark management plans.

Based on the best scientific and commercial data available the Indo-West Pacific scalloped hammerhead shark appears to be decreasing at significant rates. The species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range

(Miller et al. 2014). Evidence of heavy fishing pressure by industrial/commercial and artisanal fisheries, and reports of significant illegal, unreported and unregulated (IUU) fishing, especially off the coast of Australia, have likely led to overutilization coupled with inadequate regulatory mechanisms are the most concerning threats that may contribute to the extinction risk of the species. As a result of this fishing mortality, the Indo-West Pacific scalloped hammerhead shark population is declining.

2.2.3 Oceanic Whitetip Shark

Distribution and Population Structure

Oceanic whitetip sharks are distributed in circumtropical and subtropical regions across the world, primarily between 30° North and 35° South latitude (Compagno 1984; Baum et al. 2015; Young et al. 2017), although, the species has been reported as far as 45°N and 40°S in the Western Atlantic (Lessa et al. 1999b). These sharks occur throughout the WCPO, including Australia (southern Australian coast), China, New Caledonia, the Philippines, Taiwan, and the Hawaiian Islands south to the Samoan Islands, Tahiti and Tuamotu Archipelago, and west to the Galapagos Islands. In the eastern Pacific, they occur from southern California to Peru, including the Gulf of California and Clipperton Island (Compagno 1984). In the western Atlantic, oceanic whitetips occur from Maine to Argentina, including the Caribbean and Gulf of Mexico. In the central and eastern Atlantic, the species occurs from Madeira, Portugal south to the Gulf of Guinea, and possibly in the Mediterranean Sea. In the western Indian Ocean, the species occurs in waters of South Africa, Madagascar, Mozambique, Mauritius, Seychelles, India, and within the Red Sea.

The geographic distribution of oceanic whitetip shark occurs in a 10° band centered on the equator (Figure 6); their abundance decreases with increasing distance from the equator and increasing proximity to continental shelves (Backus et al. 1956; Strasburg 1958; Compagno 1984; Nakano et al. 1997; Bonfil et al. 2008; Clarke et al. 2011a; Hall and Roman 2013; Tolotti et al. 2013; Young et al. 2017).

Only two studies have been conducted on the genetics and population structure of the oceanic whitetip shark which suggest there may be some genetic differentiation between various populations (Camargo et al. 2016; Ruck 2016). Camargo et al. (2016) compared the mitochondrial control region in 215 individuals from the Atlantic and Indian Oceans. They found evidence of moderate levels of population structure resulting from restricted gene flow between the western and eastern Atlantic Ocean, they also found evidence of connectivity between the eastern Atlantic Ocean and the Indian Ocean (although the sample size from the Indian Ocean was only 9 individuals). It should be noted that this study only used mitochondrial markers, meaning male-mediated gene flow is not reflected in these relationships (Young et al. 2017) although other species in the Carcharhinus genus are known to exhibit male-mediated gene flow between populations (Portnoy et al. 2010). Ruck (2016) compared samples of 171 individual sharks from the western Atlantic, Indian, and Pacific Oceans specifically looking at the mitochondrial control region, a protein-coding mitochondrial region, and nine nuclear microsatellite loci and found no fine-scale matrilineal structure was discovered within ocean basins. Ruck (2016) did detect weak but significant differentiation between the Atlantic and Indo-Pacific Ocean populations. An additional analysis of the sample from both studies

(Camargo et al. 2016; Ruck 2016) did detect matrilineal population structure within the Atlantic Ocean basin with three lineages, the Northwest Atlantic, the rest of the Western Atlantic, and the Eastern Atlantic Ocean (C. Ruck, personal communication, 2016 as cited in Young et al. 2017).

Tagging studies have also provided information on potential population structure (reviewed in Young and Carlson 2020). Two studies have found evidence of site fidelity in the Atlantic Ocean (Howey-Jordon et al. 2013; Tolotti et al. 2015). Howey-Jordon et al. (2013) found that oceanic whitetip sharks tagged in the Bahamas (1 male and 10 females tagged but the tag on the male shark failed) stayed within 500 km of their tagging site for at least 30 days, at which point they dispersed in different directions across a wide area with some sharks travelling more than 1,500 km from their tagging site. The six tagged sharks that retained their tags for longer than 150 days (n = 6) were all located within 500 km of their tagging site when their tags popped off. Similarly, Tolotti et al. (2015) tagged 8 oceanic whitetip sharks (sex of sharks was not reported) and found that the tagging and pop-up locations were relatively close to each other, but some individuals traveled long distances (up to 2,500 km) in between these events. Together, these studies suggest that oceanic whitetip sharks can be philopatric (Howey-Jordon et al. 2013; Tolotti et al. 2015; Young and Carlson 2020) however it is not clear if this is a result of females exhibiting site fidelity to pupping areas or if the species has an underlying subpopulation structure (Young and Carlson 2020).

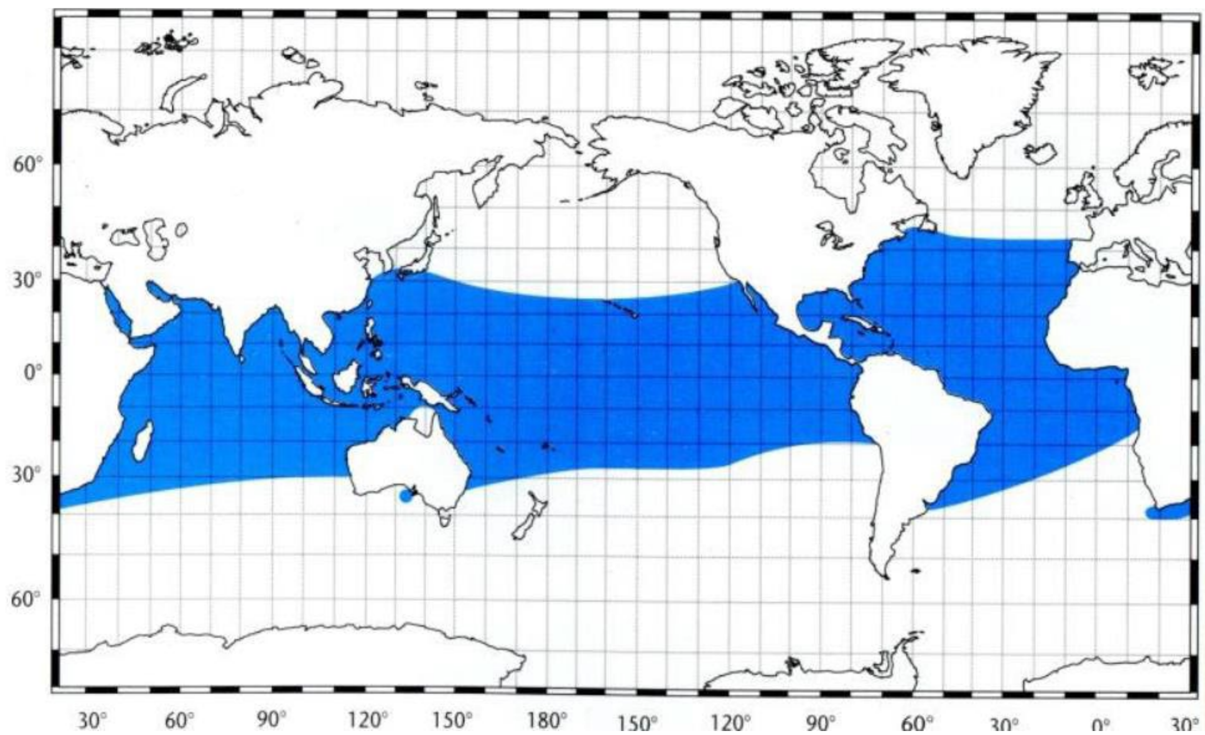

Figure 6. Geographical distribution of the oceanic whitetip shark (Last and Stevens 2009).

Status and Trends

Oceanic whitetip sharks were listed globally as threatened in 2018. Historically, oceanic whitetip sharks were described as one of the most abundant species of shark found in warm tropical and sub-tropical waters of the world (Backus et al. 1956; Strasburg 1958). Oceanic whitetip sharks occur throughout their range with no evidence of range contraction or range erosion (gaps within the species' range that form when populations become extinct locally or regionally; Lomolino and Channell 1995, 1998; Collen et al. 2011). However, recent estimates of their abundance suggest the species has experienced significant historical and continued declines throughout its range. Declines in abundance range from 80-96% across the Pacific Ocean since the late 1990s (Clarke et al. 2012; Rice and Harley 2012; Brodziak et al. 2013; Hall and Roman 2013; Rice et al. 2015; Tremblay-Boyer et al. 2019), 50-88% across the Atlantic Ocean (Baum and Meyers 2004; Santana et al. 2004; Cortes et al. 2007; Driggers et al. 2011); and have been variable across the Indian Ocean, ranging from 25-40% (Anderson et al. 2011; IOTC 2011, 2015; Ramos-Cartelle et al. 2012; Yokawa and Semba 2012).

The only formal stock assessments for the Pacific represent a portion of the total Pacific Ocean population–the West Pacific portion of the population's range (aka. the West Pacific stock). Unfortunately, it remains unclear how much of the total Pacific Ocean oceanic whitetip population this one population assessment covers. As noted above, oceanic whitetip sharks occur primarily between 30° North and 35° South latitude. We used ArcGIS to estimate the area of the Pacific Ocean between these latitudes, as well as, the area of the WCPO between these latitudes. From this assessment, we estimate that the area of oceanic whitetip shark habitat in the WCPO represents about 60% of the total habitat within the Pacific Ocean.

Two stock assessments have been conducted for the oceanic whitetip shark in the WCPO to date and the conclusions have been reinforced by additional studies (Clarke et al. 2011b; Brodziak et al. 2013; Rice et al. 2015; Tremblay-Boyer et al. 2019). Most recently, Tremblay-Boyer et al. (2019) utilized the Stock Synthesis modeling framework (Methot Jr and Wetzel 2013), which is an integrated age-structured population model. The population dynamics model was informed by three sources of data: historical catches, time series of CPUE and length frequencies. The longline fishery was split into bycatch and target fleets, and the purse-seine fishery into fleets of associated and unassociated sets. This assessment also included scenarios of discard mortality assuming 25%, 43.75% and 100% mortality on discards. The stock of oceanic whitetip shark was found to be overfished and undergoing overfishing based on SB/SBMSY and F/FMSY reference points. The current spawning stock biomass (232–-507 metric tonnes) is predicted to be below 5% of the unfished spawning biomass and the population could go extinct over the long-term based on current levels of fishing mortality (Tremblay-Boyer et al. 2019). The most recent assessment concluded that total biomass in 2010 was 19,740 metric tons and that biomass declined to 9,641 metric tons by 2016.

In previous biological opinions, NMFS has estimated that the biomass translates to 200,000 sharks (NMFS 2019) and 264,318 sharks (NMFS 2021a), following an analysis in FAO (2012). The stock assessment conducted by Tremblay-Boyer et al. (2019) included 648 model runs accounting for assumptions about life-history parameters and impact of fishing underpinning the assessment. Using the underlying data from these 648 models in their structural uncertainty grid in Tremblay-Boyer et al. (2019), the authors subsequently estimated the median value of the current total number of individuals in the WCPO at 775,214 (see NMFS 2020). We consider this estimate as the current best available scientific information and use it as our best estimate of the size of the WCPO portion of the Pacific Ocean population of oceanic whitetip sharks. Assuming a similar density of oceanic whitetip shark in the East Pacific to that of the WCPO, and using the proportion described above that the area of the WCPO between the latitudes where oceanic whitetip sharks are found represents 60% of habitat in the entire Pacific Ocean, we estimate a total population size of 1,292,023 ([775,214/60] x100) oceanic whitetip sharks in the Pacific Ocean. However, given that this estimate requires an assumption regarding the density of oceanic whitetip sharks in the East Pacific, we focus our analysis on the minimum population size estimate of 775,214 but acknowledge that the total Pacific population size may exceed one million individuals.

Rice et al. (2021) estimate that WCPO oceanic whitetip sharks will decline by an additional 13.3% (mean; 14.6% median) over 10 years which equates to an annual decrease of 1.4% (mean; 1.6% median) assuming incidental captures and mortalities remain the same as 2016. If longline fishery mortalities are decreased by 10% across the WCPO, Rice et al. (2021) estimate that the WCPO population will only decline by an additional 0.4% (mean; 1.2% median) which equates to annual declines of 0.04% (mean; 0.13% median). If longline fishery mortalities are decreased further, by 20% across the WCPO, Rice et al. (2021) estimate that the WCPO population will increase by 4.2% (mean; 3.3% median) over the next 10 years, which equates to an annual increase of 0.46% (mean; 0.36% median). Rice et al. (2021) indicate that recent catch is likely bounded by the latter two scenarios, or reductions of between 10% and 20% due to adoptions of CMMs and slight decreases in the amount of longline fishing effort. More recently, Bigelow et al. (2022) updated the projections of Rice et al. (2021) with contemporary estimates of at-vessel and post-release mortality rates, and catch reductions facilitated by switching to monofilament leaders. Their results are summarized by projections of the ratio of spawning biomass (projected to 2031) to the equilibrium unfished spawning biomass (i.e. the biomass of an unfished population). This provides a relative measure of the size of the spawning biomass of a population whereby increasing ratios indicate higher biomass. The mean values of these ratios increase from 0.039 estimated for 2016 to 0.118 with updated assumptions regarding at-vessel and post-release mortality reductions and prohibition of wire leaders and shark lines (Figure 7; see Table 3 of Bigelow et al. 2022). These results are based on optimistic post-interaction mortality rates of 3.4 to 8.1% with an at-vessel mortality rate of 19.2% (see Table 1 of Bigelow et al. 2022). It is unclear if these values will apply to all WCPO longline fisheries, however the implementation of CMM-2019-04 is anticipated to improve the survival of released sharks throughout the WCPO.

We believe this new information provided by Bigelow et al. (2022) constitutes the best available. However, Bigelow et al. (2022) do not provide specific population trends, only indicating that the trends in spawning biomass ratios are anticipated to be positive (Figure 7). Additional years of data are needed before we can calculate an estimated population trend. Given the uncertainty in the applicability of the assumption made by Bigelow et al. (2022) to the broader WCPO fisheries, we consider it reasonable to assess the range of population trends presented in Rice et al. (2021) for reductions in fishery mortality between 10 and 20%. Therefore, we focus our analysis on the scenarios presented by Rice et al. (2021) whereby the actual population trend is between a declining rate of 0.13% per year (median value for 10% reduction in fishery mortalities) and an increase rate of 0.36% per year (median value for 20% reduction in fishery mortalities). These numbers include the loss of individuals from the DSLL as currently operated.

Historic declines in abundance of WCPO oceanic whitetip sharks are attributable to impacts from pelagic fisheries, both longline and purse seine fisheries as well as smaller fisheries such as troll, handline and shortline fisheries. As noted above in the *Distribution and Population Structure* section, it is possible that oceanic whitetip sharks are philopatric; therefore, the declines in abundance may have resulted in localized depletions resulting in a loss of genetic diversity, and changes in distribution.

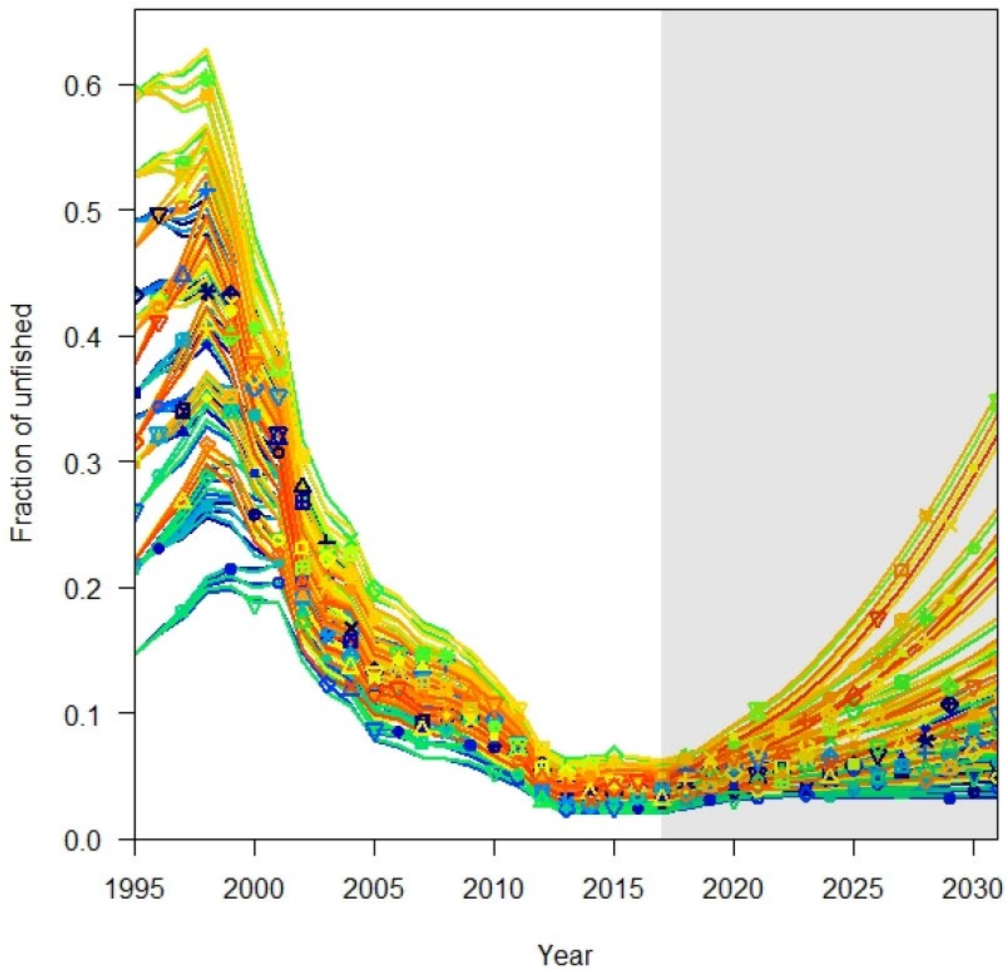

Figure 7. Projected ratios of of spawning biomass (projected to 2031) to the equilibrium unfished spawning biomass for WCPO oceanic whitetip sharks with updated at-vessel and post-release mortality rates and the prohibition of wire branchlines and shark line (Figure 7 in Bigelow et al. 2022).

Population Dynamics

Oceanic whitetip sharks are a relatively long-lived, late maturing species with low-to-moderate productivity. These sharks are estimated to live up to 19 years (Seki et al. 1998; Lessa et al.

1999a; Joung et al. 2016), although their theoretical maximum age has been estimated to be approximately 36 years. Female oceanic whitetip sharks reach maturity between 6 and 9 years of age, although this varies with geography (Seki et al. 1998; Lessa et al. 1999a; Joung et al. 2016) and give birth to live young after a very lengthy gestation period of 9 to 12 months (Bonfil et al. 2008; Coelho et al. 2009). The reproductive cycle is thought to be biennial, with sharks giving birth every one or two years in the Pacific Ocean (Seki et al. 1998; Chen 2006 as cited in Liu and Tsai 2011) and alternate years in other ocean basins. Litters range from 1 to 14 pups with an average of 6 (Seki et al. 1998; Lessa et al. 1999a; Juong et al. 2016). Their generation time has been estimated to range between 7 and 11 years (Cortes 2002; Smith et al. 2008).

Behavior

Oceanic whitetip sharks generally prefer mixed surface layers where temperatures typically remain greater than 20°C to 150 m in depth, with brief deep dives into deeper waters (Howey-Jordan et al. 2013; Howey et al. 2016; Tolotti et al. 2017; Young et al. 2017). The maximum recorded dive of the species was to a depth of 1,082 m (Howey-Jordan et al. 2013). Aggregations of oceanic whitetip sharks have been observed in the Bahamas (Madigan et al. 2015; Young et al. 2017), but there is no evidence of social interactions between individuals or groups of individuals.

Threats to the Species

The primary threat to oceanic whitetip sharks worldwide is intentional targeting and incidental bycatch in commercial fisheries, including both U.S. and foreign fisheries (Young et al. 2017; Young and Carlson 2020). Because of their preferred distribution in warm, tropical waters, and their tendency to remain at the surface, oceanic whitetip sharks have high encounter and mortality rates in fisheries throughout their range. They are frequently caught as bycatch in many global fisheries, including pelagic longline fisheries targeting tuna and swordfish, purse seine, gillnet, and artisanal fisheries. They are also a preferred species for the international fin trade, discussed in more detail below. Impacts to the species from fisheries (U.S. and foreign) that overlap the *Action Area* will be discussed in the *Environmental Baseline*, as appropriate.

Bycatch-related mortality in longline fisheries are considered the primary drivers for these declines (Clarke et al. 2011b; Rice and Harley 2012; Young et al. 2017), with purse seine fisheries being secondary sources of mortality. In addition to bycatch-related mortality, the oceanic whitetip shark is a preferred species for opportunistic retention because its large fins obtain a high price in the Asian fin market, and comprises approximately 2% of the global fin trade (Clarke et al. 2006). Despite finning bans and retention prohibitions both domestically and internationally, this high value and demand for oceanic whitetip fins incentivizes the opportunistic retention and subsequent illegal finning of oceanic whitetip sharks when caught, and thus represents the main economic driver of mortality of this species in commercial fisheries throughout its global range. As a result, oceanic whitetip biomass has declined by 88% since 1995 (Tremblay-Boyer et al. 2019). Currently, the population is overfished and overfishing is still occurring throughout much of the species' range (Rice and Harley 2012; Tremblay-Boyer et al. 2019; 83 CFR 46588). As a result, catch trends of oceanic whitetip shark in both longline and purse seine fisheries have significantly declined, with declining trends also detected in some biological indicators, such as biomass and size indices (Clarke et al. 2011b; Young et al. 2017).

U.S. fisheries in the Pacific that incidentally capture oceanic whitetip sharks include the SSLL, DSLL, and the American Samoa longline fisheries, as well as the U.S. purse seine fishery. The SSLL is estimated to interact with up to 102 oceanic whitetip sharks a year (95th percentile; NMFS 2019). The DSLL is estimated to interact with a mean of 1,708 (95th percentile: 3,185) oceanic whitetip sharks annually (McCracken 2019c; NMFS 2018b), though see the discussion in the *Effects of the Action* section regarding the effect of the fishery switching to monofilament leaders. The American Samoa longline fishery will be discussed in the *Environmental Baseline*, as that fishery overlaps the *Action Area*. No interactions have been noted with oceanic whitetip sharks in any West Coast Highly Migratory Species fishery to date (C. Villafana and C. Fahy pers. comm. to J. Rudolph; March 7, 2019).

Overall, the species has experienced significant historical and ongoing abundance declines in all three ocean basins (Atlantic, Pacific, and Indian Oceans) due to overutilization from fishing pressure and inadequate regulatory mechanisms to protect the species (Hazin et al. 2007; Lawson 2011; Clarke et al. 2012; Hasarangi et al. 2012; Hall and Roman 2013; Young et al. 2017; Tremblay-Boyer et al. 2019). Their population dynamics –long-lived and late maturing with low-to-moderate productivity– makes this species particularly vulnerable to harvests that target adults and limits their ability to recover from over-exploitation.

Conservation

Due to reported population declines driven by the trade of oceanic whitetip shark fins, the oceanic whitetip shark was listed under Appendix II of CITES in 2013. This listing went into effect as of September 2014.

Within the WCPO, finning bans have been implemented by the U.S., Australia, Cook Islands, Micronesia, New Zealand, Palau, Republic of the Marshall Islands and Tokelau, as well as by the IATTC and the WCPFC. These finning bans range from requiring fins remain attached to the body to allowing fishermen to remove shark fins provided that the weight of the fins does not exceed 5% of the total weight of shark carcasses landed or found onboard. The WCPFC has implemented several conservation and management measures for sharks with the following objectives (Clarke 2013): (1) promote full utilization and reduce waste of sharks by controlling finning (perhaps as a means to indirectly reduce fishing mortality for sharks); (2) increase the number of sharks that are released alive (in order to reduce shark mortality); and (3) increase the amount of scientific data that is collected for use in shark stock assessments. Also, specific to oceanic whitetip sharks, CMM 2011-04 prohibits WCPFC vessels from retaining onboard, transshipping, storing on a fishing vessel, or landing any oceanic whitetip shark, in whole or in part, in the fisheries covered by the Convention. This CMM was later replaced in 2019 by CMM-2019-04 for all sharks, which retains the retention prohibition for oceanic whitetip sharks, and includes additional measures on minimizing bycatch (including some gear restrictions) and implementing safe release practices.

Summary of the Status

In this section of this biological opinion, we explained that the oceanic whitetip shark is globally threatened, and that the species' population has suffered substantial historic declines and that, while the rates of declines have been reduced, numbers are continuing to decline. We used our knowledge of the species' demography and population ecology to capture the primary factors that appear to determine the oceanic whitetip shark population dynamics. Primary threats that have contributed to the species' decline and listing include overutilization due to fisheries bycatch and opportunistic trade of the species' fins, as well as inadequate regulatory mechanisms related to commercial fisheries management and the international shark fin trade (Young et al. 2017).

As a result of fishing mortality, oceanic whitetip biomass has declined by 86% in the Western and Central Pacific Ocean, with an estimated decline of 1.6% per year (Young et al. 2017; Rice et al. 2020). The stock is overfished, and overfishing may still be occurring (Rice and Harley 2012; Trembolay-Boyer et al. 2019; Bigelow et al. 2022; 83 CFR 46588). In a recent assessment, Bigelow et al. (2022) suggest the recent initiatives that prohibit retention, improve handling and release conditions, and shifts to monofilament leaders are likely to result in increasing trends for WCPO oceanic whitetip sharks. Historically, catch trends of oceanic whitetip shark in both longline and purse seine fisheries have significantly declined, with declining trends also detected in some biological indicators, such as biomass and size indices (Clarke et al. 2011a; Young et al. 2017). Similar results between analyses of The Pacific Community observer data from the larger Western and Central Pacific and the observer data from the Hawaii-based pelagic longline fishery suggest that the stock decline of oceanic whitetip sharks in this portion of its range is not just a localized trend, but rather a Pacific-wide phenomenon (Brodziak et al. 2013). Based on Bigelow et al. (2022), these trends may turn around, however fishery bycatch, direct harvest and finning continue to be the primary threats to oceanic whitetip sharks.

2.2.4 Corals

Threats Faced by All Pacific ESA-Listed Corals

Corals face numerous natural and anthropogenic threats that shape their status and affect their ability to recover. Because many of the threats are the same or similar in nature for all listed coral species, those identified in this section are discussed in a general sense for all corals. All threats are expected to increase in severity in the future. More detailed information on the threats to listed corals is found in the Final Listing Rule (79 FR 53851; September 10, 2014). Threat information specific to a particular species is then discussed in the corresponding status sections where appropriate.

Several of the most important threats contributing to the extinction risk of corals are related to the continued growth of the human population and associated changes in greenhouse gas (GHG) emissions, water quality, and extractive use of coastal and marine resources.

Ocean Warming

Because of rising atmospheric GHGs, global surface air temperatures have warmed and the rate of warming has increased. The global trend in average temperature is reflected in long-term trends in sea surface temperature. Ocean warming is one of the most important threats posing extinction risks to the listed coral species, but individual susceptibility varies among species. The primary observable coral response to ocean warming is bleaching of adult coral colonies, wherein corals expel their symbiotic algae in response to stress. For many corals, an episodic increase of only 1°C–2°C above the normal local seasonal maximum ocean temperature can induce bleaching. Corals can withstand mild to moderate bleaching; however, severe, repeated, and/or prolonged bleaching can lead to colony death. Coral bleaching patterns are complex, with several species exhibiting seasonal cycles in symbiotic algae density. Thermal stress has led to bleaching and mass mortality in many coral species during the past 25 years. Mass bleaching events, including at a regional and even global scale, are becoming more common as oceans continue to warm.

In addition to coral bleaching, other effects of ocean warming can harm virtually every life history stage in reef-building corals. Impaired fertilization, developmental abnormalities, mortality, impaired settlement success, and impaired calcification of early life phases have all been documented. Average seawater temperatures in reef-building coral habitat in the wider Caribbean have increased during the past few decades and are predicted to continue to rise between now and 2100. Further, the frequency of warm-season temperature extremes (warming events) in reef-building coral habitat has increased during the past two decades and is predicted to continue to increase between now and 2100.

Ocean Acidification

Ocean acidification is a result of global climate change caused by increased carbon dioxide (CO_2) in the atmosphere that results in greater releases of CO_2 that is then absorbed by seawater. Reef-building corals produce skeletons made of the aragonite form of calcium carbonate. Ocean acidification reduces aragonite concentrations in seawater, making it more difficult for corals to build their skeletons. Ocean acidification has the potential to cause substantial reduction in coral calcification and reef cementation. Further, ocean acidification affects adult growth rates and fecundity, fertilization, pelagic planula settlement, polyp development, and juvenile growth. Ocean acidification can lead to increased colony breakage, fragmentation, and mortality. Based on observations in areas with naturally low pH, the effects of increasing ocean acidification may also include reductions in coral size, cover, diversity, and structural complexity.

As CO_2 concentrations increase in the atmosphere, more CO_2 is absorbed by the oceans, causing lower pH and reduced availability of calcium carbonate. Because of the increase in CO_2 and other GHGs in the atmosphere since the Industrial Revolution, ocean acidification has already occurred throughout the world's oceans, and is predicted to increase considerably between now and 2100. Along with ocean warming and disease, we consider ocean acidification to be one of the most important threats posing extinction risks to coral species between now and the year 2100, although individual susceptibility varies among the listed corals.

Diseases

Disease adversely affects various coral life history events by, among other processes, causing adult mortality, reducing sexual and asexual reproductive success, and impairing colony growth. A diseased state results from a complex interplay of factors including the cause or agent (e.g., pathogen, environmental toxicant), the host, and the environment. All coral disease impacts are presumed to be attributable to infectious diseases or to poorly described genetic defects. Coral disease often produces acute tissue loss. Other forms of "disease" in the broader sense, such as temperature-caused bleaching, are discussed in other threat sections (e.g., ocean warming because of climate change).

Coral diseases are a common and significant threat affecting most or all coral species and regions to some degree, although the scientific understanding of individual disease causes in corals remains very poor. The incidence of coral disease appears to be expanding geographically, though the prevalence of disease is highly variable between sites and species. Increased prevalence and severity of diseases is correlated with increased water temperatures, which may correspond to increased virulence of pathogens, decreased resistance of hosts, or both. Moreover, the expanding coral disease threat may result from opportunistic pathogens that become damaging only in situations where the host integrity is compromised by physiological stress or immune suppression. Overall, there is mounting evidence that warming temperatures and coral bleaching responses are linked (albeit with mixed correlations) with increased coral disease prevalence and mortality.

Monitoring surveys conducted from 2002 to 2006 in the American Samoa archipelago reported total coral disease prevalence rates per island ranging from 0.04% on Swains Island to 0.5% on Tutuila (Brainard 2008). Monitoring surveys conducted from 2003 to 2007 in the Mariana Islands reported total coral disease prevalence rates per island ranging from 0.1% on Rota Island to 1.4% on Guam (Brainard 2012). These studies give us a general idea of coral disease prevalence rates across the region, but do not provide trend information that might indicate temporal patterns.

Effects of Reef Fishing

Fishing, particularly overfishing, can have large-scale, long-term ecosystem-level effects that can change ecosystem structure from coral-dominated reefs to algal-dominated reefs ("phase shifts"). Even fishing pressure that does not rise to the level of overfishing potentially can alter trophic interactions that are important in structuring coral reef ecosystems. These trophic interactions include reducing population abundance of herbivorous fish species that control algal growth, limiting the size structure of fish populations, reducing species richness of herbivorous fish, and releasing corallivores from predator control.

In the Caribbean, parrotfishes can graze at rates of more than 150,000 bites per square meter (m^2) per day (Carpenter 1986), and thereby remove up to 90-100% of the daily primary production (e.g., algae; Hatcher 1997). With substantial populations of herbivorous fishes, as long as the cover of living coral is high and resistant to mortality from environmental changes, it is very unlikely that the algae will take over and dominate the substrate. However, if herbivorous fish populations, particularly large-bodied parrotfish, are heavily fished and a major mortality of coral colonies occurs, then algae can grow rapidly and prevent the recovery of the coral population. The ecosystem can then collapse into an alternative stable state, a persistent phase shift in which algae replace corals as the dominant reef species. Although algae can have negative effects on adult coral colonies (e.g., overgrowth, bleaching from toxic compounds), the ecosystem-level effects of algae are primarily from inhibited coral recruitment. Filamentous algae can prevent the colonization of the substrate by planula larvae by creating sediment traps that obstruct access to a hard substrate for attachment. Additionally, macroalgae can block successful colonization of the bottom by corals because the macroalgae takes up the available space and causes shading, abrasion, chemical poisoning, and infection with bacterial disease. Trophic effects of fishing are a medium importance threat to the extinction risk for listed corals.

Fishing activities also lead to derelict gear that leads to significant habitat degradation. As an example of how much derelict fishing gear can affect coral reefs, Dameron et al. (2007) estimated that at least 52 metric tons of derelict fishing gear annually become entangled in reefs of the NWHI from fisheries thousands of kilometers away. In addition to derelict gear, actively fished gear can damage corals and their habitat depending on the type of gear and where it is deployed.

Land-Based Sources of Pollution

Human activities in coastal and inland watersheds introduce sediment, nutrients, chemicals, and other pollutants into the ocean by a variety of mechanisms including river discharge, surface runoff, groundwater seeps, and atmospheric deposition. Humans also introduce sewage into coastal waters through direct discharge, treatment plants, and septic leakage. Agricultural runoff leads to discharges of nutrients from fertilizers and chemicals from pesticide use. Elevated sediment levels are generated by poor land use practices, including during coastal and nearshore construction. Industry is also a source of chemical contaminants through air emissions and water discharges.

Delivery of terrestrial sediment to areas containing corals results in sediment stress in these animals. The most common direct effect of sedimentation is sediment landing on coral surfaces as it settles out from the water column. Corals with certain morphologies (e.g., mounding) can passively reject settling sediments. Corals with large calices (skeletal component that holds the polyp) tend to be better at actively rejecting sediment. When corals actively remove sediment there is a significant energy cost, meaning respiration increases, photosynthetic efficiency decreases, and the photosynthesis to respiration ratio decreases. Some coral species can tolerate complete burial for several days. Corals that cannot remove sediment will be smothered and die. Sediment can also cause sublethal effects such as reductions in tissue thickness, polyp swelling, zooxanthellae loss, and excess mucus production. In addition, suspended sediment can reduce the amount of light in the water column, making less energy available for coral photosynthesis and growth. Sedimentation also impedes fertilization of spawned gametes and reduces larval settlement and survival of recruits and juveniles. Sediment stress and turbidity can also induce coral bleaching.

Elevated nutrient concentrations in seawater affect corals through two main mechanisms: direct impacts on coral physiology, and indirect effects through stimulation of other community components (e.g., macroalgal turfs and seaweeds, and filter feeders) that compete with corals for space on the reef. Increased nutrients can decrease calcification; however, nutrients may also enhance linear extension while reducing skeletal density. Either condition results in corals that are more prone to breakage or erosion, but individual species do have varying tolerances to increased nutrients. Anthropogenic nutrients mainly come from point-source discharges (such as rivers or sewage outfalls) and surface runoff from modified watersheds. Natural processes, such as *in situ* nitrogen fixation and delivery of nutrient-rich deep water by internal waves and upwelling, also bring nutrients to coral reefs. Elevated nutrient levels have been shown to inhibit gamete development, induce a shift toward more male gametes, reduce fertilization success, and reduce larval settlement. Settlement and growth of recruits may also be affected by elevated nutrient levels. In areas where the populations of herbivores has been depleted, higher nutrient levels lead to increased growth of algae that may overgrow reef substrates.

Toxins and bioactive contaminants may also be delivered to areas containing coral habitats via point and non-point sources. Records of heavy metals in skeletal material are useful for evaluating the effects of long-term chronic exposures to things like contaminated sediments and runoff. Skeletal heavy metals were correlated with reduced coral growth rates near areas with coastal development in Jordan (Al-Rousan et al. 2007), rum refineries in Barbados (Runnals and Coleman 2003), and effects of agriculture and development in marine reserves along the Mesoamerican Reef (Carilli et al. 2010), although heavy metals are most heavily concentrated in zooxanthellae (Reichelt-Brushett and McOrist 2003). Responses to metal concentrations in corals can be species-specific. For example, *Acropora cervicornis* and *Orbicella faveolata* accumulated copper in their tissues when exposed to the metal while *Pocillopora damicornis* did not, but *Acropora cervicornis* and *Pocillopora damicornis* showed reduced photosynthesis and growth while *Orbicella faveolata* did not (Bielmyer et al. 2010). Exposure to pesticides can inhibit coral reproduction, including fertilization, settlement and metamorphosis (Markey et al. 2007). Similarly, endocrine disruptors have been shown to reduce coral growth and fecundity, and increase tissue thickness (Tarrant et al. 2004). The general effects of contaminants on coral communities are reductions in coral growth, coral cover, and species richness, and a shift in community composition to more tolerant species (Brainard et al. 2011).

Conservation and Recovery Goals

No final recovery plans currently exist for any coral species under consideration; however, a recovery outline was developed in 2015 to serve as interim guidance to direct recovery efforts, including recovery planning, until a final recovery plan is developed and approved for the 15 Indo-Pacific coral species listed in September 2014. The following short and long-term recovery goals are listed in the document for all species:

Short-Term Goals:

- Through research, improve understanding of population distribution, abundance, trends, and structure through monitoring and modeling.
- Reduce locally-manageable stress and mortality sources for coral reefs (e.g., acute sedimentation, nutrients, contaminants, and over-fishing on coral reefs).
- Improve understanding of genetic and environmental factors that lead to variability of bleaching response and disease susceptibility.

Long-Term Goals:

- Develop and implement U.S. and international measures to reduce atmospheric carbon dioxide concentrations to curb warming (and its effect on coral disease) and acidification impacts.
- Implement ecosystem-level actions to improve habitat quality and restore keystone species and functional processes to maintain adult colonies and promote successful natural recruitment.

2.2.4.1 Coral Species

Acropora globiceps

Distribution and Population Structure

Acropora globiceps was listed as threatened on September 10, 2014 (79 FR 53852). *Acropora globiceps* is distributed from the oceanic west Pacific to the central Pacific as far east as the Pitcairn Islands. In the U.S., *Acropora globiceps* occurs in American Samoa, the Northern

Mariana Islands, and the minor outlying islands (Figure 8).

Colonies of *Acropora globiceps* are typically about a foot in diameter or less, but can reach approximately 1 m in diameter. Colonies are round, with finger-like branches growing upward. Branches are uniform in size and shape, roughly finger length, diameter, and shape, with almost no side branches. Branch tips are rounded. The axial corallite is small and short. Radial corallites (i.e., corallites on the sides of branches) are uniform and fairly small, and often some are in rows. Branches are usually close together and can have a narrow, uniform crack between them, though not always. Length of branches, how close they are together, and the degree of branch tapering varies some between colonies, but usually not within colonies. Colony color is typically cream to brown, and sometimes fluorescent green in some locations. As explained below, this species is similar to some other *Acropora* species. However, *Acropora globiceps* has distinctive characteristics and can be reliably identified in the field, as noted below and in more detail in Fenner and Burdick (2016) and Fenner (2020b).

Figure 8. Range of *Acropora globiceps*, modified from the map in Veron et al. (2016), based on sources cited in the text. Dark green indicates ecoregions with confirmed observations of *Acropora globiceps* by recognized experts, and light green indicates ecoregions where it is strongly predicted to occur by recognized experts.

Status

Detecting changes in abundance over time of rare or uncommon Indo-Pacific reef-building coral species such as *Acropora globiceps* is complicated by many factors, and time-series abundance data is not available for this species. However, overall mean coral cover (i.e., percentage of live cover of all reef-building coral species combined) has declined across much of the Indo-Pacific since the 1970s, and likely many decades before then in some locations (79 FR 53851-54123; NMFS 2020). Furthermore, from 2014 to 2017, an unprecedented series of bleaching events impacted most of the Indo-Pacific's coral reefs (Eakin et al. 2019), further reducing overall mean coral cover, especially of relatively sensitive species such as many *Acropora* species including

Acropora globiceps. For example, between 2013 and 2017 on Guam, reduction in mean *Acropora* cover was much higher than the reduction in overall mean coral cover, and mortality of *Acropora globiceps* colonies from bleaching was higher than overall coral mortality from bleaching (Raymundo et al. 2019). Based on these general trends, it is likely that *Acropora globiceps*' abundance has been in decline for decades, and that the rate of its decline has accelerated in recent years.

Population Dynamics

Like other *Acropora* species, *Acropora globiceps* reproduces by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable substrates such as rock or dead coral and grow into colonies. Skeletal growth of colonies is relatively rapid compared to other reef-building corals. Prolific reproduction, rapid skeletal growth, and branching colony morphology help *Acropora globiceps* successfully compete for space. However, resilience to disturbance is low, and populations that are frequently disturbed by warming-induced bleaching, storms, and other threats have high levels of mortality, rapid turnover, and high proportions of small colonies (Darling et al. 2012; Adjeroud et al. 2015; Kayal et al. 2015).

Many *Acropora* species have branching morphologies, making them potentially susceptible to fragmentation. Fragment survival can increase coral abundance in the short-term but does not contribute new genotypes (or evolutionary opportunities) to the population.

DeVantier and Turak (2017) characterized relative abundances of each reef-building coral species present at a total of 3,075 sites distributed throughout 31 Indo-Pacific ecoregions from the Red Sea to the Great Barrier Reef. The sites were surveyed from 1994 to 2016, and included all main reef types, including fringing, patch, platform and barrier reefs, atolls, and non-reef coral communities. Non-reef areas are those where environmental conditions prevent reef formation by reef-building corals, but some reef-building coral species are present (Perry and Larcombe 2003). Surveys were generally conducted between the surface and approximately 40 m in depth, although some extended to 40 – 50 m (DeVantier and Turak 2017). The relative abundance of each species in each ecoregion was quantified on a scale of 1 to 5, where 1 = rare, 2 = uncommon, 3 = common, 4 = abundant, and 5 = dominant, then the mean relative abundance of each species was calculated for all of the ecoregions where it was reported. Of the 31 surveyed ecoregions, *Acropora globiceps* was reported from 13 ecoregions, and its mean relative abundance was 1.95 (DeVantier and Turak 2017).

In addition to the 13 ecoregions where the relative abundance of *Acropora globiceps* was estimated by DeVantier and Turak (2017), their rating method has been used to estimate relative abundances of reef-building corals in portions of several other ecoregions in the central Pacific. The relative abundances of *Acropora globiceps* in these surveys ranged from 1.3 (Saipan) to 2.5 (Wallis), and included scores of 1.8 (American Samoa), 1.5 (Tonga), 1.5 (Fiji), 2.1 (New Caledonia), and 1.7 (Marshall Islands; Fenner 2020b). Based on the results of DeVantier and Turak (2017) and Fenner (2020b), the overall relative abundance of *Acropora globiceps* is uncommon, but ranges from rare to common, depending on the location.

Based on *Acropora globiceps'* distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *Acropora globiceps* to be at least tens of millions of colonies. Dietzel et al. (2021) estimated its absolute abundance at 654 million colonies.

Within U.S. waters, *Acropora globiceps* occurs in Guam (a single island), the CNMI (an archipelago of 15 islands), American Samoa (an archipelago of 7 islands), PRIA (an administrative grouping of seven islands, atolls, and reefs widely distributed across the central Pacific), and the NWHI, as described in more detail below.

Guam: *Acropora globiceps* is widely distributed on the reef slopes around Guam. For example, David Burdick reported *Acropora globiceps* from 22 sites around Guam (2015 personal communication reported in NMFS 2021a), and the U.S. Department of Defense reported the species from 24 sites around Guam (Figure 4-14; Navy 2019).

CNMI: *Acropora globiceps* has been recorded throughout southern CNMI, including on Saipan, Tinian, Aguijan, and Rota (Maynard et al. 2015; Fenner 2020b). The islands of northern CNMI are uninhabited and rarely surveyed. However, NMFS (2021a) reports *Acropora globiceps* from Anatahan, Pagan, and Maug. In addition, *Acropora globiceps* has been reported from Farallon de Medinilla (Carilli et al. 2020), an islet between CNMI's southern and northern islands.

American Samoa: *Acropora globiceps* is widely distributed on the reef slopes around Tutuila and Aunu`u, and has also been recorded on South Bank, a seamount south of Tutuila. The species has also been recorded on four of the other five islands of American Samoa, including Ofu, Olosega, Ta`u, and Rose Atoll. Swains Island is the most isolated island of American Samoa. It has occasionally been surveyed for corals, but *Acropora globiceps* has not been recorded there (Montgomery et al. 2019; Fenner 2020a; Fenner 2020b).

PRIA: Portions of each of the seven islands, atolls, and reefs of PRIA have been surveyed over the past several years. Williams et al. (2008) and Kenyon et al. (2011) reported *Acropora globiceps* on Palmyra Atoll, while Kenyon et al. (2011) and Doug Fenner (2017 personal communication reported in NMFS 2021a) reported it from Kingman Reef and Wake Atoll, respectively, and Tony Montgomery reported it from Johnston Atoll (2019 personal communication reported in NMFS 2021a). The species has not been reported on Baker Island, Howland Island, or Jarvis Island.

NWHI: *Acropora humilis* has been recorded in the NWHI multiple times over the last several decades, although only at French Frigate Shoals and Muro Reef. Review of photos from French Frigate Shoals taken in 2014 and 2017 indicate that these colonies are *Acropora globiceps*.

Acropora retusa

Distribution and Population Structure

Acropora retusa was listed as threatened on September 10, 2014 (79 FR 53852). *Acropora retusa* is either confirmed or strongly predicted from the South Africa to French Polynesia (Veron et al. 2016). In addition, *Acropora retusa* has been confirmed in the Chagos Archipelago (NMFS 2021a; Figure 9).

Figure 9. Range of *Acropora retusa*, modified from the map in Veron et al. (2016).

Colonies of *Acropora retusa* are flat plates with short, thick finger-like branches. Branches look spiky because radial corallites are variable in length, giving the species rougher-looking branches than other digitate *Acropora* species. Colonies are typically brown or green in color. Corallites are tubular and thick walled. Similar *Acropora* species and key differences are described in Fenner and Burdick (2016) and Fenner (2020a).

Like other *Acropora* species, *Acropora retusa* reproduces by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable substrates such as rock or dead coral and grow into colonies. Skeletal growth of colonies is relatively rapid compared to other reef-building corals. Prolific reproduction, rapid skeletal growth, and branching colony morphology help *Acropora retusa* successfully compete for space, but susceptibility to threats such as warming-induced bleaching is high (79 FR 53851-54123).

Acropora retusa most commonly occurs on upper reef slopes in less than 5 m in depth. It is also sometimes found on reef flats and in backreef pools, and has been recorded as deep as 10 m on Tutuila, American Samoa (2015 personal communication from Doug Fenner reported in NMFS 2021a).

Status

Acropora retusa is highly susceptible to ocean warming, disease, ocean acidification, trophic effects of fishing, predation, and nutrients. These threats are expected to continue and increase into the future. In addition, existing regulatory mechanisms addressing global threats that contribute to extinction risk for this species are inadequate. *Acropora retusa* is restricted to shallow habitat (0 – 5 m), where many global and local threats may be more severe, especially near populated areas. Shallow reef areas are often subjected to highly variable environmental conditions, extremes, high irradiance, and simultaneous effects from multiple stressors, both local and global in nature. A limited depth range also reduces the absolute area in which the species may occur throughout its geographic range, and indicates that a large proportion of the population is likely to be exposed to threats that are worse in shallow habitats, such as simultaneously elevated irradiance and seawater temperatures, as well as localized impacts.

Acropora retusa's abundance is considered rare overall.

Overall mean coral cover (i.e., percentage live cover of all reef-building coral species combined) has declined across much of the Indo-Pacific since the 1970s, and likely many decades before then in some locations (79 FR 53851-54123; NMFS 2020). Furthermore, from 2014 to 2017, an unprecedented series of bleaching events impacted most of the Indo-Pacific's coral reefs (Eakin et al. 2019), further reducing overall mean coral cover, especially of relatively sensitive species such as many *Acropora* species. Based on these general trends, it is likely that *Acropora retusa*'s abundance has been in decline for decades, and that the rate of its decline has accelerated in recent years.

This level of abundance, combined with its restricted depth distribution where impacts are more severe, leaves the species vulnerable to becoming of such low abundance within the foreseeable future that it may be at risk from dispensatory processes, environmental stochasticity, or catastrophic events. The combination of these characteristics and future projections of threats indicates that the species is likely to be in danger of extinction within the foreseeable future throughout its range.

Population Dynamics

DeVantier and Turak (2017) characterized relative abundances of each reef-building coral species present at a total of 3,075 sites distributed throughout 31 Indo-Pacific ecoregions from the Red Sea to the Great Barrier Reef. Of the 31 surveyed ecoregions, *Acropora retusa* was present within five ecoregions, and its mean relative abundance in the five ecoregions was 1.21 (DeVantier and Turak 2017, Table S2). However, in French Polynesia (outside the area surveyed by DeVantier and Turak (2017)), *Acropora retusa* is one of the most common reef coral species (Lantz et al. 2017), making up one-third of all adult *Acropora* colonies in some locations (Lenihan et al. 2011). Thus, we consider the overall relative abundance of *Acropora retusa* to be rare to common, depending on the location.

Based on *Acropora retusa*'s distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *Acropora retusa* to be at least millions of colonies. Dietzel et al. (2021) estimated its absolute abundance at 540 million colonies.

Within U.S. waters, *Acropora retusa* occurs in Guam, CNMI, American Samoa, and PRIA, as described in more detail below.

<u>Guam</u>: Wallace et al. (2012) reported a sample of *Acropora retusa* from Guam in the Museum of Tropical Queensland collection. David Burdick has recorded the species from at least one reef slope site in Guam (2015 personal communication reported in NMFS 2021a). The U.S. Department of Defense reported the species from 2 sites on Guam (Department of Defense 2019).

<u>CNMI</u>: Within CNMI, *Acropora retusa* has only recently been reported on Tinian and Rota. The U.S. Department of Defense reported the species from one site on Tinian (Department of Defense 2019), and Doug Fenner reported it from Rota (2020 personal communication reported in NMFS 2021a).

<u>American Samoa</u>: *Acropora retusa* has been found on Tutuila (Brainard et al. 2011), including at Fagasa Bay, Fagafue Bay, Gataivai, Aoa and Asili on upper reef slopes. Doug Fenner and

Charles Birkeland both reported finding *Acropora retusa* on upper reef slopes of Ofu Island, and Doug Fenner reported the species on upper reef slopes and the reef flat on Ta'u Island (2015 personal communication from Doug Fenner reported in NMFS 2021a), while Kenyon et al. (2011) reported finding *Acropora retusa* on Rose Atoll. The species has not been reported from Swains Island.

PRIA: Kenyon et al. (2011) reported *Acropora retusa* from Johnston Atoll, Howland Island, and Kingman Reef, while Doug Fenner reported it from Wake Atoll (2017 personal communication reported in NMFS 2021a), and Venegas et al. (2019) reported it from Jarvis Island. The species has not been reported from Palmyra Atoll or Baker Island.

Acropora speciosa

Distribution and Population Structure

Acropora speciosa was listed as threatened on September 10, 2014 (79 FR 53852). *Acropora speciosa* has been either confirmed or strongly predicted in the western Indian Ocean to French Polynesia (Veron et al. 2016). In addition, *Acropora speciosa* has been confirmed in the Chagos Archipelago (NMFS 2021a), Pohnpei State of the Federated States of Micronesia (Turak 2005), the Mariana Islands, and American Samoa, and strongly predicted to occur in Yap State of FSM, Kiribati Central, and the Cook Islands (2020 personal communication from Doug Fenner reported in NMFS 2021a; Figure 10) .

Figure 10. Range of *Acropora speciosa*, modified from the map in Veron et al. (2016).

Acropora speciosa most commonly occurs on lower reef slopes. It is found between 12 m and at least 40 m of depth. Fenner (2020a) reports that it is usually found deeper than 18 m, and apparently is more common below 30 m. Montgomery et al. (2019) reported it from 46 m on Tutuila.

Acropora speciosa forms flat-topped colonies with small branches that have long smooth tips. Colonies are usually uniform grey-brown or pinkish in color, and 30 cm or less in diameter. *Acropora speciosa* is very difficult to distinguish from *Acropora globiceps* in the water, but can be distinguished under the microscope based on skeletal characteristics (Fenner and Burdick

2016; Fenner 2020a).

Like other *Acropora* species, *Acropora speciosa* reproduces by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable substrates such as rock or dead coral and grow into colonies (79 FR 53851-54123).

Status

Detecting changes in abundance over time of rare or uncommon Indo-Pacific reef-building coral species such as *Acropora speciosa* is complicated by many factors, and we do not yet have time-series abundance data for this species. However, overall mean coral cover (i.e., percentage live cover of all reef-building coral species combined) has declined across much of the Indo-Pacific since the 1970s, and likely many decades before then in some locations (79 FR 53851-54123; NMFS 2020). Furthermore, from 2014 to 2017, an unprecedented series of bleaching events impacted most of the Indo-Pacific's coral reefs (Eakin et al. 2019), further reducing overall mean coral cover, especially of relatively sensitive species such as many *Acropora* species. Based on these general trends, it is likely that *Acropora speciosa*'s abundance has been in decline for decades, and that the rate of its decline has accelerated in recent years.

Population Dynamics

Relative abundance refers to how common *Acropora speciosa* is relative to other reef-building corals. DeVantier and Turak (2017) characterized relative abundances of each reef-building coral species present at a total of 3,075 sites distributed throughout 31 Indo-Pacific ecoregions from the Red Sea to the Great Barrier Reef). Of the 31 surveyed ecoregions, *Acropora speciosa* was present within 17 ecoregions, and its mean relative abundance in the 17 ecoregions was 1.58 (DeVantier and Turak 2017, Table S2), which is between rare and uncommon on DeVantier and Turak's abundance scale.

In addition to the 17 ecoregions where the relative abundance of *Acropora speciosa* was estimated by DeVantier and Turak (2017), their rating method has been used to estimate relative abundances of reef-building corals in portions of several other ecoregions in the central Pacific. The relative abundances of *Acropora speciosa* in these surveys was 1.0 (Tonga), 2.0 (Fiji), and 2.1 – 2.5 (New Caledonia; Fenner 2020b). Based on the results of DeVantier and Turak (2017) and Fenner (2020b), we consider the overall relative abundance of *Acropora speciosa* to be rare to uncommon. Within U.S. waters, *Acropora speciosa* occurs on Guam, American Samoa, and PRIA, as described in more detail below. It has not been reported from CNMI.

<u>Guam</u>: *Acropora speciosa* was not known from the Mariana Islands until recently when a coral skeleton collected from Guam in the University of Guam's Marine Lab was identified as this species (2020 personal communication from Doug Fenner reported in NMFS 2021a) .

<u>American Samoa</u>: *Acropora speciosa* occurs on Tutuila, but has not been reported from any of the other islands of the archipelago (Montgomery et al. 2019; Fenner 2020a).

<u>PRIA</u>: Kenyon et al. (2011) reported *Acropora speciosa* from Kingman Reef. It has not been reported from elsewhere within PRIA.

Based on information from Richards et al. (2008); and Richards et al. (2019), *Acropora speciosa* had a population estimate of 10,942,000 colonies, and an effective population size of 1,204,000 colonies (79 FR 53851-54123). Dietzel et al. (2021) estimated its absolute abundance at 19.2 million colonies.

Euphyllia paradivisa

Distribution and Population Structure

Euphyllia paradivisa was listed as threatened on September 10, 2014 (79 FR 53852). *Euphyllia paradivisa* has been confirmed or strongly predicted in 18 ecoregions from Socotra (Indian Ocean) to Samoa (Veron et al. 2016). In addition, the species has been confirmed in the northern Red Sea (Eyal et al. 2016), Okinawa (Eyal et al. 2016), and Fiji (personal communication from Doug Fenner reported in NMFS 2021a), and is strongly predicted in the southern Red Sea, the Gulf of Aden, the southern Ryukyu Islands, Taiwan, the Solomon Islands, and Vanuatu. Thus, we consider *Euphyllia paradivisa*'s geographic range to consist of at least the 27 ecoregions shown in Figure 11.

Euphyllia paradivisa occurs in environments protected from wave action across a broad depth range, especially in low light habitats, such as turbid areas (Fenner 2020a) and mesophotic depths (Eyal et al. 2016). The species also sometimes occurs on shallow reefs in clear water (Turak and DeVantier 2019). Colonies of *Euphyllia paradivisa* have been reported from a variety of substrates, including fine sediment (Fenner 2020a), sand (Fenner 2001), rubble (Sinniger and Harii 2018), and rock (Loya et al. 2016; Montgomery et al. 2019). Its confirmed depth range is from 6 m (Turak and DeVantier 2019) to 75 m (Muir et al. 2018). At one study site in the northern Red Sea, it was much more common between 30 and 50 m than <30 m (Eyal et al. 2016). Colonies consist of branching, separate corallites. Polyps have branching tentacles, an important characteristic for distinguishing it from other *Euphyllia* species. Color is typically pale greenish-grey with lighter tentacle tips (Fenner and Burdick 2016; Veron et al. 2016; Fenner 2020a).

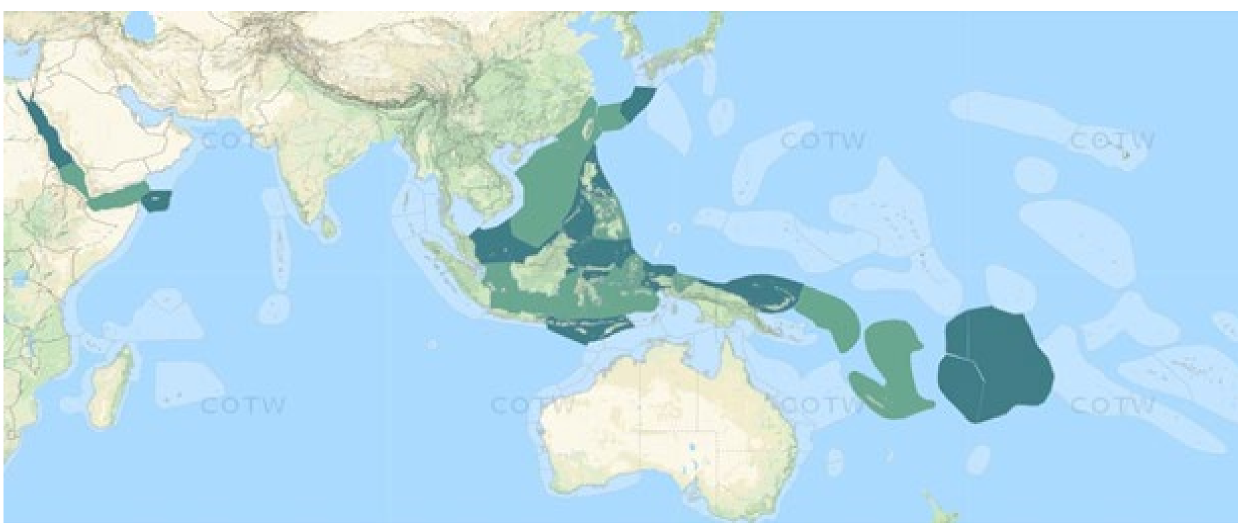

Figure 11. Range of *Euphyllia paradivisa*, modified from the map in Veron et al. (2016), based on sources cited in the text.

While the reproductive life history of *Euphyllia paradivisa* is still unknown, it most likely reproduces by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water, like other species in the genus (Luzon et al. 2017). Colonies are gonochoric, in that separate colonies produce eggs and sperm. Like all *Euphyllia* species, *Euphyllia paradivisa* has large polyps with tentacles that can be extended 10 – 20 cm resilience (Eyal et al. 2016). Like other *Euphyllia* species, *Euphyllia paradivisa* typically occurs in habitats with high sedimentation, high turbidity, and low light, although it is not limited to such habitats (see Depth section below). In the upper mesophotic zone (30 – 50 m depth) in some parts of the Red Sea, *Euphyllia paradivisa* is the dominant reef-building coral species (Eyal et al. 2016; Loya et al. 2016; Eyal et al. 2019).

Status

Detecting changes in abundance over time of rare or uncommon Indo-Pacific reef-building coral species such as *Euphyllia paradivisa* is complicated by many factors, and we do not have time-series abundance data for this species. However, overall mean coral cover (i.e., % live cover of all reef-building coral species combined) has declined across much of the Indo-Pacific since the 1970s, and likely many decades before then in some locations (79 FR 53851-54123; NMFS 2020). In 2014, the available information at that time supported the assumption that these trends applied to *Euphyllia paradivisa*.

Population Dynamics

DeVantier and Turak (2017) characterized relative abundances of each reef-building coral species present at a total of 3,075 sites distributed throughout 31 Indo-Pacific ecoregions from the Red Sea to the Great Barrier Reef. Of the 31 surveyed ecoregions, *Euphyllia paradivisa* was reported from four ecoregions, and its mean relative abundance was 1.44 (DeVantier and Turak 2017, Table S2), which is between rare and uncommon on DeVantier and Turak's abundance scale. However, as explained below, in some areas *Euphyllia paradivisa* is most abundant at 40 to 50 m in depth, deeper than most of DeVantier and Turak (2017) surveys.

In 2014 when *Euphyllia paradivisa* was listed under the ESA, it was not known to occur in the Red Sea (79 FR 53851-54123), nor was it found at any of the Red Sea sites reported by DeVantier and Turak (2017). However, recent mesophotic research has shown that *Euphyllia paradivisa* is the most common reef coral species in the upper mesophotic zone in the northern Red Sea (Eyal et al. 2016; Loya et al. 2016; Eyal et al. 2019). For example, surveys conducted along a depth gradient from 5 to 150 m in depth in the Gulf of Eilat in the northern Red Sea reported that while *Euphyllia paradivisa* was absent from <30 m depth, it was abundant from 36 to 72 m where it dominated the reef coral community. At some sites between 40 and 50 m, it made up 73% of all live coral cover (Eyal et al. 2016).

Elsewhere in the Indo-Pacific, *Euphyllia paradivisa* has been reported in low abundances from both shallow and mesophotic depths. At 287 sites surveyed from approximately five to ten m to 35 – 50 m of depth in the Coral Triangle and adjacent areas, *Euphyllia paradivisa* was found at two sites, one at six m and one at >30 m (Turak and DeVantier 2019). Single colonies of *Euphyllia paradivisa* have been reported from <30 m in American Samoa and Fiji (personal communication from Doug Fenner reported in NMFS 2021a). Montgomery et al. (2019) reported a group of *Euphyllia paradivisa* colonies from 49 m in American Samoa. Waheed and Hoeksema

(2014) reported *Euphyllia paradivisa* from 3 out of 31 sites (two sites >30 m, one site <30 m) surveyed in Malaysia, and that it was among the least common species in the survey. The species has also been reported at 45 – 53 m (Eyal et al. 2016) and 55 m (Sinniger and Harii 2018) in Okinawa, Japan, although abundance was not mentioned. Thus, we consider the overall relative abundance of *Euphyllia paradivisa* to range from rare to common, depending on the location.

Euphyllia species including *Euphyllia paradivisa* are relatively sediment-tolerant compared to other reef corals (Rachello-Dolmen and Cleary 2007; Morgan et al. 2016), often occurring on shallow, inshore reefs where turbidity and sediment are naturally high (DeVantier and Turak 2017; Morgan et al. 2017), but such turbid sites may not be included in coral reef surveys. For example, in American Samoa, shallow coral reef surveys were conducted for decades without finding *Euphyllia paradivisa*, but the species was observed in turbid water in a bay below the depth of the surveys (personal communication from Doug Fenner reported in NMFS 2021a). On the Great Barrier Reef, fisheries managers working with the coral collection industry report *Euphyllia paradivisa* at "high densities" in "turbid inshore northern waters" (Roelofs 2018), but *Euphyllia paradivisa* is not reported from the Great Barrier Reef in the scientific literature. This may be due to species identification uncertainty by coral collectors, lack of scientific surveys on turbid reefs, or some combination thereof. Regardless, turbid reef species such as *Euphyllia paradivisa* may be under-represented in scientific coral survey results. Within U.S. waters, *Euphyllia paradivisa* occurs on American Samoa, and is described in more detail below. It has not been reported from CNMI or PRIA.

American Samoa: *Euphyllia paradivisa* are found in single colonies or small groups in American Samoa (Fenner, pers. com., Montgomery et al. 2019).

Based on *Euphyllia paradivisa'*s distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *Euphyllia paradivisa* to be at least tens of millions of colonies. However, that estimate was based on the assumptions that *Euphyllia paradivisa*'s distribution was smaller, and its abundance lower, than shown by the recent information cited above.

Isopora crateriformis

Distribution and Population Structure

Isopora crateriformis was listed as threatened on September 10, 2014 (79 FR 53852). *Isopora* remained a subgenus of *Acropora* until Wallace et al. (2007) presented clear evidence that *Isopora* is a separate, valid genus. Since that time, *Isopora* has been treated as a genus, including *Isopora crateriformis* (Wallace et al. 2012; Veron et al. 2016), which is accepted by the World Register of Marine Species (Hoeksma and Cairns 2021).

Isopora crateriformis most commonly occurs in habitats with strong wave action, such as upper reef slopes and reef flats near the reef crest. It may occur on lower reef slopes or backreef pools with strong wave action, but is absent from habitats protected from wave action such as lagoons and harbors. The species is most common in depths of approximately 5 m, but extends to at least 12 m depths (Fenner 2020a). *Isopora crateriformis* has been either confirmed or strongly predicted in 30 ecoregions from the Coral Triangle to Tonga (Figure 12).

Isopora crateriformis forms flattened, solid, encrusting plates, usually with ripples on the surface. Most colonies are tan, but a few have tiny green spots which are the retracted polyps.

Colonies are usually up to about 40 cm in diameter but can be over 1 m in diameter. Corallites are 1-2 millimeters in diameter, rounded projecting tubes, larger on the ridges and smaller between. When a colony occurs on a slope, the lower edge is often lifted as a plate (Veron and Stafford-Smith 2000; Fenner and Burdick 2016). This species is similar to some other *Isopora* species, but *Isopora crateriformis* has distinctive characteristics that can usually be reliably identified in the field. However, it is not distinguishable from juvenile, unbranched *I. cuneata*, as described in Fenner and Burdick (2016).

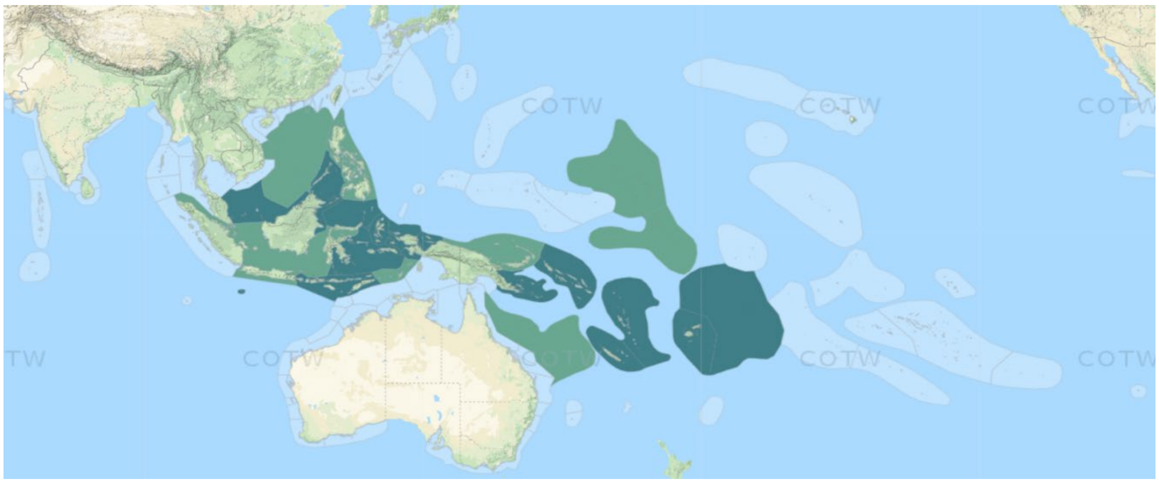

Figure 12. Range of *Isopora crateriformis* (Veron et al. 2016).

Status

Surveys of reef-building corals were conducted at Fagatele Bay, American Samoa, in 1985, 1995, 2002, and 2018. The only ESA-listed coral species to be detected in more than one of the surveys was *Isopora crateriformis*, which showed steadily declining relative abundances of 1.8% of all colonies surveyed in 1985, 1.2% in 1995, 1.1% in 2002, and 0.4% in 2018 (Birkeland 2021). In addition, overall mean coral cover (i.e., percentage live cover of all reef-building coral species combined) has declined across much of the Indo-Pacific since the 1970s, and likely many decades before then in some locations (79 FR 53851-54123; NMFS 2020). Furthermore, from 2014 to 2017, an unprecedented series of bleaching events impacted most of the Indo-Pacific's coral reefs (Eakin et al. 2019), further reducing overall mean coral cover, especially of relatively sensitive species such as many *Isopora* species. For example, between 2013 and 2017 on Guam, the 5 coral genera with the highest percentage of full-colony bleaching-associated mortality included *Isopora* (Raymundo et al. 2019). Based on this information, it is likely that *Isopora crateriformis*'s abundance has been in decline for decades, and that the rate of its decline has accelerated in recent years.

Population Dynamics

DeVantier and Turak (2017) characterized relative abundances of each reef-building coral species present at a total of 3,075 sites distributed throughout 31 Indo-Pacific ecoregions from the Red Sea to the Great Barrier Reef. Of the 31 surveyed ecoregions, *Isopora crateriformis* was present in five ecoregions, and its mean relative abundance in the five ecoregions was 1.40

(DeVantier and Turak 2017, Table S2), which is between rare and uncommon on DeVantier and Turak's abundance scale.

In addition to the five ecoregions where the relative abundance of *Isopora crateriformis* was estimated by DeVantier and Turak (2017), their rating method has been used to estimate relative abundances of reef-building corals in portions of several other ecoregions in the central Pacific. The relative abundances of *Isopora crateriformis* in these surveys was 1.5-1.6 (Fiji), 1.6-1.8 (American Samoa), 1.6-2.0 (New Caledonia), and 1.9 (Wallis; Fenner 2020b), all of which fall between the rare and uncommon categories. However, the species can be common or even dominant in some locations: Wallace (1999) and the Corals of the World website (Veron et al. 2016) note that *Isopora crateriformis* is common in parts of Indonesia. In addition, Fenner (2020a) and Fenner (2020b) notes that the species is dominant on some upper reef slopes on the southwest side of Tutuila, but this is unusual. Based on the information summarized above, we consider the relative abundance of *Isopora crateriformis* to be rare to common, depending on the location. Within U.S. waters, *Isopora crateriformis* has only been observed in American Samoa, and not in the Mariana Islands or any PRIA.

American Samoa: *Isopora crateriformis* is relatively abundant locally throughout American Samoa.

Based on *Isopora crateriformis'*s distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *Isopora crateriformis* to be at least millions of colonies. Dietzel et al. (2021) estimated its absolute abundance at 69.6 million colonies.

3 ENVIRONMENTAL BASELINE

By regulation, the Environmental Baseline refers to the condition of the listed species or its designated critical habitat in the *Action Area*, without the consequences to the listed species or designated critical habitat caused by the *Proposed Action*. The listed resources considered in this biological opinion have been exposed to a wide variety of the past and present state, federal, and private actions in the *Action Area*, which includes of all proposed federal projects in the *Action Area* that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with this consultation. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline. While the impact of those activities on the status, trend or the demographic processes of threatened and endangered species is largely unknown, some are likely to have had and will continue to have lasting effects on the Endangered and threatened species considered in this consultation. The environmental baseline is "an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem, within the action area" (FWS and NMFS 1998). The purpose of describing the environmental baseline in this manner in a biological opinion is to provide context for effects of the *Proposed Action* on listed species.

The preceding section of this biological opinion addresses global climate change, fisheries and fisheries bycatch, vessel strikes, pollution from chemicals and marine debris, and ocean noise from variety of sources and effects these stressors have on listed resources. Some of these stressors have resulted in mortality or serious injury to individual animals (e.g., fishing, vessel strike), whereas other stressors (e.g., noise) may induce sub-lethal responses like changes in behavior that could impact important biological functions such as feeding or breeding.

The most relevant stressors that affect the two shark species and giant manta ray in the *Action Area* is commercial fishing, and illegal harvest. For coral species, climate change and their associated effects like increasing water temperature have the most significant effect to coral.

Globally averaged annual surface air temperatures have increased by about 1.8 ºF (1.0 ºC) over the last 115 years (1901 to 2016; Wuebbles et al. 2017). The earth's climate is now the warmest in the history of modern civilization. All of the relevant evidence points to human activities, particularly emissions of greenhouse gases since the mid-20th century, as the probable cause of this warming pattern (Wuebbles et al. 2017). Without major reductions in emissions, the increase in annual average global temperature relative to preindustrial times could reach 9 ºF (5 ºC) or more by the end of this century (Wuebbles et al. 2017). With significant reductions in emissions, the increase in annual average global temperature could be limited to 3.6 ºF (2 ºC) or less (Wuebbles et al. 2017). There is broad consensus that the further and the faster the earth warms, the greater the risk of potentially large and irreversible negative impacts (Wuebbles et al. 2017).

Increases in atmospheric carbon and changes in air and sea surface temperatures can affect marine ecosystems in several ways including changes in ocean acidity, altered precipitation patterns, sea level rise, and changes in ocean currents. Global average sea level has risen by about seven to eight inches since 1900, with almost half of that rise occurring since 1993. It is very probable that human-caused climate change has made a substantial contribution to sea level rise, contributing to a rate of rise that is greater than during any preceding century in at least 2,800 years (Wuebbles et al. 2017). Global average sea levels are expected to continue to rise by at least several inches in the next 15 years, and by one to four feet by 2100 (Wuebbles et al. 2017). Climate change can influence ocean circulation for major basin wide currents including intensity and position of western boundary currents (Gennip et al. 2017). These changes have potential for impact to the rest of the biological ecosystem in terms of nutrient availability as well as phytoplankton and zooplankton distribution (Gennip et al. 2017).

Elasmobranch species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Climate-related shifts in range and distribution have already been observed in some marine mammal populations (Silber et al. 2017). Hazen et al. (2012) predicted up to a 35% change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses.

Significant impacts to elasmobranch species from ocean acidification may be indirectly tied to foraging opportunities resulting from ecosystem changes (Busch et al. 2013; Haigh et al. 2015; Chan et al. 2017). Nearshore waters off California have already shown a persistent drop in pH from the global ocean mean pH of 8.1 to as low as 7.43 (Chan et al. 2017). The distribution, abundance and migration of baleen whales reflects the distribution, abundance and movements of dense prey patches (e.g., copepods, euphausiids or krill, amphipods, and shrimp), which have in turn been linked to oceanographic features affected by climate change (Learmonth et al. 2006). Ocean acidification may cause a shift in phytoplankton community composition and biochemical composition that can impact the transfer of essential nutrients to predators that eat plankton (Bermudez et al. 2016). Increased ocean acidification may also have serious impacts on fish development and behavior (Raven et al. 2005), including sensory functions (Bignami et al. 2013) and fish larvae behavior that could impact fish populations (Munday et al. 2009) and piscivorous ESA-listed species that rely on those populations for food.

Other climatic aspects, such as extreme weather events, precipitation, ocean acidification and sea level rise also have potential to affect elasmobranch species. Changes in global climatic patterns will likely have profound effects on the coastlines of every continent, thus directly impacting marine species that use these habitats (Wilkinson and Souter 2008).

Because habitat for many shark and ray species is comprised of open ocean environments occurring over broad geographic ranges, large-scale impacts such as climate change may impact these species. Chin et al. (2010) conducted an integrated risk assessment to assess the vulnerability of several shark and ray species on the Great Barrier Reef to the effects of climate change. Scalloped hammerheads for instance were ranked as having a low overall vulnerability to climate change, with low vulnerability to each of the assessed climate change factors (i.e., water and air temperature, ocean acidification, freshwater input, ocean circulation, sea level rise, severe weather, light, and ultraviolet radiation). In another study on potential effects of climate change to sharks, Hazen et al. (2012) used data derived from an electronic tagging project and output from a climate change model to predict shifts in habitat and diversity in top marine predators in the Pacific out to the year 2100. Results of the study showed significant differences in habitat change among species groups but sharks as a whole had the greatest risk of pelagic habitat loss.

Environmental changes associated with climate change are occurring within the *Action Area* and are expected to continue into the future. Marine populations that are already at risk due to other threats are particularly vulnerable to the direct and indirect effects of climate change. The oceanic whitetip shark and giant manta ray considered in this opinion have likely already been impacted by this threat through the pathways described above.

The anthropogenic climate change stressors that are affecting marine and coral reef ecosystems across the globe are, as noted above, also occurring in the *Action Area*, and are impacting corals including ESA-listed corals. The Mariana Islands and some islands in the PRIA has experienced extensive and unprecedented thermal stress and coral bleaching events over the last several years. Since 2012, reefs in CNMI have experienced bleaching events in 2013, 2014, 2016 and 2017. The first of these major bleaching events occurred in 2013 when bleaching was observed in 85% of coral taxa on Saipan and Guam (Reynolds et al. 2014). This was followed in 2014 by a second mass bleaching event that impacted the entire archipelago (Heron et al. 2016). These consecutive annual bleaching events resulted in over 90% loss of staghorn *Acropora* spp. corals in Saipan Lagoon (BECQ-DCRM, Long-Term Monitoring Program, unpub. data) and high mortality of shallow water coral communities throughout the island chain (Heron et al. 2016; NOAA Coral Reef Ecosystem Program (CREP) unpub. data). In 2016, mild bleaching occurred throughout the region (Raymundo 2019). In 2017, the most severe mass bleaching event on record occurred across the region: on Saipan, nearly all coral taxa were impacted down to at least 20 m depth (BECQDCRM unpub. data) and preliminary data indicated that 90% of *Acropora* spp. corals and 70% of *Pocillopora* spp. corals died on shallow (<10 m) reefs (NMFS 2020a). Widespread coral bleaching occurred in American Samoa in the early 2000s, and locally bleaching occurred in 2014 and 2015, but is considered to be in "good"[2] condition (Donovan et al. 2020). Some atolls within the PRIA, notably Palmyra experienced mass bleaching in 2016, but are similarly considered in "good" condition.

Corals are also affected by natural disasters and oscillations. In 2015, the Marianas experienced El Niño Southern Oscillation (ENSO)-related extreme low tides that exposed reef flats for prolonged periods during the dry season. This exposed and killed entire colonies or portions of colonies. The Mariana Islands were directly hit by Super Typhoons Soudelor in 2015 and Yutu in 2018. While damage from waves and debris are expected from such events, the coral reefs did not experience widespread damage or irreparable loss.

Local point source and non-point source pollution can have significant effects to colonies where stormwater dumps sediments or chemical pollutants to nearshore waters. Storm runoff often includes sewage and animal feces that run off from residential and rural properties. Coastal development can also disrupt freshwater input regimes, and increase water temperatures through impervious surfaces or lack of coastal shading. While unpopulated or lightly-populated places such as the atolls in PRIA are almost unaffected by man-made development and pollution, some nearshore areas close to urban areas in American Samoa and the Mariana Islands have seen degradation in recent decades (Houk and van Woesik 2008; Houk and Camacho 2010; Kendall et al. 2017). As more development occurs, for example in Saipan, we can expect more degradation of coral reefs and their colonies (NMFS 2020). We have recently completed several section 7 consultations in Guam and American Samoa for adding diffusers or other improvements to sewage outfalls that improve dispersal, which improves water quality.

Commercial fishing in the *Action Area* affects oceanic whitetip shark, Indo-West Pacific scalloped hammerhead shark, and giant manta rays. To summarize the historic impact of the DSLL, between 2004 and 2020, 45 giant manta rays were incidentally captured with an estimated 305 total and 5,149 oceanic whitetip sharks were observed, with an estimated 26,180 sharks incidentally captured (McCracken 2019c; McCracken and Cooper 2020a, 2020b; NMFS 2018). There were four documented Indo-West scalloped hammerhead sharks observed captured with an estimated total of 19 interactions from during this same time frame (McCracken 2019c; McCracken and Cooper 2020a, 2020b; NMFS 2018). Bycatch of these three ESA-listed elasmobranchs is reasonably likely to continue. It is difficult to know if it will continue at similar rates because populations are generally decreasing but fishing effort (number of hooks) are increasing (NMFS 2018).

Giant manta rays face a high probability of extirpation as a result of environmental and demographic stochasticity. Due to their particular life-history characteristics (e.g., slow growth, late maturity, and low fecundity), giant manta rays have little potential to withstand high and sustained levels of fishing exploitation. The information available suggests that giant manta rays have high a probability of becoming extirpated in the Pacific Ocean unless they are protected

[2] NMFS Coral Reef Conservation Program defined scores from very good to critical. The coral reefs in the Mariana Islands were scored as fair, and coral reefs in PRIA and American Samoa were scored as good.
Fair: Some indicators meet reference values. Conditions in these locations are moderately impacted or have declined moderately. Human connections are moderate.
Good: Most indicators meet reference values. Conditions in these locations are lightly impacted or have lightly declined. Human connections are high.

from the combined threats of incidental take in the industrial purse-seine fishery and target take in the artisanal gillnet fisheries that supply the international mobulid gill raker market. The number of individuals that continue to be captured and killed in fisheries in the *Action Area* contributes to the increased extinction risk of the species.

Of the other activities and their associated stressors, the propensity of vessel strikes to go unnoticed or unreported by vessel operators impedes an accurate assessment of the magnitude this threat poses to giant manta ray. However, giant manta ray occur in the pelagic waters within the *Action Area* where their density is sparse in comparison to nearshore aggregation sites where as a result of a higher density of rays, there is an increased risk of a vessel strike. Therefore, we do not expect vessel strikes to contribute to the increased extinction risk of the species.

Because giant manta rays must filter hundreds to thousands of cubic meters of water daily to obtain adequate nutrition (Paig-Tran et al. 2013), they can ingest microplastics directly from the water or indirectly through their contaminated planktonic prey (Setala et al. 2014). Microplastics can prohibit adequate nutrient absorption and physically damage the digestive track (Germanov et al. 2018), they can harbor high levels of toxins and persistent organic pollutants and transfer these toxins to the animal once ingested (Worm et al. 2017). If entangled in marine debris, the giant manta ray is at risk of severing of the cephalic and pectoral fin, severe injuries that can lead to a reduction in feeding efficiency and even death. The number of individuals that continue to ingest and become entangled in marine debris in the *Action Area* contributes to the increased extinction risk of the species.

The stressors discussed in this *Environmental Baseline* are also a threat for the oceanic whitetip shark and Indo-West Pacific scalloped hammerhead shark. Oceanic whitetip sharks are vulnerable to catastrophic population crashes because of both environmental and demographic stochasticity. Due to their life-history characteristics, oceanic whitetip sharks are more susceptible to the effects of high fishing exploitation. The information available suggests that oceanic whitetip sharks have high a probability of being extirpated in the Pacific Ocean unless they are protected from the combined threats of incidental take and commercial utilization from worldwide fisheries.

The Indo-West Pacific scalloped hammerhead shark are less vulnerable because they have a large distribution ranging from east Africa to French Polynesia. Bycatch of Indo-West Pacific scalloped hammerhead sharks through the U.S. fisheries are considerably lower than that of oceanic whitetip sharks. Despite that, the number of individuals that continue to be captured and killed in fisheries in the Action Area contributes to the increased extinction risk of the species.

4 EFFECTS OF THE ACTION

Effects of the action refers to all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.

As we described in the *Approach to the Assessment* section of this biological opinion, we organize our effects' analyses using a stressor identification - exposure – response – risk assessment framework. The *Integration and Synthesis* section of this opinion follows the *Effects of the Action* and integrates information we presented in the *Status of Listed Resources* and *Environmental Baseline* sections of this biological opinion with the result of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species. Species and critical habitat not likely to be adversely affected by the proposed action are discussed in the *Status of Listed Resources Not Considered Further section* 2.1 and in Appendix A.

4.1 Potential Stressors

We determined that the following stressors are not likely to adversely affect any species (See Appendix A for more details):

1. Interactions with sharks during spearfishing activities,
2. Changes in food availability;
3. Anchoring;
4. Potential injuries or behavioral changes from sound sources;
5. Interaction with, including capture of non-target species, such as listed species, or their prey;
6. Interaction with derelict gear;
7. Introduction of oily discharges, cardboard, plastics, and other waste into marine waters;
8. Collisions with vessels;
9. Vessel groundings; and
10. Vessel emissions.

As a result, in this section, we focus primarily on the stressors created by active fishing, which results in hooking and entanglement; tagging and genetic sampling, and directed take of coral specimens, as these stressors are likely to adversely affect listed species under consideration. The potential stressors associated with the proposed action are:

1. Entanglement in troll and bottomfishing gear;
2. Hooking
3. Tagging and genetic sampling;
4. Direct take of coral specimens;

4.1.1 Entanglement in Troll and Bottomfishing Gear

Marine mammals, sea turtles, and elasmobranchs can get entangled in any troll and bottomfishing gear that PIFSC places in the water to collect resources. This includes tow nets, tow traps, crab and juvenile fish traps, bottomfish and troll line, and instruments. The probability of entanglement increases with the amount of material in the water, the duration of potential exposure, the position in the water column, and the rigidity and strength of the material. Most instruments that are left at the benthos are rigid and have low risk of entanglement. Bottom traps are set for about no more than four hours. Trolling, bottomfishing, net tows of all kinds are "day trip" activities, which are actively monitored. Bottomfish reel fishing are generally in deeper areas where giant manta rays generally do not feed which makes entanglement during those activities even more uncommon.

Considering the methods of fishing proposed in this action, trolling or bottom fishing would likely be the main source of entangling lines due to trailing fishing lines. Sharks, turtles, or seals could become entangled in trailing fishing line as a byproduct of becoming hooked. Depending on the length of the line or where on the body the hook attaches, the line may trail until the hook is released, or entangle the animal, wrapping flippers, or around fins, necks, tails or other parts of the animals which could hinder movement. This can lead to wounds or in severe cases, dismemberment or cause starvation. We are reasonably certain that entanglement interactions from trolling or bottomfishing will be uncommon for giant manta rays, and occur at most once per each shark species considered during the five-year period.

4.1.2 Hooking

Sharks are incidentally captured when they bite baited hooks or depredate on catch. Injuries to sharks from hooks can be external-generally in the mouth, jaw, gills, roof of mouth, tail and fin or ingested internally, considered deeply hooked or gut-hooked. Oceanic white tip sharks and scalloped hammerhead sharks can be accidentally hooked if they depredate fish caught in troll or bottomfish fisheries. These events are rare and considering the limited number of samples proposed for this action, the probability of hooking an ESA-listed animal is low.

The effect of being hooked can vary in severity, from simple piercing of flesh, to internal ingestion that can pierce internal organs which can cause life-threatening injuries. The effects associated with hookings are not limited to the piercing itself, but also the stress that sharks endure while fighting on the line. Hooked sharks can expend maximum energy which can lead to eventual death.

As with other marine species, even if the hook is removed, which is often possible with a lightly hooked shark, the hooking interaction can be a significant event. During capture, the amount of water flow over the gills is limited and biochemical recovery can take up to 2 to 7 days, and even longer for injured sharks (Campana et al. 2009). In addition, sharks are vulnerable to predation while being captured due to their restricted mobility, and after their release due to exhaustion and injury. Furthermore, handling procedures can cause additional damage (e.g., cutting the jaw, tail, gaffing, etc.), stress, or death.

A gut-hooked shark is at risk of severe damage to vital organs and excessive bleeding. Campana et al. (2009) found in a post-release mortality study that 33% of tagged blue sharks with extensive trauma such as a gut-hooking perished. Campana et al. (2009) attribute rapid post-release mortality of sharks to occur because of the trauma from the hooking rather than any interference with digestion or starvation.

Unlike sharks, manta rays do not actively prey on distressed fish and unlike longline fishing, the fishing methods used in this action do not send out miles of fishing line in which to get entangled. Considering the locations and the method of fishing, the probability of interactions from fishing gear during this action and giant manta rays are extremely unlikely, and therefore discountable.

If it were to occur, hooking and entanglement in gear would be the most significant hazard to ESA-listed Indo-West Pacific scalloped hammerhead and oceanic whitetip sharks. In addition, if air-breathing species are hooked or entangled, they could drown after being prevented from surfacing for air. All listed species that are hooked or entangled, but do not immediately die from their wounds can suffer impaired swimming or foraging abilities, altered migratory behavior, and altered breeding or reproductive patterns, and latent mortality from their interactions.

Despite several efforts to assess the significance of unobserved or slipped catch, the number of unobserved interactions (for example, Moyes et al. 2006; Murray 2011; and Warden and Murray 2011; Gilman et al. 2013), and the difference between the number of observed interactions and the actual number of interactions remains unknown. Some species have a better opportunity to escape capture before being observed by the vessel by breaking the line either through sheer force or by biting the line.

Interactions such as shark depredation on trolling lines are generally rare. Considering the status of the species in the *Action Area*, the probability of the interactions being oceanic whitetip sharks or the ESA-listed populations of scalloped hammerhead sharks would be even rarer. Bottomfishing sets are not soaked long, which limits the opportunity for sharks to depredate bait or distressed fish. The life stages (adult) of ESA-listed sharks that are expected to be exposed during this action are generally pelagic and surficial, which limits exposure to the benthic nature of bottomfishing.

The state of Hawaii has recorded “whitetip sharks” caught as bottomfish bycatch which could include both oceanic whitetip sharks and reef whitetip sharks (*Triaenodon obesus*). Despite the benthic nature of whitetip reef sharks, at least some of the bycatch were believed to be oceanic whitetip sharks. We do not have similar data on scalloped hammerhead sharks, nor in regions outside of Hawaii. Bycatch of both oceanic whitetip sharks and scalloped hammerhead sharks in the bottomfish fishery are generally rare but not discountable.

Considering the scarcity of ESA-listed individual sharks, low densities in random fishing areas, small effort, number of hooks used, and short durations of the fishing effort, we are reasonably certain that bycatch of oceanic whitetip sharks and Indo-West Pacific sharks would be limited to one individual each for the duration of this action. We cannot predict the nature of the hooking or associated injury so we evaluated death for both individual sharks as the worst case scenario.

4.1.3 Tagging and Genetic Sampling Activities

As noted in the Description of the Proposed Action section, it is anticipated that up to 30 giant manta rays will be exposed to tagging or sampling activities per year (150 individuals over the course of the project [five years]). Additionally, up to 250 scalloped hammerheads would be affixed with satellite tags and/or undergo tissue sampling (50 individuals per year). These research activities will be conducted opportunistically when individual giant manta rays or Indo-West Pacific scalloped hammerhead sharks are captured incidentally under normal, otherwise lawful fishing operations in the DSLL, U.S. WCPO purse seine fisheries, and any other fishery or operation associated with this consultation if the tags are available at the time of accidental capture. Attachment of the external tags will typically involve placement of a single-barb dart into the animal. PSAT tags are programmed for a year. Tissue samples obtained will involve a fin clip and/or small dermal tissue sample for population genetic analyses.

Based on observations in this program previously, only one in more than 100 tagged oceanic whitetip sharks experienced immediate mortality following tagging due to poor tag placement (NMFS 2021a). We do not know the details of why that individual died and it could have been because of several other factors other than the wound itself. It is possible that sharks and rays could experience stress and infection from tagging or sampling activities. Elasmobranchs regenerate tissue and heal incredibly fast (Heupel and Bennett 1997; Chin et al. 2015; McGregor et al. 2019), so minor injury associated with tagging is expected to heal quickly. The condition of the individual prior to tagging, and handling of the individual are more important factors in their survival. In summary, it would be rare that tagging would result in any long-term injury or adverse effects to the long-term health or fitness of any tagged individuals.

Most flesh wounds will heal within a few days without serious injury. In rare cases, wounds can increase the probability of getting infected from bacteria, viruses, or disease which could lead to more severe injury. While tagging or tissue collection is expected to be collected quickly, the additional handling may increase stress to individuals that would otherwise be cut free immediately.

The proposed tagging and tissue sampling procedures are common and accepted practice in elasmobranch research. The effects of collection of tissue are expected to be similar to those experienced from tagging. Tissue sample sites are known to heal quickly and completely when used on a variety of vertebrates such as sharks, rays, teleosts, and marine mammals (Weller et al. 1997; Krutzen et al. 2002). While the shark or ray will also experience some level of stress, it is unlikely that genetic sampling will result in any long-term injury or adverse effects to the long-term health or fitness of any sampled individuals. There is the small possibility that the biopsy site could become infected, but this would be an incredibly rare occurrence.

While the mere task of stabbing a tagging device or carving of flesh will cause minor injuries, the act of handling a large animal under duress could have more serious effects. PIFSC will monitor captured ESA-listed sharks and rays to determine whether it is in a healthy enough condition to withstand the additional handling necessary to place tags or take samples. PIFSC will also determine if it is safe for both animal and crew to tag or take samples of animals to avoid increasing stress to animals. During tagging or tissue sampling PIFSC will implement best management practices (BMPs) listed in the BA and in CMM 2019-05, such as only tagging healthy individuals that are likely to survive additional handling, limiting the duration of their captured state during tagging, and releasing by using dehookers or line clippers to minimize further stress from handling.

4.1.4 Direct Take of Coral Specimens

The proposed action would include the directed take of voucher specimens of *Acropora globiceps*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, and *Isopora crateriformis*. The RAMP Surveys collect up to 500 samples per year of corals, including ten voucher samples for each of the five ESA-listed coral species annually over five years (250 samples total). The fewest samples needed are collected for characterization of disease and confirmation of identity. The total number cited (i.e., 500) is the maximum of all disease/invasion/ID/ESA collections.

PIFSC is not specifically targeting ESA-listed corals for specimen collection so the actual number of specimens from ESA-listed corals will be a fraction of the total number. Large numbers of ESA-taxa are not proposed to be sampled, but are required to confirm a suspected ESA-listed coral sighting. The smallest possible fragments of corals are collected by gloved hands or by using small tools that are cleaned between each use. Each sample is intended to act as a skeletal and genomic voucher, and typically consist of 2 cm by 2 cm pieces. This size is large enough to determine and record skeletal features. As noted in the *Description of the Proposed Action* section of this opinion, coral tissue samples will be carefully collected from threatened corals using bone cutters or hammer and chisel (as necessary). None of the individual specimens will constitute a complete colony. In the case of *Euphyllia paradivisa*, the biopsy metrics considered for these harvests are based on the skeletal features and not the extended soft tissue of the polyp. Due to the growth pattern of *Euphyllia paradivisa* and maximum allowable extent of harvest, the resultant individual specimen is expected to be a singular branched polyp with or without buds. Two polyps per *Euphyllia paradivisa* specimen would be the maximum expected harvest per 7 cm sample.

For all species of threatened corals, the removal and loss of tissue and subsequent regrowth of tissues has energetic costs that could slow other growth and reproduction, exposed areas of coral skeleton are prone to bioerosion and overgrowth by algae and certain sponges, and damaged and stressed tissue may be more susceptible to infection by coral diseases that may hinder or prevent healing to the point that the colony dies. Even so, coral colonies will continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. The sampling described in this opinion would potentially injure and negatively affect colony polyps, but given the small sample size (and associated sampling protocol), and the colonial nature of corals, we would not expect significant injury would occur to any colony of any species. As such, the proposed specimen samples would not likely represent a serious threat to the health or survival of the colony sampled of any species. Breakage of coral fragments are common naturally as surf breaks on coral colonies move objects that break corals, and fish such as parrotfish graze on coral or in the bumphead parrotfish's case break and ingest pieces of branching corals. Most coral colonies will heal their wounds and live after samples are taken.

Lesions often heal naturally, may do so quickly with little to no effect on the colonies (Jayewardene 2010), but can result in the affected coral colony being subject to reduced fitness in three ways. First, coral tissue regeneration requires energy so that resources may be diverted from growth and reproduction (e.g., Kobayashi 1984; Rinkevich and Loya 1989; Meesters et al 1994; Van Veghel and Bak 1994; Lirman 2000). Secondly, colony health and survival may be compromised because open lesions provide sites for the entry of pathogens and bioeroders and space for the settlement of other organisms such as algae, sponges, and other corals (Bak et al 1977). Third, injuries reduce the coral's surface area available for feeding, photosynthesis and reproduction (e.g. Jackson and Palumbi 1979; Wahle 1983; Hughes and Jackson 1985), which may alter colony survivorship (e.g. Hughes and Jackson 1985; Babcock 1991; Hall and Hughes 1996). Severe injuries to colonies can lead to death, especially if the colony is simultaneously exposed to other stressors such as warm sea temperatures, and bleaching (e.g. Meesters and Bak 1993).

The ability for lesions to heal ultimately depends on the species of coral, colony growth form, the surrounding environment, colony interactions with other organisms on the reef, and the size and shape of the lesion (Meesters et al 1994). *Acropora globiceps colonies* are typically small (about 12 cm in diameter) round, with finger-like branches growing upward. Branches are uniform in size and shape, roughly finger length, diameter, and shape, with almost no side branches. The size and appearance of branches depends on degree of exposure to wave action, but are always short, closely compacted, with dome-shaped ends (NMFS 2020). *Acropora globiceps* lives on reef flats, but also upper reef slopes often exposed to surf. A coral with these characteristics likely experiences natural breakage. To survive in such conditions, *Acropora globiceps* like many of the *Acropora spp*. that are digitate, branching, or table- or plate-like, have likely adapted to breakage and are more likely to heal readily.

A study by Hall (1997) on 18 branching *Acropora* spp. colonies noted that all lesions in the study healed within 74 days, while some began vertical branch extension from the lesion. In Saipan, ten out of 11 lesions on *Acropora globiceps* parent colonies from which fragments were taken in 2019 as part of the Saipan coral nursery pilot project healed successfully within 2-4 months post collection. Regenerated tissue across lesions included symbionts, and formed new apical polyps. The lesion on the one parent colony that did not heal successfully is believed to have been adversely affected by boring sponges that were documented on the colony when the initial fragmentation occurred (Steve McKagan, NMFS HCD, personal communication 2020). Monitoring of a lesion on a single fragment of *Acropora globiceps* in the coral nursery in the summer of 2020 indicated that tissue regenerated across the lesion within a single week.

NMFS believes that the magnitude and intensity of the impact from the directed take of voucher specimens for all species considered herein will be mitigated by the following factors: 1) the small number of colonies from which specimen material would be collected compared to the estimated abundance of the species; 2) the infrequent surveys; 3) the use of random sample design; and 4) the strict adherence to BMPs for sampling coral species which includes: sampling no more than one specimen of the target taxa present at any of the survey sites and not sampling if it is judged that collection may inhibit the capacity of the colony to replenish itself.

However, it is possible that parent colonies may become stressed from the damage, in particular if simultaneously exposed to other environmental stressors, which may reduce their fitness and possible lead to death. PIFSC will collect up to 500 samples, including up to 250 voucher samples from colonies of ESA-listed corals. Considering how diverse the coral communities are and the random nature of selecting corals for sampling, only a few ESA-listed corals will be sampled. Of those sampled, most will survive as lesions heal. However, in a worst case scenario, some colonies will die or be severely hampered while recovering. We cannot predict how many of those would be ESA-listed corals but it would likely be no more than ten (2% of the total).

Some of these species are locally common (*Acropora. globiceps*, *Isopora crateriformis*, *Euphyllia paradivisa*), and others are widespread (*Acropora globiceps*, *Acropora retusa*). Total global population for these species range from the 10,000s to millions. The loss of ten colonies throughout their range would have a negligible effect on the species as a whole. The loss of those colonies represents negligible risk to any sampled populations for all species considered. We therefore conclude that the proposed action presents negligible risk to the overall species. NMFS considers the risk negligible that project-related effects from sampling the coral colonies would appreciably reduce reproduction rates, numbers, or distribution of these five species in the *Action Area*, and across their global range.

5 CUMULATIVE EFFECTS

"Cumulative effects", as defined in the ESA implementing regulations, are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). For an action to be considered reasonably certain to occur, it must be based on clear and substantial information, using the best scientific and commercial data available. Factors to consider when evaluating whether activities caused by the proposed action (but not part of the proposed action) or activities reviewed under cumulative effects are reasonably certain to occur include, but are not limited to: 1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action; 2) existing plans for the activity; and 3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward. (50 CFR 402.17). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

NMFS searched for information on future State, tribal, local, or private actions that were reasonably certain to occur in the *Action Area*. Most of the *Action Area* is outside of territorial waters of the U.S., which would preclude the possibility of future state, tribal, or local action that would not require some form of federal funding or authorization. NMFS conducted electronic searches of business journals, trade journals, and newspapers using Google scholar, WorldCat, and other electronic search engines. Those searches produced no evidence of future private action and their effects in the *Action Area* that would not require federal authorization or funding and is reasonably certain to occur.

While we considered various state managed vessel-based fisheries that exist in Hawaiian waters, we do not believe they will overlap in geographical space for fishing activities and would only overlap when vessels from this fishery transit to Hawaiian ports. The same could be said for recreational boating around the MHI as well. The primary effects we would expect from State fisheries and recreational boating, would include injury and mortality from ship strikes and fishing, as well possibly changes in local prey numbers and distribution. NMFS is not aware of any actions that are likely to occur in the *Action Area* during the foreseeable future.

6 INTEGRATION AND SYNTHESIS OF EFFECTS

The *Status of the Listed Resources*, *Environmental Baseline*, and *Cumulative Effects* described the pre-existing condition of the listed species globally and within the *Action Area* given the effects of activities such as commercial fisheries, direct harvests and modification or degradation of habitat caused by marine debris and climate change. The pre-existing condition of these species serves as the point of reference for our conclusions. The *Effects of the Action* section of this biological opinion describes the direct and indirect effects of the PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean.

This section of this biological opinion recapitulates, integrates, and synthesizes the information that has been presented thus far to evaluate the risks that PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean poses to giant manta rays, Indo-West Pacific scalloped hammerhead sharks, oceanic whitetip sharks, *Acropora globiceps*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, and *Isopora crateriformis* in the Pacific Ocean.

The "risks" this section of the opinion considers are (1) increases in the extirpation/extinction probability of particular populations and of the species as they have been listed; and (2) reductions in their probability of being conserved (that is, of reaching the point where they no longer warrant the protections of the ESA). These two probabilities correspond to the species' likelihood of surviving in the wild (that is, avoiding extinction) and their likelihood of recovering in the wild (that is, being conserved). Our analyses give equal consideration to both probabilities; however, to satisfy the explicit purposes of the ESA and NMFS' obligation to use its programs to further those purposes (16 U.S.C. 1536(a)(1)), a species' probability of being conserved has greater influence on our conclusions and jeopardy determinations. As part of these analyses, we consider the action's effects on the reproduction, numbers, and distribution of each species.

Our analyses find that the proposed action, while it results in sublethal injuries or stress due to handling of individual threatened oceanic whitetip shark, threatened Indo-West Pacific scalloped hammerhead shark, and threatened giant manta, it has very small effects on the dynamics of the populations those individuals represent or the species those populations comprise. As a result, we believe it does not appreciably reduce these species' likelihood of survival and recovery in the wild. Similarly, we anticipate up to ten ESA-listed coral colonies to have fragments or core samples taken from them, which could lead to lesions or increased stress. We cannot predict the exact distribution of the number of colonies by each species but at least some colonies of *Acropora globiceps*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, and *Isopora crateriformis* could experience cores being drilled into them or fragments removed. In very rare occasions, sampled colonies could die. Some of these species are locally common (*Acropora globiceps*, *Euphyllia paradivisa*, *Isopora crateriformis*), and others are widespread (*Acropora globiceps*, *Acropora retusa*). Total global population for these species range from the 10,000s to millions. The loss of ten colonies throughout their range would have a negligible effect on the species as a whole.

We explain the basis for this conclusion in the following sections. These summaries integrate the results of the exposure, response, and risk analyses we presented earlier in this biological opinion with background information from the *Status of the Listed Species* and *Environmental Baseline* sections of this biological opinion to assess the effect that PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean is likely to pose to endangered and threatened individuals, the population or populations those individuals represent, and the "species" as it was listed pursuant to the ESA of 1973, as amended.

6.1 Fisheries Interactions with Elasmobranchs

As described in the *Effects of the Action* section, there is a potential for bycatch during fishing activities proposed in this action. As discussed in the effects section, unlike sharks, manta rays do not actively prey on distressed fish and unlike longline fishing, the fishing methods used in this action do not send out miles of fishing line in which to get entangled. Considering the locations and the method of fishing, the probability of interactions from fishing gear during this action and giant manta rays are extremely unlikely, and therefore discountable.

Due to the limited amount of fishing effort and the relatively short durations of effort while fishing, we consider accidental hooking, depredation, or entanglement of gear to be rare. Nonetheless, we conservatively predict one oceanic whitetip shark and one Indo-West Pacific scalloped hammerhead shark to be hooked, entangled, or otherwise injured from depredating baited hooks or hooked fish. Injuries from these interactions could range from minor hookings in the mouth or outer flesh to swallowed hooks that lodge into internal organs or full entanglements or ingestion of fishing line. We cannot predict the nature of the hooking or associated injury so we evaluated death for both individual sharks as the worst case scenario.

Oceanic whitetip sharks are listed as threatened throughout their range. Outside the scope of this project, they are exposed to fishing activities throughout the *Action Area* for many different fisheries. As discussed in the *Status of Listed Species*, two stock assessment has been completed to date, estimating the population at 264,318 and only pertains to the Western Pacific. Stock assessments have not been conducted for either the Eastern Pacific or for the global population. Overall, the species has experienced significant historical and ongoing abundance declines in all three ocean basins due to overutilization from fishing pressure and inadequate regulatory mechanisms to protect the species (based on CPUE). However, Young et al. (2017) believe CPUE may have stabilized at a depressed state in the Pacific.

The Indo-West Pacific scalloped hammerhead shark population is estimated at approximately 5.4 million adults. As displayed in the *Status of the Listed Resources* section, this estimate is from a combination of population estimates from six known geographic populations throughout the species' range. All geographical populations are thought to be stabilized (Miller et al. 2014).

We predict future interaction levels of one individual in the *Action Area* in five years. We are also evaluating the worst case scenario that the individual dies. The action is not expected to reduce the abundance of individuals in the population (less than .01% of the estimated population in the western Pacific), which may consequently affect the population's viability. Hooking will only kill 0.004% of the WCPO oceanic whitetip shark stock and less than 0.0002% of the Indo-West Pacific scalloped hammerhead shark population. We find no analyses or models that demonstrate death of these low percentages of a population will meaningfully effect its reproduction rates, numbers, or distribution. Thus, we are reasonably certain it will not measurably reduce the population's abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures.

PRD has considered the action's effects with the other threats occurring to the species, and even with the worst case scenario (loss of individuals due to this action) added to other losses discussed in the *Environmental Baseline* and *Cumulative Effects* sections, these actions reasonably would not be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of these species in the wild by reducing the reproduction, numbers, or distribution.

6.2 Opportunistic Tagging and Sampling of Giant Manta Rays and Scalloped Hammerhead Shark

As described in the *Effects of the Action* section, up to 150 giant manta rays and 250 scalloped hammerhead sharks could be tagged or sampled during the action. These tagged or sampled animals are limited to those accidentally caught in various fisheries throughout the region. PIFSC will pierce the skin of individuals for tagging or cut small pieces of flesh for samples. If individuals are either in poor condition, or if it is either too dangerous for the crew or captured individual to cut tissue samples or tag, PIFSC will avoid the procedure and release the animal immediately.

Giant manta rays are listed as threatened throughout their range, while scalloped hammerhead sharks are listed in some of their global range. Any scalloped hammerhead shark born within the HARA is not an ESA-listed shark. Outside the scope of this project, each species is exposed to fishing activities throughout the *Action Area* for many different fisheries. Both species are caught as bycatch throughout their range and within the *Action Area*. All species are also exposed to purposeful harvest throughout their range. Purposeful harvest is illegal in the *Action Area*, but occurs at unknown levels. Other threats to the ESA-listed elasmobranchs include bioaccumulative pollutants, marine debris, and common natural threats such as predators, and changing and variable ocean conditions.

The potential impacts from climate change on open water habitat are highly uncertain, but given their broad distribution in various habitat types, these species can move to areas that suit their biological and ecological needs. Therefore, while effects from climate change have the potential to pose a threat to sharks in general, including habitat changes such as changes in currents and ocean circulation and potential impacts to prey species, species-specific impacts to oceanic whitetip sharks and their habitat are currently unknown, but are considered a low level threat (Miller et al. 2014; Miller and Klimovich et al. 2017).

PRD has considered the action's effects with the other threats occurring to the species. In most cases, tagged or sampled individuals will swim away largely unaffected by the flesh wound that will heal in a few days. Some may experience stress from the wound or handling, and in an unusual event, severe injury or death. We do not expect lethal take, however one tagged oceanic whitetip shark died after tagging in Hawaii (one of 100). Considering those odds, at least two giant manta rays could die from the activities.

Given the limited number of tags and tissue samples as described in the *Effects Analysis*, NMFS predicts future interaction of 250 Indo-West Pacific scalloped hammerhead sharks and 150 giant manta rays in the *Action Area* on an annual basis. Every interaction that includes data collection (tagging and genetic sampling) is harm. Of those sampled, most will recover without long-term effects, and at most, we are reasonably certain that no more than two giant manta rays and three Indo-West Pacific scalloped hammerhead sharks may die as a result of the wounds or handling stress associated with tagging. Therefore, the action is not expected to reduce the abundance of individuals in the population (less than 0.01% of the estimated population), and will not appreciably affect the population's viability.

Fewer tags and samples are proposed for scalloped hammerhead sharks which reduces the probability of death. Not all sharks or rays that die after tagging would have necessarily died from the tagging or tissue sampling, as sharks or rays hooked on a fishing line or caught in a net will have already experienced stress that can kill them. Various experts have predicted local populations of scalloped hammerhead sharks and we have combined those numbers to estimate that there are over 1.2 million oceanic whitetip sharks of all relevant DPS' in the Pacific Ocean, and around 280,000 of the Indo-West Pacific DPS. With the worst case scenario (loss of up to three scalloped hammerhead individuals due to this action) added to other losses discussed in the

Environmental Baseline and *Cumulative Effects* sections, we do not expect these actions to result in appreciable reduction of the species.

We are more uncertain about the total population of giant manta rays throughout the world. There are 23 known populations ranging from 100-1,500 individuals in each population. With the worst case scenario (loss of two individuals due to this action) added to other losses discussed in the *Environmental Baseline* and *Cumulative Effects* sections, we do not expect these actions to result in appreciable reduction of the species. Therefore, when taken in context with the *Status of the Listed Resources*, the *Environmental Baseline*, *Cumulative Impacts and Effects*, the proposed action is not likely to appreciably reduce the number of Indo-West Pacific scalloped hammerhead sharks and giant manta rays in the *Action Area*, or appreciably reduce the likelihood of their survival and recovery globally.

6.3 Direct Take of Coral Specimens

As described in the *Effects of the Action* section, we estimate that PIFSC will collect up to 250 voucher samples from ESA-listed coral colonies. These fragments or core samples will be removed from the colony and all polyps that are associated with the collected fragments or samples will die. However, coral colonies are resilient and lesions left behind are expected to heal. In rare cases, the colonies will die and we evaluated risk of the worst case scenario (death of the colony) to each species. While we cannot predict how many of each species would be sampled and therefore harmed, due to the random selection of colonies to be sampled and the diversity of coral species at sample sites, we are reasonably certain that all of the five predicted colony deaths would not be from one species. Furthermore, we are also reasonably certain that all samples would not be from the same location. This reduces the possibility of extirpating or severely reducing the number of colonies within an area, thereby affecting distribution.

As discussed in *the Status of the Listed Resources* section, these five species are widely distributed (at least four eco-regions ranging thousands of miles and several archipelagos), and numbers range from the millions to hundreds of millions of colonies. American Samoa represents the eastern edge of distribution for both *Euphyllia paradivisa* and *Isopora crateriformis*. Both species are locally abundant in areas within American Samoa.

PIFSC will harm ESA-listed colonies by collecting fragments or coring samples, which will leave lesions which could make the colony more prone to disease, boring sponges, or other agents that could increase stress to the colony. Colonies would expend energy to heal lesions which could cause more stress. In extreme cases, colonies could die. We are reasonably certain losing ten colonies from species that have millions of colonies spread throughout multiple oceans and large distribution areas will not measurably reduce the abundance, reproduction, spatial structure and connectivity, growth rates, or variance in these measures. Thus, the proposed action will not lead to an appreciable reduction in the likelihood of survival or recovery of any of the five ESA-listed coral species.

7 CONCLUSION

After reviewing the *Status of Listed Resources*, the *Environmental Baseline* for the *Action Area*, the *Effects of the Proposed Action*, and the *Cumulative Effects*, it is NMFS' biological opinion that the PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean is not likely to jeopardize the continued existence of the following species:

Threatened giant manta ray, threatened Indo-West Pacific scalloped hammerhead shark, threatened oceanic whitetip shark, threatened *Acropora globiceps*, *Acropora retusa*, *Acropora speciosa*, *Euphyllia paradivisa*, and *Isopora crateriformis*.

8 INCIDENTAL TAKE STATEMENT

The proposed action results in the incidental take of threatened giant manta ray, threatened Indo-West Pacific scalloped hammerhead shark, and threatened oceanic whitetip shark. Currently there are no take prohibitions for oceanic whitetip sharks, giant manta ray, and Indo-West Pacific scalloped hammerhead shark, so an exemption from the take prohibitions of Section 9 of the ESA is neither necessary nor appropriate. However, consistent with the decision in *Center for Biological Diversity v. Salazar*, 695 F.3d 893 (9th Cir. 2012), we have included an ITS to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger so the action does not jeopardize the species if the level of take analyzed in the biological opinion is exceeded. In addition, 50 CFR 402.14(i)(3) provides that in order to monitor the impacts of incidental take, "the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the [ITS]." For these reasons, PIFSC is required to monitor and report its compliance with the ITS, and if the ITS is exceeded, shall promptly reinitiate consultation to ensure that it does not jeopardize any species.

Tagging and sampling during the proposed action results in the directed take of 150 threatened giant manta rays, 250 threatened Indo-West Pacific scalloped hammerhead sharks, and 250 colonies of listed corals in the form of voucher specimen collections. This take is not incidental, as tagging and sampling for scientific research is the purpose of the activity. An incidental take statement is not required for take that is direct, and not incidental to the otherwise lawful activity. However, if any of the take amounts exceed the directed take anticipated in this Biological Opinion (150 threatened giant manta rays, 250 threatened Indo-West Pacific scalloped hammerhead sharks, and 250 colonies of listed corals), reinitiation of formal consultation will be required because the regulatory reinitiation triggers set out 50 CFR 402.16(2) & (3) will have been met.

8.1 Amount or Extent of Take

The following levels of incidental take may be expected to result from the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. NMFS uses causal inference to determine if individual threatened and endangered species, or their designated critical habitat, would likely be taken by harassing, harming, pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting or attempting to engage in any such conduct. If take is anticipated to occur then the Services must describe the amount or extent of such anticipated take and the reasonable and prudent measures, and terms and conditions necessary to minimize the impacts of incidental take (FWS and NMFS 1998). If, during the course of the action, this level of incidental take is exceeded for any of the species as listed, NMFS PIFSC must immediately reinitiate formal consultation with NMFS PRD pursuant to the Section 7 regulations (50 CFR 402.16). NMFS PRD anticipates the following incidental take as a result of the proposed action:

1. No more than one oceanic whitetip shark harmed by hooking or entanglement in the five year period,
2. No more than one Indo-West Pacific scalloped hammerhead shark harmed by hooking or entanglement in the five year period.
3. No more than two giant manta rays and three Indo-West Pacific scalloped hammerhead sharks to die.

8.2 Reasonable and Prudent Measures

NMFS PRD has determined that the following reasonable and prudent measures, as implemented by the terms and conditions that follow, are necessary and appropriate to minimize the impacts of PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean as described in the proposed action, on threatened species and to monitor the level and nature of any incidental takes. These measures are non-discretionary.

1. NMFS PIFSC shall prioritize the health and safety of living elasmobranchs that are accidentally caught, while tagging or gathering tissue samples.
2. PIFSC shall establish record keeping and reporting standards for these data collections and provide an annual summary to NMFS PRD to track the take of the ESA-listed species.

8.3 Terms and Conditions

NMFS PIFSC shall undertake and comply with the following terms and conditions to implement the reasonable and prudent measures identified in Section 10.2 above. These terms and conditions are non-discretionary.

1. The following terms and conditions implement Reasonable and Prudent Measure No. 1:
    a. NMFS PIFSC shall collect tag or collect tissue samples from only healthy individuals who are captured to ensure supporting the highest probability of survival and rapid healing of wounds, or collecting tissue samples from dead individuals.
    b. NMFS PIFSC shall release lethargic individuals, or ones who look stressed or violently thrashing which would make tagging or sample collecting dangerous for either animal or crew.

3. The following terms and conditions implement Reasonable and Prudent Measure No. 2.
    a. PIFSC shall immediately begin monitoring the actual take from the research activities against the anticipated take in this opinion. This report should be provided to NMFS PRD annually, by the end of each calendar year.

8.4 Reinitiation Notice

This concludes formal consultation on PIFSC's Fishery and Ecosystem Research Activities in the Western and Central Pacific Ocean. Reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of anticipated incidental take is exceeded;
2. New information reveals that the action may affect ESA-protected marine species or critical habitat in a manner or to an extent not considered in this Opinion;
3. The action is subsequently modified in a manner that may affect ESA-protected marine species or critical habitat to an extent, or in a manner not considered in this Opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

Additionally, if any of the take amounts exceed the directed take anticipated in this Biological Opinion (150 giant manta rays, 250 Indo-West Pacific scalloped hammerhead sharks, 250 listed coral colonies), reinitiation of formal consultation will be required because the regulatory reinitiation triggers set out in (2) & (3) above will have been met.

9 APPENDIX A: LISTED RESOURCES NOT CONSIDERED FURTHER

The proposed action is not likely to adversely affect Central North Pacific, Central South Pacific, and Central West Pacific green sea turtle, hawksbill sea turtle, Leatherback sea turtle, North Pacific loggerhead sea turtle, olive ridley sea turtle, blue whale, fin whale, sei whale, sperm whale, Hawaiian monk seal, MHI insular false killer whale, North Pacific right whale, and chambered nautilus. We also conclude that the action is not likely to adversely affect critical habitats of the Hawaiian monk seal and MHI insular false killer whale, and not likely to adversely modify or destroy proposed critical habitat of Pacific Ocean corals.

9.1 Stressors Not Likely to Adversely Affect Listed Resources

9.1.1 Sound Exposure

Man-made sounds can affect animals exposed to them in several ways such as: non-auditory damage to gas-filled organs, hearing loss expressed in permanent threshold shift (PTS) or temporary threshold shift (TTS) hearing loss, and behavioral responses. They may also experience reduced hearing by masking (i.e., the presence of one sound affecting the perception of another sound).

Subsequently, NMFS (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were determined based on the approximately 65 dB threshold from the normalized composite audiograms, with an exception for lower limits for low-frequency cetaceans where the result was deemed to be biologically implausible and the lower bound of the low-frequency cetacean hearing range from Southall et al. (2007) retained. Marine mammal hearing groups and their associated hearing ranges are provided in Table 8. Sea turtles hearing was characterized in (Finneran 2016) and thresholds were identified in NMFS' Multi-species Pile Driving Calculator (NMFS 2022, unpublished spreadsheet).

To develop some of the hearing thresholds of received sound sources for sea turtles, expected to produce TTS and PTS, the Navy compiled all sea turtle audiograms available in the literature in an effort to create a composite audiogram for sea turtles as a hearing group. Measured or predicted auditory threshold data, as well as measured equal latency contours, were used to influence the weighting function shape for sea turtles. For sea turtles, the weighting function parameters were adjusted to provide the best fit to the experimental data. The same methods were then applied to other species for which TTS data did not exist.

Table 8. Marine Mammal Hearing Groups (NMFS 2018).

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz

Hearing Group	Generalized Hearing Range*
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz
***** Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).	

However, because these data were insufficient to successfully model a composite audiogram via a fitted curve as was done for marine mammals, median audiogram values were used in forming the sea turtle hearing group's composite audiogram. Based on this composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to hearing loss or damage. Sea turtles generally have a limited hearing range that appears to end near 1 kHz. It is described in detail in the technical report Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III) (Navy 2017). The frequencies around the top portion of the function, where the amplitude is closest to zero, are emphasized, while the frequencies below and above this range (where amplitude declines) are de-emphasized, when summing acoustic energy received by a sea turtle (Navy 2017). Furthermore, sea turtle' hearing appears to be affected more by particle velocity rather than sound pressure, which is what we generally use for management of sound effects for all animals.

Current data indicate that not all marine mammal species have equal hearing capabilities (e.g., Richardson et al. 1995; Wartzok and Ketten 1999; Au and Hastings 2008). To reflect this, Southall et al. (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges based on available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. No direct measurements of hearing ability have been successfully completed for mysticetes (i.e., low-frequency cetaceans). Similarly, sea turtles and elasmobranchs have different ear structures and have different ranges of frequencies than marine mammals. We used a modified version of the publicly available NMFS marine mammal sound calculator (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance, accessed June 2022), to calculate the distances for all sound sources. Thresholds for all sound types, exposure types, and hearing groups are presented in the calculator. The thresholds identified in the calculator is established by NMFS (2018). We used thresholds established by the Navy (2017) for sea turtles in their projects. We grouped all species of sea turtles as one because they are similar in body type, ear structure, and hearing range. Barotrauma is predicted for all animals at 237 dB (re 1 μPa). Sea turtles exposed to peak pressures as loud as 232 dB and 204 dB for SEL could experience permanent threshold shifts (PTS) or hearing loss. We also predict that all animals may experience temporary threshold shifts (TTS) at levels 15 dB less than the PTS thresholds. For continuous underwater sound, we use a threshold for behavioral response of 160 decibels (dB) re 1 μPa (micro-Pascals) rms for sea turtles, 120 dB re 1 μPa rms for whales, including MHI insular false killer whales, and pinnipeds, and 150 dB re 1 μPa rms for sharks and rays.

Given the number of vessels PIFSC uses (and the small number of vessels in the fishery and the wide area they cover), the fact that the sound field produced by the vessels is relatively small and would move with the vessel, the animals would be moving as well, vessel transit vectors would be predictable, and sudden or loud noises would be unlikely or infrequent, we are reasonably certain any exposure to noises generated by this fishery would be short-term and transient. These will generally be ignored by animals that are temporarily exposed to sounds emanating from the vessels in this fishery. Numerous studies demonstrate that marine animals are unlikely to change their behavior when confronted with stimuli with these attributes, and we would also expect masking would be highly unlikely to occur, if not improbable. Although hydraulics may have the potential to create loud noises; due to the expected above water operations, frequency and duration of time these species spend at the surface, dissipation of sound from the source, and the poor transference of airborne generated sounds from the vessel to ocean water through the hull, it is highly unlikely noises generated from vessel operations would elicit behavioral reactions from ESA-listed species considered in this consultation. NMFS is reasonably certain some individuals of ESA-listed resources will hear noise, but the resulting response will not rise to the level of harm or harassment. Thus, will have insignificant effects.

PIFSC will expose listed species to other man-made sound through various sources including, active acoustics, echo locators, vocal playbacks, and sound generated from divers installing instruments or other activities. It is not likely to have a measurable increase in sound intensity, frequency of exposure, or duration of effect from the current baseline. PIFSC proposes to use recorded sounds to locate whales. By design, these sounds will cause a behavioral response. Individuals of the species targeted for study who can hear the sounds might call back to them, ignore the sounds, halt their activities, approach or retreat from the sounds. The sounds will not be loud enough or sustained long enough to cause temporary or permanent hearing loss, or non-auditory injury. While the sounds could temporarily change the behavior of exposed animals, PIFSC plans to emit the minimal amount and duration of sound necessary to collect their data. Exposed animals are not expected to change their behavior in a measurable manner, and return to their normal behavior as soon as PIFSC halts emission.

All individuals within those respective thresholds could experience the disturbance described. A wide range of active acoustic sources are used in PIFSC fisheries surveys for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus and resolution on specific objects. PIFSC also uses passive listening sensors (i.e., remotely and passively detecting sound rather than producing it), which do not have the potential to affect marine mammals. PIFSC active acoustic sources include various echosounders (e.g., multibeam systems), scientific sonar systems, positional sonars (e.g., net sounders for determining trawl position), and environmental sensors (e.g., current profilers).

Mid- and high-frequency underwater acoustic sources typically used for scientific purposes operate by creating an oscillatory overpressure through rapid vibration of a surface, using either electromagnetic forces or the piezoelectric effect of some materials. A vibratory source based on the piezoelectric effect is commonly referred to as a transducer. Transducers are usually designed to excite an acoustic wave of a specific frequency, often in a highly directive beam, with the directional capability increasing with operating frequency. The main parameter characterizing directivity is the beam width, defined as the angle subtended by diametrically opposite "half power" (-3 dB) points of the main lobe. For different transducers at a single operating frequency the beam width can vary from 180° (almost omnidirectional) to only a few degrees. Transducers are usually produced with either circular or rectangular active surfaces. For circular transducers, the beam width in the horizontal plane (assuming a downward pointing main beam) is equal in all directions, whereas rectangular transducers produce more complex beam patterns with variable beam width in the horizontal plane.

The types of active sources employed in fisheries acoustic research and monitoring, based largely on their relatively high operating frequencies and other output characteristics (*e.g.*, signal duration, directivity), should be considered to have very low potential to cause effects to marine mammals that would cause behavior responses from marine mammals. Sea turtles and elasmobranchs will not hear these sounds. Acoustic sources operating at high output frequencies (>180 kHz) that are outside the known functional hearing capability of any marine mammal are unlikely to be detected by marine mammals. Although it is possible that these systems may produce subharmonics at lower frequencies, this component of acoustic output would also be at significantly lower SPLs. While the production of subharmonics can occur during actual operations, the phenomenon may be the result of issues with the system or its installation on a vessel rather than an issue that is inherent to the output of the system. Many of these sources also generally have short duration signals and directional beam patterns, meaning that any individual marine mammal would be unlikely to even receive a signal that would likely be inaudible.

Acoustic sources present on most PIFSC research vessels include a variety of single, dual, and multi-beam echosounders (many with a variety of modes), sources used to determine the orientation of trawl nets, and several current profilers with lower output frequencies that overlap with hearing ranges of certain marine mammals (*e.g.*, 30-180 kHz). However, while likely potentially audible to certain species, these sources also have generally short ping durations and are typically focused (highly directional) to serve their intended purpose of mapping specific objects, depths, or environmental features. These characteristics reduce the likelihood of an animal receiving or perceiving the signal. Furthermore, for cumulative sound exposure levels to build, the individual would have to experience repeated exposures over a long period of time. This is even more unlikely.

PIFSC also proposes to use several types of echo sounders throughout the region for oceanographic mapping and other data collection. PIFSC will operate the echo sounders intermittently throughout the surveys. The vessel generally travels at 8 knots with intermittent pings. The pings range from 0.001 to 0.4 microseconds, at a ping rate that ranges from 0.33 to 10 Hz.

Acoustic sources used by PIFSC vary in frequency, intensity, duration, rate of input, and other factors. The acoustic system used during a particular survey is optimized for surveying under specific environmental conditions (e.g., depth and bottom type). Lower frequencies of sound travel further in the water (i.e., longer range) but provide lower resolution (i.e., less precision). Pulse width and power may also be adjusted in the field to accommodate a variety of environmental conditions. Signals with a relatively long pulse width travel further and are received more clearly by the transducer (i.e., good signal-to-noise ratio) but have a lower range resolution. Shorter pulses provide higher range resolution and can detect smaller and more closely spaced objects in the water. Similarly, higher power settings may decrease the utility of collected data. For example, power level is adjusted according to bottom type, as some bottom types have a stronger return and require less power to produce data of sufficient quality. Accordingly, power is typically set to the lowest level possible in order to receive a clear return with the best data. Survey vessels may be equipped with multiple acoustic systems; each system has different advantages that may be utilized depending on the specific survey area or purpose. In addition, many systems may be operated at one of two frequencies or at a range of frequencies. Primary source categories are described below, and characteristics of representative predominant sources are summarized in Table 9. Predominant sources are those that, when operated, would be louder than and/or have a larger acoustic footprint than other concurrently operated sources, at relevant frequencies.

Table 9. Operating Characteristics of Representative Predominant PIFSC Active Acoustic Sources.

Active acoustic system	**Operating frequencies**	**Maximum source level**	**Single ping duration (ms) and repetition rate (Hz)**	**Orientation/ Directionality**	**Nominal beamwidth**
Simrad EK60 narrow beam echosounder	38, 70, 120, 200 kHz	224 dB	1 ms at 1 Hz	Downward looking	7°
Simrad EM300 multibeam echosounder	30 kHz	237 dB	0.7-15 ms at 5 Hz	Downward looking	1°
ADCP Ocean Surveyor	75 kHz	223.6 dB	1 ms at 4 Hz	Downward looking (30° tilt)	4°
Netmind	30, 200 kHz	190 dB	up to 0.3 ms at 7-9 Hz	Trawl-mounted	50°

Predominant active acoustic sources used by PIFSC are the Simrad EM300 echosounder, operated at an assumed primary frequency of 30 kilohertz (kHz), Simrad EK60 (30-200 kHz), and Acoustic Doppler Current Profiler (ADCP) Ocean Surveyor (75 kHz). Assuming a generalized hearing range (GHR) extending to 35 kHz, we assume that mysticete cetaceans may be able to detect sound from the Simrad EM300 and the Simrad EK60 when it operates at the lower frequency. However, the beam pattern is extremely narrow (1 degree) at that frequency. The ADCP Ocean Surveyor operates at 75 kHz, which is outside of baleen whale hearing capabilities. Therefore, we are reasonably certain the probability of exposures to signals above the behavioral threshold in mysticete cetaceans, sea turtles, or elasmobranchs is extremely unlikely and therefore discountable. While whales in the mid-frequency group like the MHI Insular false killer whales, and phocid pinnipeds like Hawaiian monk seals may be able to hear some of the frequencies of the sounds emitted by various equipment used by PIFSC, the probabilities of extended exposure are not likely to occur to the level of harassment or harm. Thus, for these species, the response is insignificant.

9.1.2 Vessel Collision

The proposed action would expose all ESA-listed marine species under NMFS' jurisdiction found in both the coastal and pelagic exposure categories (both potential and observed) to the risk of collision with vessels. Vessel sizes range up to nearly the maximum 100-ft limit, but the average size is 65 to 70 ft. PIFSC vessels have displacement hulls and travel at speeds less than 10 kts. Vessel speed is an important component of the risk for a collision between a vessel and an individual from a listed species.

PIFSC is proposing to have 300 days at sea with NOAA vessels. The current NOAA vessels that could be used during this action are the NOAA vessels Oscar Elton Sette, Rainier, Reuben Lasker, and Okeanos Explorer. All vessels are no larger than 231 feet long and cruises at no more than 12 knots. From the main ships, PIFSC will travel an estimated 650-900 vessel trips from smaller vessels. These vessels are no greater than 36 feet long and travel no higher than 25 knots. Small vessels are generally more commonly deployed nearshore, which biases exposure to nearshore species more often. Sea turtles in their neritic phase can occur in high densities in some places, especially in the Hawaiian Islands. PIFSC will minimize exposure by operating vessels with professional and certified vessel operators who are trained to operate safely and avoid all visible objects and wildlife at the surface. Observers will alert operators of wildlife at the surface to help avoid collisions.

Turtles and monk seals

Kelly (2020) documented vessel collisions with sea turtles resulting in lethal and sub-lethal injuries. Sea turtles may be in the *Action Area*, and could potentially be struck by the transiting vessel during the proposed activities. NMFS (2008) estimated 37.5 vessel strikes of sea turtles per year from an estimated 577,872 trips per year from vessels of all sizes in Hawaii. More recently, we estimated as many as 200 green sea turtle strikes annually in Hawaii (Kelly 2020). If these turtle strikes are evenly distributed around the islands, the probability of a green sea turtle strike from any one vessel trip is extremely low (on average 0.035%, calculated by dividing the most recent strike estimate of 200 per year by the best estimate of all vessel transits of 577,872 per year). However, green sea turtle strikes are not evenly distributed throughout the islands. They are concentrated in areas where small vessel activity is highest (e.g., near small boat harbors and boat launches), such as Kaneohe Bay and Pearl Harbor on Oahu (Kelly 2020).

Green sea turtles are most vulnerable to small vessels (< 15 m), travelling at fast rates (>10 kts) (Kelly 2020). Increased vessel speed decreases the ability of sea turtles to recognize a moving vessel in time to dive and escape being hit, as well as the vessel operator's ability to recognize the turtle in time to avoid it. The vessels used in the proposed action will be under a speed restriction in areas of known turtle activity. The *Action Area* includes all areas within the Pacific Island Region and Kelly (2020) only identified hot spots for green sea turtle strikes in the Hawaiian Islands. Green sea turtle densities are much higher in the Hawaiian Islands than other places within the region. Generally, the other research areas, especially the Mariana Islands, have lower densities of sea turtles which make collisions less likely to occur. Therefore, the probability of a green sea turtle strike is likely less than the overall rate calculated above. Thus, we are reasonably certain the likelihood of exposure of any green sea turtle to vessel strikes from this action is extremely unlikely, and therefore discountable.

Vessel activities may also occur in American Samoa, which has a considerably smaller density of sea turtles in their surrounding waters compared to the density of green sea turtles around the Hawaiian Islands. We expect that the chances of a PIFSC vessels strike a turtle is even less due to the lower density of turtles around the islands compared to the density of turtles around Hawaii.

The other sea turtle species have a lower rate of striking than green sea turtles. This is likely mostly due to their low abundance numbers and preference for deeper offshore waters (Kelly 2020). There were only four documented vessel strikes of hawksbill sea turtles between 1984 and 2020 and two olive ridley sea turtles in Hawaii (Kelly 2020). We have no documentation of vessel strikes on leatherback or loggerhead sea turtles in Hawaii. Because the probability of a vessel striking any other sea turtles is even lower than that of a green sea turtle, and because of the transit speeds into port are slow, we are reasonably certain the likelihood of exposure of any individual is extremely unlikely, and therefore discountable.

According to PIFSC's database there have been only four verified vessel strikes of Hawaiian monk seals between 1981 and 2016 (John Henderson, pers. comm., PIFSC 5/4/17). Other wounds and blunt force trauma have been documented but wounds, especially those that have healed, are difficult to distinguish between vessel strikes and other blunt force trauma such as intentional killing.

Considering that vessels involved these research activities do not move at speeds that typically pose collision risks when transiting, the rarity of document vessel strikes, that vessels would only be expected to transit through areas where monk seals may occur, and the low abundance and widely scattered nature of monk seals in the *Action Area*; we are reasonably certain the likelihood of exposure of any monk seal to vessel strikes from this proposed action is extremely unlikely, and therefore discountable.

Whales

Whales surface to breathe, with calves surfacing more regularly than adults. While at the surface, a whale is at risk of being struck by a vessel. Vanderlann and Taggart (2007) found that the severity of injury to large whales is directly related to speed, the probability of lethal injury from large ships increased from 21% for vessels traveling at 8.6 kts, to over 79% for vessels moving at 15 kts or more. In a study by Lammers et al. (2003), 22 whale/vessel incidents were recorded from 1975 – 2003, with 14 of those occurring during the years from 1994 – 2003. Using the ten-year period of highest vessel strikes, and the same number vessel transits mentioned above, that calculates to a probably of a collision between a whale and a transiting vessel to be 0.0000024%. According to the study by Lammers et al. (2003), the vast majority (17) of the vessel strikes were from vessels traveling at speeds in excess of 15 kts, and nearly all of them occurred in close proximity to the coastline of the main four Hawaiian Islands.

Based on the expected transit speeds for vessels in this fishery, the collision risks from the references cited above, and the low abundance and widely scattered nature of the whale species in the *Action Area*; we are reasonably certain the likelihood of an individual from the whale being struck is extremely unlikely, and therefore discountable.

Invertebrates

Chambered nautiluses are closely associated with steeply-sloped forereefs and muddy bottoms and are found in depths typically between 200 and 500 m and are not known to swim in the open water column nor found in shallow water depths except for rare occasions when the water is cold enough (Miller 2018). Open ocean environments and specific temperature gradients are considered geographic barriers to movement as the species does not swim through the mid-water (Miller 2018). Therefore, it is extremely unlikely a chambered nautilus would be exposed to vessels at the surface within this fishery and would only pertain to vessel trips that transit to American Samoa.

While it has properly been assumed for listed coral species that physical contact of equipment or humans with an individual constitutes an adverse effect due to high potential for harm or harassment, the same assumption does not hold for ESA-listed corals due to two key biological characteristics:

1. All corals are simple, sessile invertebrate animals that rely on their stinging nematocysts for defense, rather than predator avoidance via flight response. So whereas it is logical to assume that physical contact with a vertebrate individual results in stress that constitutes harm and/or harassment, the same does not apply to corals because they have no flight response.
2. Most reef-building corals, including all the listed species, are colonial organisms, such that a single larva settles and develops into the primary polyp, which then multiplies into a colony of hundreds to thousands of genetically-identical polyps that are seamlessly connected through tissue and skeleton. Colony growth is achieved mainly through the addition of more polyps, and colony growth is indeterminate. The colony can continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. The individual of these listed species is defined as the colony, not the polyp, in the final coral listing rule (79 FR 53852). Thus, affecting some polyps of a colony does not necessarily constitute harm to the individual.

Corals are sessile invertebrates which do not move locations except for extenuating circumstances such as when progeny are broadcasted into ocean currents or breakage and recolonization of substrate from severe weather events. Vessels are expected to use established transportation channels or be deep enough water to avoid contact with corals and would only pertain to transits in MARA, ASARA, WCPRA, and the small portions of the HARA where *Acropora globiceps* has been documented (i.e. NWHI; NMFS 2021a).

In conclusion, given the small number of vessels participating in these research activities, the small number of anticipated vessel trips, the slow vessel speeds during fishing operations and vessel transiting, the expectation that ESA-listed marine species would be widely scattered throughout the proposed *Action Area*, the potential for an incidental vessel strike is extremely unlikely to occur. Thus, NMFS is reasonably certain this the probability of vessel collision with a listed coral is extremely unlikely, and therefore discountable.

9.1.3 Introduction of Vessel Wastes and Discharges, Gear Loss, and Vessel Emissions

The diffuse stressors associated with the vessel operations: vessel waste discharge, gear loss, and carbon emissions and greenhouse gasses, can affect both pelagic and coastal areas. ESA-listed resources could be exposed to discharges, and run-off from vessels that contain chemicals such as fuel oils, gasoline, lubricants, hydraulic fluids and other toxicants. PIFSC research and fishery vessels burn fuel and emit carbon into the atmosphere during fishing operations and transiting. Parker et al. (2018), estimates that in 2011, the world's fishing fleets burned 40 billion liters of fuel and emitted 179 million tons of carbon dioxide greenhouse gasses into the atmosphere. Between 1990 and 2011, emissions grew by 28% primarily due to increased harvests of crustaceans, a fuel intensive fishery (Parker et al. 2018). While we don't have an accurate estimate of the carbon footprint of the PIFSC research activities, we expect the contribution to global greenhouse gases to be relatively inconsequential based on the low number of participants in the fishery.

PIFSC will implement BMPs to prevent the introduction of plastics and spills. If any accidental spill were to occur, it is anticipated to be small in size, contained, and quickly cleaned up prior to entering the aquatic environment. Based on the low likelihood of an ESA-listed species in the vicinity in the unlikely event of a spill occurring, and the adherence to the BMPs that will prevent or minimize potential exposure from spills, we are reasonably certain the probability of exposure of ESA-listed species to wastes and discharges is extremely unlikely and, therefore be discountable.

Although leakage, wastes, gear loss and vessel emissions could occur as a result of PIFSC research activities, given the small number of vessels, use of BMPs, large *Action Area*, low density of listed species,, the probability that ESA-listed resources will be exposed to measurable or detectable amounts of wastes, gear, or emissions from this fishery, is extremely unlikely, and therefore discountable on the ESA-listed resources in Table 4.

9.1.4 Changes in Food Availability

While researchers may harvest fish species that ESA-listed species under NMFS' jurisdiction identified in Table 4, forage on, it is not expected that the amount of proposed harvest would reduce the opportunity for an ESA-listed species to successfully capture prey, or affect the available prey density as described in the BA. Thus, any reduction in food availability is extremely unlikely, and therefore discountable. Listed coral within the *Action Area* obtain food through two processes, photosynthesis and filter feeding (Soo and Todd 2014; Veron 2014). We do not expect any research operations for this survey to affect water quality or phytoplankton communities in a manner that would affect a listed coral. CTD casts will collect small quantities of seawater and would not create an appreciable reduction in the plankton community. Thus, any reduction in food availability is extremely unlikely, and therefore discountable.

9.1.5 Demersal and handline fishing

Demersal and handline fishing will occur throughout the HARA, MARA, and ASARA. Recreational fishing methods pose hooking and entanglement risks to green, hawksbills, loggerhead, leatherback and olive Ridley sea turtles; oceanic whitetip shark, scalloped hammerhead shark, and the giant manta ray. These fishing activities will not occur within the Hawaiian monk seal or Main Hawaiian Insular false killer whale's range. While various cetacean species may depredate bait or catch, we do not expect the ESA-listed cetacean species noted in Table 4 to do so as most are large baleen whales. Cetacean depredation of either bait or catch by toothed whale species could occur, but typically results in only the fish being removed from the hook. However, cetaceans could possibly be entangled in the fishing lines.

Hooking can result in physical damage to the animal, increase the opportunity for a depredation event by a higher level predator while the animal is on the line, interfere with reproduction, reduce foraging efficiency, require extra energy for movement, and in the case of sea turtles and marine mammals, may result in drowning.

Hawaiian monk seals are commonly caught in shoreline fisheries in Hawaii. Hawaiian monk seals appear to favor live bait, or fish attached to a hook, but have been known to feed on squid bait as well. A captured bottomfish could also be depredated as well. Bottomfish set ups are similar to shore fishing (squid-baited circle hooks), and occur in areas where Hawaiian monk seals have been known to feed. We investigated the potential of exposure but found no data or reports from commercial bottomfish fisheries. Interactions could occur but was not considered a major threat. Hawaiian monk seal presence in deep offshore areas are sparse, and as bottomfish rigs are only soaked for 30 minutes, the co-occurrence is considered extremely rare. Hawaiian monk seals and turtles generally do not chase bait in troll fisheries. PIFSC has never reported a Hawaiian monk seal hooking or depredation during similar sampling activities. We are reasonably certain the probability of exposure of any individual Hawaiian monk seal is extremely unlikely, and therefore discountable.

In addition to being entangled, sea turtles are also injured and killed by being hooked. Sea turtles are commonly caught in shore fishing in Hawaii where there are high densities of green sea turtles and shore fishing. Shore fishing is not proposed in this action. However, bottomfish fishing uses the same method (i.e. squid-baited circle hooks) that is commonly used in shore fishing. Sea turtles generally do not forage in deep locations where bottomfish sampling occurs, and PIFSC and federally permitted commercial bottomfish fisheries has never reported a hooked a sea turtle during bottomfish activities as described in the proposed action. Interactions could occur but was not considered a major threat. Hawaiian monk seal presence in deep offshore areas are sparse, and as bottomfish rigs are only soaked for 30 minutes, the co-occurrence is considered extremely rare. Hawaiian monk seals generally do not chase bait in troll fisheries. We also predict that the primarily nearshore nature of the fishing proposed in this action would have a low probability of hooking whales. We are reasonably certain the probability of exposure of any individual sea turtle, Hawaiian monk seal, or cetacean is extremely unlikely, and therefore discountable.

Entanglements can also create physical damage to the animal by constriction of the line which can partially sever limbs or flippers, create penetrating injuries, increase the opportunity for necrosis or death of tissues to occur, and can potentially immobilize an animal (Andersen et al. 2007; Parga 2012). Entanglements also interfere with reproduction, reduce foraging efficiency, and require extra energy for movement, and in the case of sea turtles and marine mammals, may also result in drowning. Ingestion of fishing line by sea turtles causes delayed mortality by blocking intestinal tracts leading to starvation as summarized by Parga (2012).

Cetaceans would not be expected to be boarded in the highly unlikely event they were hooked. Based on their size, strength, and the fishing gear to be used, it would be expected that the line would part. Entanglement would be the primary stressor for these species. Passive entanglement could occur if large baleen whales were transiting through the area and happened to contact the deployed fishing line. However, based on the species distribution, abundance, and expected food sources, we do not expect the bait or catch to be depredated by species listed in Table 4 and Table 4 and the likelihood that a large baleen whale would contact a small number of lines would be extremely unlikely. Along with established BMPs to survey the area, maintaining a watch for listed species around the vessel, and termination of operations if animals are spotted, we consider the interaction of a cetacean becoming entangled in a demersal fishing line to be extremely unlikely and therefore discountable.

9.1.6 Anchoring

The PIFSC prefers not to anchor vessels in coral reef ecosystems where their work routinely takes place. An anchor could potentially have severe consequences for listed coral depending on the severity of damage it inflicts, ranging from tissue damage, fragmentation, or complete destruction of the colony or bivalve (Dinsdale and Harriott 2004). Ocean conditions are dynamic and unforeseen issues with vessels can potentially occur as well. While operations are not expected to take place in harsh ocean conditions, if one of the auxiliary boat Captains needs to set an anchor for safety reasons, anchoring would permissible as long the BMPs are properly implemented and would be removed at the conclusion of the days operation. This includes a diver assisting the deployment and setting of the anchor, anchorage will only occur in sand with periodic visual observation to monitor dragging and to identify if proper tension is being maintained on the line thereby reducing opportunities for entanglements by listed species, and monitoring of ocean conditions that might affect the anchors functionality.

The PIFSC does not expect this operation will require anchoring and operations will only occur during favorable sea state conditions. For these reasons, along with the established BMPs, and the fact that the vessels can deploy the divers and move to deeper waters if need be, we believe anchoring that could potentially affect listed species is extremely unlikely to occur and therefore discountable.

The mooring design for this action, in the unlikely event that it is even deployed, consists of single anchor line that would use the minimum line length necessary to account for expected fluctuations in water depth due to tides and waves from the vessel(s) to the ocean floor. While intact, the anchor line is expected to be held tight by the combination of buoyancy of the vessel, the pressure exerted on the line by currents and waves, and the anchors holding power. Thus the potential for loops to form in the line is extremely remote.

Most ESA-listed species under consideration, like sea turtles, the scalloped hammerhead shark, giant manta ray, etc., are highly mobile species which can avoid anchor lines. ESA-listed corals are sessile animals and anchor lines would pose no threat of entanglement. We do not expect anchoring to occur in Hawaiian waters during the transit phase, thus the Hawaiian monk seal and MHI insular false killer whale are not considered. For the remaining vertebrate ESA-listed species under NMFS' jurisdiction that could potentially interact with anchor lines, the combined weight of the anchor and the pressure exerted on the line by currents make the potential for entanglement extremely unlikely. A taut anchor line would pass harmlessly along the body of a marine animal should an animal encounter one. Further, failed anchors would sink to the seafloor such that any loose line would be short, and the risk of an encounter during the descent of the line with an ESA-listed marine animal is extremely unlikely. Anchor lines could then be manually recovered by the dive team.

Because of the unlikely probability that an anchor would actually be deployed, and the established BMPs, including active monitoring of the anchor system in the unlikely event that it is, we are reasonably certain the probability of exposure of species in Table 4 and Table 5 **is** extremely unlikely, and therefore discountable.

9.1.7 Entanglement

PIFSC is using various sizes of trawl nets at various depths and durations for their research. The breakdown of each trawl method and their details are presented in Table 1. For our evaluation, we consider the total duration of nets in the water, compare it to the likelihood of encountering a listed species, and the probability of a listed species being caught and entangled in these nets. Most sampling occurs in pelagic areas where large animal density is low and co-occurrence of nets and listed species are minimal.

Over the course of a year, PIFSC will deploy over 5,000 nets, ranging from 1-4 hours per tow. PIFSC is also proposing to set up to 175 traps at the bottom of the ocean at bottomfish fishing sites to gather data on juvenile fish communities. These traps are either 8-ft long by 5-ft wide by 3-ft high, with 1.5 inch mesh; or 2-ft long by 1-ft wide by 1-ft high with 0.5-inch mesh. The traps will be left in place for 6-24 hours per set. PIFSC will set traps as deep as 400 m, where sea turtles generally do not forage, but Hawaiian monk seals might forage. The traps are designed with plastic mesh at the entries, which turtles, seals or other large animals can break and escape.

PIFSC will implement BMPs such as observing areas for listed species prior to setting equipment out into the water column, which will reduce the probability of interactions. PIFSC has never captured a sea turtle, monk seal, cetacean, or elasmobranch during any of the tow or trawls, nor has ever entangled them in any other sampling efforts. Other bait trap activities such as the trapping for *Ranina ranina* in the Mariana Islands are actively managed while trapping is occurring, which reduces the likelihood of accidental capture or entanglement. Bottomfish set ups have rigid mainlines that do not entangle easily, while other trap lines like the *Ranina ranina* traps are located in relatively shallow areas where the pelagic-based cetaceans and elasmobranchs rarely occur and are managed during the set.

We are not reasonably certain entanglements with ESA-listed cetaceans will occur. Tows and trawls will be conducted and actively monitored during the tow, and PIFSC will minimize interactions by implementing BMPs. Interactions are limited due to a low number of tows, and low densities of cetaceans in open ocean areas. Most fishing and trapping occur relatively close to shore where cetaceans generally do not occur and either reel lines are rigid and difficult to entangle or monitored closely during operation.

The Navy gathered data and developed a species densities database for their consultations on training exercises in the Pacific Ocean (Navy 2017). The database includes estimates of animals per square km, which is useful to estimate the probability of interacting with gear used in this action. The densities range from 0.0005 (blue whales) to 0.4 animals (green sea turtles – coastal Hawaii) per square km. These densities project that interactions between activities and ESA-listed species would be extremely unlikely, and therefore discountable.

9.1.8 Nearshore and Land-based Surveys

The Pacific RAMP, Marine Debris Research and Removal Surveys, and Marine Turtle Biology and Assessment Program involve circumnavigating islands and atolls using small vessels that may approach the shoreline. Additionally, the Marine Turtle Biology and Assessment Program activities include visual observations, and underwater and land-based captures and sampling of sea turtles, and the Marine Debris Research and Removal Surveys may involve land vehicle (trucks) operations in areas of marine debris where vehicle access is possible from highways or rural/dirt roads adjacent to coastal resources. These activities have the potential to disturb monk seals hauled out during research activities either from approaches of nearshore small vessel based research or land based debris research and clean-up activities.

PIFSC will be deploying numerous instruments that may directly contact species (ROVs, cameras, BRUVs, and other various equipment etc.). Considering the large *Action Area* and disperse distribution of most of the listed species in Table 1, it would be extremely rare for concurrent existence. Furthermore, PIFSC's will implement BMPs which include avoiding working in areas where listed species are observed, and halting work when they are in the work area and can potentially be harmed by activities. Instruments will either be moving as they are towed, or left in place for a period of time to collect data. Exposure to objects in water increase with duration. Because of PIFSC BMPs to avoid listed species, we are reasonably certain direct contact or associated disturbance is extremely unlikely, and therefore discountable.

9.2 Critical Habitat

Critical habitat exists within the *Action Area* for three of the species analyzed in this document (see Table 5).

9.2.1 Main Hawaiian Islands Insular False Killer Whale

Critical Habitat for MHI insular false killer whale includes waters from the 45-meter (m) depth contour to the 3,200-m depth contour around the main Hawaiian Islands from Niihau east to Hawaii Island. We defined the essential features for MHI insular false killer whales as island-associated marine habitat with four characteristics that support this feature. The four characteristics include: 1) adequate space for movement and use within shelf and slope habitat; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; (3) waters free of pollutants of a type and amount harmful to MHI insular false killer whales; and (4) sound levels that will not significantly impair false killer whales' use or occupancy.

PIFSC will conduct activities within MHI insular false killer whale critical habitat in some of the HARA. While traps, fishing sets, and other equipment could potentially be hazardous to MHI insular false killer whales as entanglement, hooking, or other risks, they are temporary in nature and will have no long-term effects on the habitat or the essential features of the habitat once they are removed from the research areas. PIFSC will remove all equipment after research activities are complete. With the implementation of BMPs, PIFSC will avoid or minimize the effects of sound, vessel traffic, and hazardous chemicals to expose MHI insular false killer whales to levels that would prevent them from occupying the area, supporting prey species, or providing areas where they can forage, rest, reproduce, or transit through.

9.2.2 Hawaiian monk seal

The proposed action will occur in monk seal critical habitat. Specific areas for designated critical habitat include 16 occupied areas within the range of the species: ten areas in the NWHI and six in the MHI. These areas contain one or a combination of habitat types: Preferred pupping and nursing areas, significant haul-out areas, and/or marine foraging areas, that will support conservation for the species. Specific areas in the NWHI include all beach areas, sand spits and inlets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef waters, and including marine habitat through the water's edge, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, out to the 200-m depth contour line around the ten areas: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island. Specific areas in the MHI include marine habitat from the 200-m depth contour line, including the seafloor and all subsurface waters and marine habitat within 10 m of the seafloor, through the water's edge 5 m into the terrestrial environment from the shoreline between identified boundary points on the islands of: Kaula, Niihau, Kauai, Oahu, Maui Nui (including Kahoolawe, Lanai, Maui, and Molokai), and Hawaii.

PIFSC will conduct activities within Hawaiian monk seal critical habitat in some of the HARA. While traps, fishing sets, and other equipment could potentially be hazardous to monk seals as entanglement, hooking, or other risks, they are temporary in nature and will have no long-term effects on the habitat or the essential features of the habitat once they are removed from the research areas. PIFSC will remove all equipment after research activities are complete. With the implementation of BMPs, PIFSC will avoid or minimize the effects of sound, vessel traffic, and hazardous chemicals to expose monk seals to levels that would prevent important activities such as foraging, pupping, or resting.

9.2.3 Proposed Pacific Coral Critical Habitat

On November 27, 2020, NMFS announced a proposed rule in the Federal Register (85 FR 76262) to designate critical habitat for seven of the fifteen threatened Indo-Pacific corals, A. globiceps, Acropora retusa, A. jacquelineae, Acropora speciosa, Seriatopora aculeata, Euphyllia paradivisa, and Isopora crateriformis. Critical habitat is proposed for most of the geographic area occupied by these seven listed corals in U.S. Pacific Islands waters and includes a total of 17 specific occupied units, or areas, containing physical features essential to the conservation of the coral species.

Proposed critical habitat is defined as all waters 0-40 meters depth around each occupied unit, except for the areas specified below. The proposed coral critical habitat consists of substrate and water column habitat characteristics essential for the reproduction, recruitment, growth, and maturation of the listed corals. Sites that support the normal function of all life stages of the corals are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column. Several attributes of these sites determine the quality of the area and influence the value of the associated feature to the conservation of the species:

(1) Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae; (2) Reefscape (all the visible features of an area of reef) with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae; (3) Marine water with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function; and (4) Marine water with levels of anthropogenically-introduced (from humans) chemical contaminants that do not preclude or inhibit any demographic function.

Proposed critical habitat does not include the following particular areas where they overlap with the 0-40 meter depth in:

1) All areas that were excluded for national security, economic impact, or on military lands managed by Integrated Natural Resources Management Plans that provide sufficient conservation value. Those excluded areas are listed in the proposed listing (86 FR 16325). Critical habitat also does not include areas where the essential feature does not occur (e.g., where hard substrate does not occur);

2) All managed areas that may contain natural hard substrate but do not provide the quality of substrate essential for the conservation of threatened corals. Managed areas that do not provide the quality of substrate essential for the conservation of the seven Indo-Pacific corals are defined as particular areas whose consistently disturbed nature renders them poor habitat for coral growth and survival over time. These managed areas include specific areas where the substrate has been disturbed by planned management authorized by local, territorial, state, or Federal governmental entities at the time of critical habitat designation, and will continue to be periodically disturbed by such management. Examples include, but are not necessarily limited to, dredged navigation channels, shipping basins, vessel berths, and active anchorages;

3) Artificial substrates including but not limited to: Fixed and floating structures, such as aids-to-navigation (AToNs), seawalls, wharves, boat ramps, fishpond walls, pipes, submarine cables, wrecks, mooring balls, docks, aquaculture cages;

4) The Commonwealth Ports Authority harbors, basins, and navigation channels, their seawall breakwaters; all other channels, turning basins, berthing areas that are periodically dredged or maintained, and a 25 m radius of substrate around each of the AToN bases;

Given that the duration of the proposed action (5-years) may overlap with a final designation of the proposed coral critical habitat, NMFS PIRO PRD is with this consultation conferencing with PIFSC on the effects of the proposed action on the proposed critical habitat in the *Action Area* to gain efficiencies in the process, and avoid disruption of the proposed action if the critical habitat is designated.

We evaluated the effect of removing fragments or core samples from not only ESA-listed corals but all corals to proposed coral critical habitat. Potential effects to non-listed corals can affect the critical habitat proposed for ESA-listed corals. We also evaluated the effects of other activities such as temporary placement of instruments near coral reefs, trapping, spearfishing, and other activities in critical habitat. PIFSC will avoid or minimize injuring coral, breaking or altering hard substrate by implementing BMPs to avoid contact with existing corals, and measures to ensure hard structure is kept intact. We discussed the effect of removing coral fragments and samples on the individual colonies. In rare cases, sampling could lead to death of the colony. Most colonies will heal and survive but considering up to 500 are being sampled, we anticipate that few may die. PIFSC will select corals are selected at random distributions and will avoid oversampling in one area. This avoids creating a large void in small areas, which could affect the overall health of the coral community.

We evaluated the effect of taking up to 500 coral samples from coral colonies throughout the region, over five years. Proposed Pacific coral critical habitat exists in the MARA, ASARA, and WCPRA, but not in the HARA. Not all sampling locations within the MARA, ASARA, and WCPRA will be in critical habitat, however, we expect most places where PIFSC proposes to collect samples will be. Corals would be collected as sparingly as possible from each location to avoid affecting large numbers of colonies in one area. This will minimize the risk of killing multiple colonies in a small area, which could have a large scale effect to the local coral community, and minimize the magnitude of the effect to essential features of coral critical habitat. We expect most coral colonies to heal lesions and continue to live after PIFSC's sampling. This further reduces the long-term effect to the coral community and critical habitat. The death of a few colonies could occur but considering the implementation of BMPs, we do not expect a loss of a few colonies in communities that have thousands of colonies to have long-term and lasting effects to the local coral community and the essential features of critical habitat in the *Action Area*.

Direct physical contact with proposed coral critical habitat's hard substrate, including essential features (1) and (2) as listed above, may occur from the same set of activities as described in Section 5.3 of this document. Depending on the nature of contact, direct physical contact can reduce the quality and quantity of hard substrate needed for listed corals to settle and grow.

However, the BMPs to be employed to avoid contact with listed corals and their habitat (BMPs 1-4 and 8-10), will minimize direct contact with critical habitat's hard substrate including essential features (1) and (2). Given the nature of the stressor, direct physical contact will have no effect on proposed critical habitat's water column, including essential features (3) and (4).

PIFSC will only place traps or set anchors in sandy areas to avoid damage to hard substrate or coral. Placement of instruments and traps are temporary and the habitat will return to its ambient state once the instruments are removed. PIFSC will remove some fish from coral reef communities but will only take what they need for sampling. This will ensure important functions provided by fish to coral colonies and the reef are not significantly reduced. With the BMPs in place, we do not expect activities with the exception of coral sampling to alter the essential features of critical habitat in the long term.

Based on this information, the likelihood of proposed coral critical habitat being exposed to direct physical contact is considered extremely unlikely, and therefore discountable.

Entanglement with the proposed coral critical habitat's hard substrate, including essential features (1) and (2), may occur if traps, anchors, or other equipment are poorly placed, or drifts into or drapes and eventually becomes lodged around live or dead corals or other hard substrate structures. Depending on the nature of the entanglement, this can reduce the quantity or quality of the hard substrate by damaging, altering and/or removing attributes such as crevices and holes, which can negatively impact the reef frameworks upon which listed corals depend on. Given the nature of the stressor, entanglement will not affect proposed critical habitat's water column, including essential features (3) and (4). Based on the above and PIFSC proposed implementation of BMPs, the likelihood of the proposed coral critical habitat being exposed to entanglement is considered extremely unlikely, and therefore discountable.

There is a potential for the introduction of invasive species from vessels, equipment, and divers associated with proposed activities to have an effect on proposed coral critical habitat's hard substrate, including essential features (1) and (2), during all phases of the project. Introduced invasive species, such as fleshy algae or sponges, have the potential to reduce the quantity or quality of the hard substrate, through occupation and dominance of the hard substrate, which can negatively impact the reef frameworks upon which listed corals depend on. However, PIFSC will implement BMPs which will ensure no organisms are being introduced or transported amongst project sites. PIFSC will use gear and equipment washed in fresh water after every work day and will ensure that organisms are not being transported from different sites. Given the nature of the stressor, introduction of invasive species will not have any effects on proposed critical habitat's water column, including essential features (3) and (4). Based on this information, the likelihood of the proposed coral critical habitat being exposed to the introduction of invasive species is considered extremely unlikely, and therefore discountable.

As mentioned above for sea turtles and corals, waste, discharge and other pollutants may be introduced to the marine environment from vessels, equipment and divers during all phases of project activities in the form of hydrocarbon-based chemicals, debris/trash, and toxins from materials used for settlement units and/or sunscreen. Similar to the analysis provided for *Acropora retusa* and *Seriatopora aculeata* corals, depending on the nature of the discharge/s, these may affect proposed critical habitat hard substrate, including essential features (1) and (2), and critical habitat's water column, including essential features (3) and (4). The quantity and quality of hard substrate needed for corals to settle and grow may be reduced through for example contaminants harming live coral tissue, nutrients promoting fleshy algal growth, and trash abrading and breaking coral skeletons. In addition, discharge may reduce water quality. However, as mentioned above for listed corals, various measures including BMPs will be implemented to limit discharges and their effects on organisms, hard substrate and water quality. Therefore, the likelihood of proposed coral critical habitat being exposed to waste, discharge and other pollutants is considered extremely unlikely, and therefore discountable.

Vessel collisions with proposed coral critical habitat hard substrate, including essential features (1) and (2), will not occur due to the lack of spatial overlap between hard substrate and vessel movement in the water column. In addition, given the nature of the stressor, vessel collisions will have no effect on proposed critical habitat's water column, including essential features (3) and (4).

Noise exposure of proposed coral critical habitat's hard substrate, including essential features (1) and (2), will not occur as there is no evidence, as mentioned for corals above, that coral colonies, or hard substrate, can "hear" sound. The temporary and minor levels of sound generated from project activities as mentioned above, are not expected to be associated with pressure waves. In addition, given the nature of the stressor, noise will have no effect on proposed critical habitat's water column, including essential features (3) and (4). Increased turbidity Increased turbidity exposure of proposed coral critical habitat's hard substrate, including essential features (1) and (2), and critical habitat's water column, including essential features (3) and (4), is extremely unlikely to occur due to the lack of spatial overlap between hard substrate (and the overlaying water column) and any turbidity plume/s generated by the sediment disturbance activities associated with the proposed action. Turbidity would be associated only with activities causing disturbance of sand, which is expected to be limited to a few occurrences for a matter of minutes at a time once per the 5-year project duration per location at most, and infrequently for vessel anchoring across the *Action Area* during all phases of activities. Any turbidity generated is expected to be temporary and confined to the immediate vicinity (> 3 m) of the source of disturbance. Based on this analysis, the likelihood of proposed coral critical habitat being exposed to increased turbidity is considered extremely unlikely, and therefore discountable.

Benthic disturbance and change in proposed coral critical habitat's hard substrate, including essential features (1) and (2) will be exposed to the benthic disturbance and change in habitat stressor as a result of the placement of settlement units and installation of plot markers on hard substrate at reef sites, and placement of data-gathering equipment. Benthic disturbance and change in habitat can reduce the quality and quantity of the essential features listed above, and the hard substrate needed for the listed corals to settle and grow. Given the nature of the stressor, benthic disturbance and change in habitat will have no effect on proposed critical habitat's water column, including essential features (3) and (4). The level of exposure of proposed coral critical habitat to the disturbance and change in habitat stressor is expected to be minor.

Proposed coral critical habitat's hard substrate and associated water column, including essential features (1), (2), (3) and (4) are extremely unlikely to be exposed to direct physical contact; entanglement; introduction of invasive species; introduction of wastes and other pollutants; and vessel collisions. PIFSC will not increase levels of noise; and turbidity to levels that will diminish water quality that prevents or reduces survival of existing coral colonies or settlement of coral.

9.3 Conclusion

Considering the information and assessments presented in the consultation request and available reports and information, and in the best scientific information available about the biology and expected behaviors of Central North Pacific, Central South Pacific, and Central West Pacific green sea turtle, hawksbill sea turtle, Leatherback sea turtle, North Pacific loggerhead sea turtle, olive ridley sea turtle, blue whale, fin whale, sei whale, sperm whale, Hawaiian monk seal, MHI insular false killer whale, North Pacific right whale, and chambered nautilus, all effects of the proposed action are either discountable or insignificant. We also conclude that the action is not likely to adversely modify or destroy critical habitats of Hawaiian monk seal and MHI insular false killer whale, and not likely to adversely modify or destroy proposed critical habitat of Pacific Ocean corals. Accordingly, we concur with your determination that the proposed action is not likely to adversely affect them.

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Coastal Zone Management Act Consultation

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 • Honolulu, Hawai'i 96818
(808) 725-5300

December 16, 2019

Ms. Mary Alice Evans, Manager
Hawai'i Coastal Zone Management Program
Department of Business, Economic Development, and Tourism
P.O. Box 2359
Honolulu, HI 96804

Dear Ms. Evans:

The National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) is proposing to conduct fisheries and ecosystem research throughout the Pacific Islands Region including the Hawaiian Archipelago. Activities would start as soon as the draft Programmatic Environmental Assessment (DPEA) for Fisheries and Ecosystem Research Conducted and Funded by PIFSC (enclosed) is finalized and would continue for 5 years or until research activities change such that new or additional environmental analysis is required. We have evaluated the activities described in the DPEA and have determined that these activities are consistent to the maximum extent practicable with the enforceable policies of the approved Coastal Zone Management Program of the State of Hawai'i. This consistency determination is submitted in compliance with federal consistency regulations, 15 C.F.R. Part 930.

The U.S. Department of Commerce, NOAA/NMFS is undertaking a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands, the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support of NOAA's mission of science, service and stewardship. Our research activities are authorized by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have included a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support management decisions by fisheries management organizations such as NMFS' Pacific Islands Regional Office, and the Western Pacific Regional Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals.

PIFSC administers and conducts a wide variety of marine research activities throughout the Hawaiian Archipelago. These activities are summarized in Tables 2.2-1 and 2.3-1 in the DPEA. PIFSC research activities include surveys utilizing a wide array of research equipment and fishing gear to capture fish and invertebrates for stock assessment and other research purposes, collection of plankton and larval life stages of organisms to facilitate ecosystem studies, and gathering oceanographic and acoustic data to characterize the marine environment. These research activities are conducted using NOAA Ships and charter vessels as research support platforms.

Before and during implementation of the activities described in the DPEA, PIFSC intends to conduct a suite of measures designed, in part, to mitigate potential adverse effects on coastal uses and resources that might result from implementing the proposed activities. These mitigation measures which were also considered in our consistency determination include[1]:

- **Trawl surveys**
  - Mitigation measures for protected species and habitats include visual monitoring for protected species prior to trawling operations, implementing the "move on" rule when protected species are sighted in the vicinity of research operations prior to setting trawling gear and moving at a slow speed (<4 knots) when conducting trawling operations.

- **Longline gear**
  - Shallow-set longline research: Using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, setting only at night and keeping lighting to a minimum.
  - Deep-set longline research: Attaching 45 gram or heavier weights within 1 meter (m) of each hook, using a line shooter to set the mainline, using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, using a bird curtain and deploying gear so hooks do not resurface.

- **Small boat and diver operations**
  - Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species.
  - Remaining at least 100 m from marine mammals and at least 50 m from sea turtles.
  - Reducing vessel speed up to 10 kilometers (km) or less when piloting vessels in the proximity of marine mammals or 5 km or less when piloting vessels in areas of known or suspected turtle activity.
  - Placing the engine in neutral if approached by a marine mammal or sea turtle.
  - Minimizing the spread of disease and invasive species by soaking scientific equipment in freshwater 1:32 dilution with commercial bleach for at least 10 minutes and using only disinfected equipment at each dive site.
  - Using at least two containment systems (combination of bags and jars underwater) when collecting potentially invasive species or diseased organisms.
  - Disinfecting dive gear in a 1:52 dilution of commercial bleach in freshwater and physical removal of any organic matter.

- **Marine debris removal**

[1] A full description of mitigation measures is included in Section 2.2.1 of the DPEA.

- o Avoiding historic properties, cultural features or properties when conducting marine debris removal operations.
- o Removing marine debris in accordance with the Marine Debris Removal Protocols decision matrix (Figure 2.2-1 in DPEA).

As discussed above, the activities undertaken by NMFS would not cause any direct effects to Hawai'i's coastal zone management area. The underlying objective of the activity is to improve our understanding of ocean ecosystems. That objective is very much in line with the policies and objectives of Hawai'i's Coastal Zone Management Program, particularly those related to the conservation and management of marine resources. See Hawai'i Revised Statutes § 205A-2. Pursuant to section 307 of the Coastal Zone Management Act (16 U.S.C. § 1456(c)(1)(C)), we have determined that the proposed action is consistent to the maximum extent practicable with the enforceable policies of the approved Coastal Zone Management Program of Hawai'i. In accordance with 15 C.F.R. Parts 930.39 and 930.41, we request your concurrence within 60 days of receipt of this letter. If we do not receive your response within 60 days, we will presume concurrence.

Enclosed is the analysis supporting this determination. Please send any comments or direct inquiries to: Hoku Johnson, PIFSC Supervisory Natural Resource Management Specialist at the address above (telephone (808) 725-5323, electronic mail Hoku.Johnson@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 • Honolulu, Hawai'i 96818
(808) 725-5300

November 29, 2019

Mr. Edwin Reyes, Manager
Administrator
Guam Coastal Management Program
Bureau of Statistics and Plans
P.O. Box 2950
Hagatna, Guam 96932
Tel: (671) 475-9672
Fax: (671) 475-4512
Email: Edwin.Reyes@bsp.guam.gov

Dear Mr. Reyes:

The National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) is proposing to conduct fisheries and ecosystem research throughout the Pacific Islands Region including the Mariana Archipelago. Activities would start as soon as the draft Programmatic Environmental Assessment (DPEA) for Fisheries and Ecosystem Research Conducted and Funded by PIFSC (enclosed) is finalized and would continue for 5 years or until research activities change such that new or additional environmental analysis is required. We have evaluated the activities described in the DPEA and have determined that these activities are consistent to the maximum extent practicable with the enforceable policies of the approved Coastal Zone Management Program of the Territory of Guam. This consistency determination is submitted in compliance with federal consistency regulations, 15 C.F.R. Part 930.

The U.S. Department of Commerce, NOAA/NMFS is undertaking a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands, the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support of NOAA's mission of science, service and stewardship. Our research activities are authorized by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have included a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support management decisions by fisheries management organizations such as NMFS' Pacific Islands Regional Office, and the Western Pacific Regional

Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals.

PIFSC administers and conducts a wide variety of marine research activities throughout the Marianas Archipelago. These activities are summarized in Tables 2.2-1 and 2.3-1 in the DPEA. PIFSC research activities include surveys utilizing a wide array of research equipment and fishing gear to capture fish and invertebrates for stock assessment and other research purposes, collection of plankton and larval life stages of organisms to facilitate ecosystem studies, and gathering oceanographic and acoustic data to characterize the marine environment. These research activities are conducted using NOAA Ships and charter vessels as research support platforms.

Before and during implementation of the activities described in the DPEA, PIFSC intends to conduct a suite of measures designed, in part, to mitigate potential adverse effects on coastal uses and resources that might result from implementing the proposed activities. These mitigation measures which were also considered in our consistency determination include[1]:

- **Trawl surveys**
  - Mitigation measures for protected species and habitats include visual monitoring for protected species prior to trawling operations, implementing the "move on" rule when protected species are sighted in the vicinity of research operations prior to setting trawling gear and moving at a slow speed (<4 knots) when conducting trawling operations.

- **Longline gear**
  - Shallow-set longline research: Using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, setting only at night and keeping lighting to a minimum.
  - Deep-set longline research: Attaching 45 gram or heavier weights within 1 meter (m) of each hook, using a line shooter to set the mainline, using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, using a bird curtain and deploying gear so hooks do not resurface.

- **Small boat and diver operations**
  - Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species.
  - Remaining at least 100 m from marine mammals and at least 50 m from sea turtles.
  - Reducing vessel speed up to 10 kilometers (km) or less when piloting vessels in the proximity of marine mammals or 5 km or less when piloting vessels in areas of known or suspected turtle activity.
  - Placing the engine in neutral if approached by a marine mammal or sea turtle.
  - Minimizing the spread of disease and invasive species by soaking scientific equipment in freshwater 1:32 dilution with commercial bleach for at least 10 minutes and using only disinfected equipment at each dive site.
  - Using at least two containment systems (combination of bags and jars underwater) when collecting potentially invasive species or diseased organisms.
  - Disinfecting dive gear in a 1:52 dilution of commercial bleach in freshwater and physical removal of any organic matter.

[1] A full description of mitigation measures is included in Section 2.2.1 of the DPEA.

- **Marine debris removal**
  - Avoiding historic properties, cultural features or properties when conducting marine debris removal operations.
  - Removing marine debris in accordance with the Marine Debris Removal Protocols decision matrix (Figure 2.2-1 in DPEA).

Consistency Evaluation
The policies and objectives of Guam's Coastal Zone Management Program, as set forth in Guam Land-Use Policies, Exec. Order 78-37 (Nov. 15, 1978), promote the sustainable development and use of marine and coastal resources. As discussed above, the proposed activity will not cause adverse effects to Guam's coastal zone management area. The underlying objective of the proposed activity is to improve our understanding of ocean ecosystems. Pursuant to section 307 of the Coastal Zone Management Act (16 U.S.C. § 1456(c)(1)(C)), we have determined that the proposed action is consistent to the maximum extent practicable with the enforceable policies of Guam's Coastal Zone Management Program. In accordance with 15 C.F.R. Parts 930.39 and 930.41, we request your concurrence within 60 days of receipt of this letter. If we do not hear from you in 60 days we will presume concurrence.

Enclosed is the analysis supporting this determination. Please send any comments or direct inquiries to: Hoku Johnson, PIFSC Supervisory Natural Resource Management Specialist at the address above (telephone (808) 725-5323, electronic mail Hoku.Johnson@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 • Honolulu, Hawai'i 96818
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November 29, 2019

Ms. Janice Castro
Director
CNMI Division of Coastal Resources Management
P.O. Box 10007
Saipan, MP 96950
Tel: (670) 664-8300
Fax: (670) 664-8315

Dear Ms. Castro:

The National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) is proposing to conduct fisheries and ecosystem research throughout the Pacific Islands Region including the Mariana Archipelago. Activities would start as soon as the draft Programmatic Environmental Assessment (DPEA) for Fisheries and Ecosystem Research Conducted and Funded by PIFSC (enclosed) is finalized and would continue for 5 years or until research activities change such that new or additional environmental analysis is required. We have evaluated the activities described in the DPEA and have determined that these activities are consistent to the maximum extent practicable with the enforceable policies of the approved Coastal Zone Management Program of the Commonwealth of the Northern Mariana Islands (CNMI). This consistency determination is submitted in compliance with federal consistency regulations, 15 C.F.R. Part 930.

The U.S. Department of Commerce, NOAA/NMFS is undertaking a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, CNMI, the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support of NOAA's mission of science, service and stewardship. Our research activities are authorized by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have included a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support management decisions by fisheries management organizations such as NMFS' Pacific Islands Regional Office, and the Western Pacific Regional Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals.

PIFSC administers and conducts a wide variety of marine research activities throughout the Mariana Archipelago. These activities are summarized in Tables 2.2-1 and 2.3-1 in the DPEA. PIFSC research activities include surveys utilizing a wide array of research equipment and fishing gear to capture fish and invertebrates for stock assessment and other research purposes, collection of plankton and larval life stages of organisms to facilitate ecosystem studies, and gathering oceanographic and acoustic data to characterize the marine environment. These research activities are conducted using NOAA Ships and charter vessels as research support platforms.

Before and during implementation of the activities described in the DPEA, PIFSC intends to conduct a suite of measures designed, in part, to mitigate potential adverse effects on coastal uses and resources that might result from implementing the proposed activities. These mitigation measures which were also considered in our consistency determination include[1]:

- **Trawl surveys**
  - Mitigation measures for protected species and habitats include visual monitoring for protected species prior to trawling operations, implementing the "move on" rule when protected species are sighted in the vicinity of research operations prior to setting trawling gear and moving at a slow speed (<4 knots) when conducting trawling operations.

- **Longline gear**
  - Shallow-set longline research: Using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, setting only at night and keeping lighting to a minimum.
  - Deep-set longline research: Attaching 45 gram or heavier weights within 1 meter (m) of each hook, using a line shooter to set the mainline, using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, using a bird curtain and deploying gear so hooks do not resurface.

- **Small boat and diver operations**
  - Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species.
  - Remaining at least 100 m from marine mammals and at least 50 m from sea turtles.
  - Reducing vessel speed up to 10 kilometers (km) or less when piloting vessels in the proximity of marine mammals or 5 km or less when piloting vessels in areas of known or suspected turtle activity.
  - Placing the engine in neutral if approached by a marine mammal or sea turtle.
  - Minimizing the spread of disease and invasive species by soaking scientific equipment in freshwater 1:32 dilution with commercial bleach for at least 10 minutes and using only disinfected equipment at each dive site.
  - Using at least two containment systems (combination of bags and jars underwater) when collecting potentially invasive species or diseased organisms.
  - Disinfecting dive gear in a 1:52 dilution of commercial bleach in freshwater and physical removal of any organic matter.

[1] A full description of mitigation measures is included in Section 2.2.1 of the DPEA.

- **Marine debris removal**
  - Avoiding historic properties, cultural features or properties when conducting marine debris removal operations.
  - Removing marine debris in accordance with the Marine Debris Removal Protocols decision matrix (Figure 2.2-1 in DPEA).

Consistency Evaluation

The policies and objectives of CNMI's Coastal Zone Management Program, as set forth in CNMI Administrative Code, (N. Mar. I. Admin. Code § 15-10, Part 1500.), guides the use, protection, and development of land and ocean resources within the CNMI coastal zone. As discussed above, the proposed activity will not cause adverse effects to CNMI's coastal zone management area. The underlying objective is to improve our understanding of ocean ecosystems. The objective is in line with the policies and objectives of CNMI's Coastal Zone Management Program. Thus, we have therefore determine that the proposed action is consistent to the maximum extent practicable with the enforceable policies of CNMI's Coastal Zone Management Program. As provided at 15 C.F.R. Parts 930.39 and 930.41, we request your concurrence within 60 days of receipt of this letter. If we do not receive your response within 60 days, we will presume concurrence.

Enclosed is the analysis supporting this determination. Please send any comments or direct inquiries to: Hoku Johnson, PIFSC Supervisory Natural Resource Management Specialist at the address above (telephone (808) 725-5323, electronic mail Hoku.Johnson@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 • Honolulu, Hawai'i 96818
(808) 725-5300

November 29, 2019

Ms. Sandra Lutu
American Samoa Coastal Management Program
Department of Commerce
Executive Office Building, 2nd Floor
Utulei, American Samoa 96799
Tel: (684) 633-5155
Fax: (684) 633-4195
Email: Sandra.Lutu@doc.as

Dear Ms. Lutu:

The National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) is proposing to conduct fisheries and ecosystem research throughout the Pacific Islands Region including American Samoa. Activities would start as soon as the draft Programmatic Environmental Assessment (DPEA) for Fisheries and Ecosystem Research Conducted and Funded by PIFSC (enclosed) is finalized and would continue for 5 years or until research activities change such that new or additional environmental analysis is required. We have evaluated the activities described in the DPEA and have determined that these activities are consistent to the maximum extent practicable with the enforceable policies of the approved Coastal Zone Management Program of the Territory of American Samoa. This consistency determination is submitted in compliance with federal consistency regulations, 15 C.F.R. Part 930.

The U.S. Department of Commerce, NOAA/NMFS is undertaking a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands, the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support of NOAA's mission of science, service and stewardship. Our research activities are authorized by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have included a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support management decisions by fisheries management organizations such as NMFS' Pacific Islands Regional Office, and the Western Pacific Regional Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals.

PIFSC administers and conducts a wide variety of marine research activities throughout the Hawaiian Archipelago. These activities are summarized in Tables 2.2-1 and 2.3-1 in the DPEA. PIFSC research activities include surveys utilizing a wide array of research equipment and fishing gear to capture fish and invertebrates for stock assessment and other research purposes, collection of plankton and larval life stages of organisms to facilitate ecosystem studies, and gathering oceanographic and acoustic data to characterize the marine environment. These research activities are conducted using NOAA Ships and charter vessels as research support platforms.

Before and during implementation of the activities described in the DPEA, PIFSC intends to conduct a suite of measures designed, in part, to mitigate potential adverse effects on coastal uses and resources that might result from implementing the proposed activities. These mitigation measures which were also considered in our consistency determination include[1]:

- **Trawl surveys**
  - Mitigation measures for protected species and habitats include visual monitoring for protected species prior to trawling operations, implementing the "move on" rule when protected species are sighted in the vicinity of research operations prior to setting trawling gear and moving at a slow speed (<4 knots) when conducting trawling operations.

- **Longline gear**
  - Shallow-set longline research: Using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, setting only at night and keeping lighting to a minimum.
  - Deep-set longline research: Attaching 45 gram or heavier weights within 1 meter (m) of each hook, using a line shooter to set the mainline, using completely thawed blue-dyed bait, retaining spent bait and fish parts for strategic offal discard, using a bird curtain and deploying gear so hooks do not resurface.

- **Small boat and diver operations**
  - Divers, spotters, and coxswains undertake consistent due diligence and take every precaution during operations to avoid interactions with any listed species.
  - Remaining at least 100 m from marine mammals and at least 50 m from sea turtles.
  - Reducing vessel speed up to 10 kilometers (km) or less when piloting vessels in the proximity of marine mammals or 5 km or less when piloting vessels in areas of known or suspected turtle activity.
  - Placing the engine in neutral if approached by a marine mammal or sea turtle.
  - Minimizing the spread of disease and invasive species by soaking scientific equipment in freshwater 1:32 dilution with commercial bleach for at least 10 minutes and using only disinfected equipment at each dive site.
  - Using at least two containment systems (combination of bags and jars underwater) when collecting potentially invasive species or diseased organisms.

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[1] A full description of mitigation measures is included in Section 2.2.1 of the DPEA.

- Disinfecting dive gear in a 1:52 dilution of commercial bleach in freshwater and physical removal of any organic matter.

- **Marine debris removal**
  - Avoiding historic properties, cultural features or properties when conducting marine debris removal operations.
  - Removing marine debris in accordance with the Marine Debris Removal Protocols decision matrix (Figure 2.2-1 in DPEA).

As discussed above, the activities undertaken by NMFS would not cause any direct effects to the coastal zone management area of American Samoa. The underlying objective of the activity is to improve our understanding of ocean ecosystems. That objective is very much in line with the policies and objectives of American Samoa's Coastal Zone Management Program, particularly those related to the conservation and management of marine resources. Pursuant to section 307 of the Coastal Zone Management Act (16 U.S.C. § 1456(c)(1)(C)), we have determined that the proposed action is consistent to the maximum extent practicable with the enforceable policies of the approved Coastal Zone Management Program of American Samoa. In accordance with 15 C.F.R. Parts 930.39 and 930.41, we request your concurrence within 60 days of receipt of this letter. If we do not receive your response within 60 days, we will presume concurrence.

Enclosed is the analysis supporting this determination. Please send any comments or direct inquiries to: Hoku Johnson, PIFSC Supervisory Natural Resource Management Specialist at the address above (telephone (808) 725-5323, electronic mail Hoku.Johnson@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

OFFICE OF PLANNING
STATE OF HAWAII

235 South Beretania Street, 6th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

DAVID Y. IGE
GOVERNOR

MARY ALICE EVANS
DIRECTOR
OFFICE OF PLANNING

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DTS201912261331HA

February 24, 2020

Michael P. Seki, Ph.D.
Director
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
1845 Wasp Blvd., Bldg. 176
Honolulu, Hawaii 96818

Attention: Ms. Hoku Johnson

Dear Dr. Seki:

Subject: Hawaii Coastal Zone Management Program Federal Consistency Review of National Marine Fisheries Service, Pacific Islands Fisheries Science Center, Fisheries and Ecosystem Research throughout the Pacific Islands Region, including the Hawaiian Archipelago

The Hawaii Coastal Zone Management (CZM) Program has completed the review of the National Marine Fisheries Service (NMFS), Pacific Islands Fisheries Science Center (PIFSC), federal consistency determination (dated December 16, 2019; received December 26, 2019) to conduct fisheries and ecosystem research throughout the Pacific Islands Region, including the Hawaiian Archipelago (proposed activity).

The Hawaii CZM Program conditionally concurs with the NMFS PIFSC determination that the proposed activity is consistent to the maximum extent practicable with the enforceable policies of the Hawaii CZM Program. The following conditions shall apply to all PIFSC supported fisheries and ecosystem research activities associated with the proposed activity.

1. The proposed monitoring and mitigation measures that are represented in the consistency determination (p. 2, December 16, 2019) and in section 2.3.1 Mitigation Measures for Protected Species, of the "Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center" (November 2019), which was submitted in support of the consistency determination, shall be fully implemented. This condition is necessary to ensure consistency with the Hawaii CZM Program coastal ecosystems policies established in HRS Chapter 205A, Coastal Zone Management, which is the federally approved enforceable policy that applies to this condition.

2. If any research activities involving the take of regulated organisms, the use of regulated gear, or activities within State of Hawaii regulated areas (as established in the CZM enforceable policies: Hawaii Administrative Rules Title 13 Department of Land and Natural Resources, Subtitle 4 Fisheries, Chapters 28 - 100; and HRS Chapter 188 Fishing Rights and Regulations) result in cumulative impacts to aquatic resources in state waters over the course of the research time period, then NMFS PIFSC shall consider modifications to minimize the cumulative impacts.

In addition, the Hawaii CZM Program solicited and received comments from the State Department of Land and Natural Resources, Division of Aquatic Resources (DAR), on the proposed activity. The DAR comments, which are enclosed, state support of Alternative 2 Preferred Alternative, while also providing important comments that should be considered by NMFS PIFSC. The DAR comments are relevant and important to the Hawaii CZM Program, and therefore, are being provided for your consideration.

If the requirements for conditional concurrences specified in 15 CFR § 930.4(a), (1) through (3), are not met, then all parties shall treat this conditional concurrence letter as an objection pursuant to 15 CFR Part 930, subpart C. This conditional concurrence does not represent an endorsement of the proposed activity nor does it convey approval with any other regulations administered by any state or county agency. Thank you for your cooperation in complying with the Hawaii CZM Program. If you have any questions, please call John Nakagawa of our CZM Program at 587-2878.

Sincerely,

Mary Alice Evans

Mary Alice Evans
Director

Enclosure

cc: Catherine Gewecke, DLNR Division of Aquatic Resources (by email, w/o enclosure)

DAVID Y. IGE
GOVERNOR OF
HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

Date: 2/6/2020
DAR # 6073

MEMORANDUM

TO: Brian J. Neilson
DAR Administrator

FROM: Catherine Gewecke, Bryan Ishida, Aquatic Biologist
Maria A Carnevale, PMNM Co-Manager

SUBJECT: Hawaii CZM Program Federal Consistency Review of NMFS PIFSC Fisheries and Ecosystem Research throughout the Hawaiian Archipelago

Request Submitted by: Coastal Zone Management - Office of Planning - State of Hawaii

Location of Project: Hawaiian Archipelago (MHI and NWHI)

Brief Description of Project:

The National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) is proposing to conduct fisheries and ecosystem research throughout the Pacific Islands Region including the Hawaiian Archipelago. PIFSC conducts a wide range of activities including resource surveys and stock assessments, fisheries monitoring, oceanographic research and monitoring, critical habitat evaluation, life history and ecology studies, advanced oceanographic and ecosystem modeling and simulations, and economic and sociological studies. These research activities are conducted using NOAA ships and charter vessels as research support platforms.

Comments:

☐ No Comments ☒ Comments Attached

Thank you for providing DAR the opportunity to review and comment on the proposed project. Should there be any changes to the project plan, DAR requests the opportunity to review and comment on those changes.

Comments Approved: [signature] Date: 2-7-2020

Brian J. Neilson
Acting DAR Administrator

DAR# 6073

Brief Description of Project

The National Marine Fisheries Service (NMFS) Pacific Islands Fisheries Science Center (PIFSC) is proposing to conduct fisheries and ecosystem research throughout the Pacific Islands Region including the Hawaiian Archipelago. PIFSC conducts a wide range of activities including resource surveys and stock assessments, fisheries monitoring, oceanographic research and monitoring, critical habitat evaluation, life history and ecology studies, advanced oceanographic and ecosystem modeling and simulations, and economic and sociological studies. These research activities are conducted using NOAA ships and charter vessels as research support platforms.

The purpose of these research activities is to improve NMFS understanding of ocean ecosystems and support National Oceanic and Atmospheric Administration's (NOAA) mission of science, service and stewardship. The PIFSC implements a multidisciplinary research strategy including scientific analysis and an ecosystem observation system to support an ecosystem-based approach to the conservation, management, and restoration of living marine resources.

The research activities are authorized by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. NMFS has conducted various aspects of this research for over 60 years and have included a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support management decisions by fisheries management organizations such as NMFS' Pacific Islands Regional Office, and the Western Pacific Regional Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals.

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Brief Description of Project

The types of surveys and methods to be conducted in State waters in Draft EA in Alternative 2 - Preferred Alternative - Conduct Federal Fisheries and Ecosystem Research (NEW SUITE OF RESEARCH) with Mitigation for MMPA and ESA Compliance, include the following:

1) Cetacean Ecology Assessment (Addition of Cobb midwater trawls, addition of eDNA water sampling, and increase from 90 to 180 days at sea (DAS) compared to Status Quo protocols). Survey transects conducted in conjunction with cetacean visual and acoustic surveys within the Hawai'i EEZ to develop ecosystem models for cetaceans. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.

Methods include: Passive Acoustics Calibration - Transmit sound (synthetic pings, dolphin whistles or echolocation clicks, etc.) to passive acoustic recording devices for purposes of in-situ calibration, Underwater sound playback system, Intermittent Stationary Passive Acoustic Recording - Placement of long-term acoustic listening devices for the purposes of recording cetacean occurrence and distribution, ambient and anthropogenic noise levels, and presence of other natural sounds. Passive Acoustic Monitoring - Deployment of passive acoustic monitoring devices in conjunction with other sampling measures, such as on fishing gear or free-floating, Continuous Passive Acoustic or Oceanographic Gliders - Autonomous underwater vehicles used for sub-surface profiling and other sampling over broad areas and long time periods, Seaglider; WaveGlider; or similar platform, AUV Continuous, Collection of eDNA samples.

2) Marine Debris Research and Removal (Expanded from Status Quo protocols to include net tows, UAS gear, and Structure-fromMotion surveys, and to include all research areas) Surface. Methods include: Surface and midwater plankton tows to quantify floating microplastic in seawater, use of UAS platforms to direct efforts to high density areas, collection and sieving of mesoplastics from beach sand located between the low and high tide lines. Plastics are removed for sampling and further study and Structure-from-Motion (SfM) surveys consist of marking off plots on the seafloor (1-3 m depth) with cable ties and/or stainless steel pins, collecting photographs of the plots and processing them using PhotoScan software to create dense point clouds, 3D models and spatially accurate photomosaic images.

3) Pacific RAMP (Ecosystem and oceanographic characterization surveys of coral reef ecosystems/Visual reef fish surveys/Mapping/Photo-mosaic): Expanded from Status Quo protocols to include EARs, water sampling devices, carbonate sensing instruments, UAS and

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Brief Description of Project

USVs, additional BMUs and CAUs deployments, collection of live rock, and additional DAS for reef fish surveys).

4) Insular fish Abundance Estimation Comparison Surveys : Comparison of Fishery-Independent Methods to Survey Bottomfish Assemblages in the MHI (Geographic scope expanded from HARA to include all research areas compared to Status Quo protocols, and addition of eDNA water sampling). Methods include: active acoustics, stereo baited underwater video camera systems (BotCam, MOUSS, BRUVS), autonomous underwater vehicle (AUV) equipped with stereo video cameras, towed optical assessment device (TOAD), and hook-and-line fishing.

5) Pelagic Troll and Handline Sampling. Surveys would be conducted to collect life history and molecular samples from pelagic species. Other target species would be taggedand-released. Different tags would be used depending upon the species and study, but could include: passive, archival, ultrasonic, and satellite tags. Fishery observers or NOAA scientists conduct on-board documentation of catch and survival.

6) West Hawai'i Integrated Ecosystem Assessment Cruise (Adds hook-and-line fishing component to Status Quo protocols). Survey transects conducted off the Kona coast and Kohala Shelf area to develop ecosystem models for coral reefs, socioeconomic indicators, circulation patterns, larval fish transport and settlement. Sampling includes active acoustics to determine relative biomass density of sound scattering layers; trawls to sample within the scattering layers; cetacean observations; surface and water column oceanographic measurements and water sample collection.

7) Sampling of Juvenile-stage Bottomfish via Settlement Traps. Sampling activity to capture juvenile recruits of eteline snappers and grouper that have recently transitioned from the pelagic to demersal habitat. The specimens will provide estimates of birth date, pelagic duration, settlement date, and pre-and post-recruitment growth rates derived from the analysis of otoliths. The target species include Deep-7 bottomfish and the settlement habitats these stages are associated with.

8) Fishing Impacts of Non-Target Species. Bycatch reduction research, post release survival and ecological research on sharks commonly encountered in recreational, commercial purse seine and longline fisheries in the Pacific Ocean. Research would include post-release survival studies

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Brief Description of Project

to identify and develop best handling methods in recreational, purse seine and longline fisheries for improved post-release survival rates and ensuring crew safety. The deployment and analysis of electronic tags would generate robust post-release survival estimates which would improve the rigor of stock assessments and aid in the development of best handling practices for fisheries impacting shark populations.

9) Bycatch Reduction in Longline Fisheries. Investigating additional methods to reduce bycatch and mitigate seabird and sea turtles interaction in Pacific fisheries including use of Tori-lines in the longline fisheries to reduce albatross bycatch, and investigating the use of novel de-hooking devices to dehook sea turtles caught as part of longline fishing.

Note: Some proposed activities conducted outside of State waters, > 3 nautical miles from shore, are not included in the list above; see pg. 79-83 of the draft EA for these additional activities conducted in federal or US territory waters.

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<u>Comments</u>

The actions, surveys and methods as proposed under Alternative 2 in the Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research conducted and funded by the PIFSC (Preferred Alternative - Conduct Federal Fisheries and Ecosystem Research with Mitigation for MMPA and ESA Compliance), appear generally consistent with previous survey and sampling techniques. Proposed expansions or modifications to surveys will benefit resource managers and researchers by providing more information to evaluate and make effective management decisions.

If the proposed research actions include regulated activities such the take of regulated organisms (freshwater or marine), the use of regulated gear, or activities conducted in regulated areas, (as outlined under Hawaii Administrative Rules Title 13 Department of Land and Natural Resources, Subtitle 4 Fisheries, Chapters 28-100 or 2013 Hawaii Revised Statutes Title 12. Conservation and Resources 188. Fishing Rights and Regulations), then either a Special Activity Permit (MHI) or a Papahanaumokuakea Marine National Monument Conservation and Management Permit (NWHI) will be required from the Division of Aquatic Resources.

DAR is supportive of Alternative 2 (Preferred Alternative), provided that any modifications necessary to minimize cumulative impacts to aquatic resources within state waters can be evaluated and/or implemented, during more detailed consultations for permits for any applicable regulated activities, in the future.

State permits for any of the proposed activities that have regulated components are generally issued on an annual basis, after evaluation of the proposed activities for each location each year.

In addition to adhering to General and Special conditions, including Best Management Practices (BMPs) required as part of the Papahanaumokuakea Marine National Monument Permit authorizations for activities within the NWHI Marine Refuge, DAR may request minimization measures in the MHI that address concerns including, but not limited to, the following:

1) Aquatic Invasive Species (AIS) mitigation plans.

2) Minimizing disease/parasites/AIS movement through gear, supplies and activities of the researchers.

3) Minimizing incidental harm to surrounding environment through collection activities.

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4) Ensuring collection activities are distributed across shoreline/reef flat/benthic areas, to not consolidate the impacts of collection in one location.

5) Limitations on the sizes, amounts, species or collection locations of coral colony/fragment or other marine organism sampling; exceptions can be provided, subject to review and approval by the Division.

6) Return of coral or organisms to the marine environment with a protocol for adhering loose corals (if applicable, after observations are made for disease/parasites/AIS that may have colonized while in aquarium captivity).

7) Voluntary sampling moratorium or mandatory sampling moratoriums, for certain organisms during times of ecosystem pressure caused by natural or anthropogenic stressors. Example of ecosystem pressure may include coral bleaching events.

8) Sampling restrictions during coral bleaching events (depth of sampling, species, collection location, etc.).

9) Coral core collection and post-monitoring.

10) Use of gear and equipment.

11) Minimizing the incidental take of coral or live rock through the deployment of monitoring equipment or marine instruments; retrieval of concrete blocks, weights and equipment/instruments at as many locations as possible; return of benthic organisms that are recovered after the equipment/marine instruments are raised.

12) Entanglement Prevention; minimizing the amount of structures or components that may potentially cause entanglement during research operations. Notification to DAR and the appropriate federal agency to report the entanglement of any protected species if incidental entanglement occurs.

13) Attendance of regulated gear or nets at all times (if possible) or inspection or retrieval of regulated gear, nets or traps at regular intervals, to remove the target organisms for sampling and to return all incidental bycatch (non-target spp.) immediately to the ocean; exceptions can be provided, subject to review and approval by the Division.

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14. Ensuring that all new (preferred alternative) protected species training activities are conducted prior to field events.

15. Documentation of the loss of all fishing gear including type, location, time, and size. In the event that lost gear poses a significant human and/or ecosystem threat, contact DAR immediately.

16. Implementing steps to minimize all significant depredation loss during bottomfishing surveys to minimize over-sampling (e.g. moving to new locations if significant depredation loss occurs during sampling period). Recording all loss due to depredation including location, species consumed, and predator species (general ID can be made if species cannot be determined).

In addition to these general comments, DAR has specific technical edits and additions for the draft document which will be provided directly to the NOAA/PIFSC document preparers. Thank you for providing DAR the opportunity to review and comment as part of the Hawaii CZM Program Federal Consistency Review of NMFS PIFSC Fisheries and Ecosystem Research throughout the Hawaiian Archipelago. DAR looks forward to receiving the final EA and working with your agency regarding these activities as appropriate.

Lourdes A. Leon Guerrero
Governor of Guam

Joshua F. Tenorio
Lieutenant Governor

BUREAU OF STATISTICS & PLANS
SAGAN PLANU SIHA YAN EMFOTMASION
Government of Guam
P.O. Box 2950 Hagåtña, Guam 96932
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Tyrone J. Taitano
Director
Matthew Santos
Deputy Director

FEB 2 1 2020

Michael P. Seki, Ph.D.
Director
Pacific Island Fisheries Science Center
National Marine Fisheries Service
U.S. Department of Commerce
1845 Wasp Blvd. Bldg. 176
Honolulu, Hawaii 96818

RE: Coastal Zone Management Act (CZMA) Federal Consistency Review for Pacific Island Fisheries Science Center's proposed fisheries and ecosystem research throughout the Pacific Islands Region including the Mariana Archipelago *(GCMP FC No. 2019-0024)*

Hafa adai! The Guam Coastal Management Program of the Bureau of Statistics and Plans (Bureau) has completed its review of the Federal Consistency Determination by the Pacific Island Fisheries Science Center received in December 23, 2019. The Pacific Island Fisheries Science Center ("the federal agency") has submitted its consistency determination relative to the proposed fisheries and ecosystem research throughout the Pacific Islands Region including the Mariana Archipelago.

The Bureau coordinated this review with partnering agencies, provided Public Notice, and received comments from the Department of Land Management and the State Historic Preservation Officer of the Department of Parks and Recreation. Furthermore, the Bureau hereby concurs with the federal agency's determination that the proposal is consistent with the enforceable policies of the Bureau's Guam Coastal Management Program (GCMP) and will be conducted in a manner consistent with the program. Our consistency concurrence, however, does not preclude the need for securing other federal and Government of Guam permits, clearances and approvals prior to the start of this project.

The proposed action shall be operated and completed as represented in the Coastal Zone Management (CZM) federal consistency determination. Significant changes to the subject proposal shall be submitted to the Bureau for review and approval and may require a full CZM federal consistency review, including publication of a public notice and provision for public review and comment. This condition is necessary to ensure that the proposed actions are implemented as reviewed for consistency with the enforceable policies of GCMP. Guam Land Use policies (E.O. 78-37), are the federally approved enforceable policies of GCMP that applies to this condition.

Please do not hesitate to contact Mr. Julian Janssen, Federal Consistency Coordinator at 475-9664 or email julian.janssen@bsp.guam.gov or Mr. Edwin Reyes, Coastal Program Administrator at 475-9672 or email edwin.reyes@bsp.guam.gov. *Si Yu'os Ma'åse'.*

Sincerely,

TYRONE J. TAITANO
Director

Cc: DoAg-DAWR
DLM
DPR-SHPO
DPW
GEPA
GWA
NOAA-OCM

Commonwealth of the Northern Mariana Islands
OFFICE OF THE GOVERNOR
Bureau of Environmental and Coastal Quality
Division of Coastal Resources Management
P.O. Box 501304, Saipan, MP 96950
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www.dcrm.gov.mp

Eli D. Cabrera
Administrator

Janice E. Castro
Director, DCRM

January 29, 2020

Mr. Michael Seki
Director, Pacific Island Fisheries Science Center
National Marine Fisheries Service, Pacific Islands Region
1845 Wasp Blvd., Bldg. 176
Honolulu, Hawaii 96818

Re: Federal Consistency Determination for the draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by Pacific Island Fisheries Science Center

Dear Mr. Seki,

The Commonwealth of the Northern Mariana Islands (CNMI) Division of Coastal Resources Management (DCRM) has reviewed the request for a consistency determination of the draft Programmatic Environmental Assessment (DPEA) for Fisheries and Ecosystem Research Conducted and Funded by Pacific Island Fisheries Science Center (PIFSC). The proposed actions are in accordance with federal consistency regulations 15 C.F.R. Part 930, as well as various federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. The DPEA outlines various proposed research activities and mitigation measures for potential adverse effects throughout the Marianas Archipelago addressing trawl surveys, longline gear, small boat and diver operations, marine debris removal, and other activities.

Based on the project details, DCRM concurs that the proposed action will be performed in a manner that is consistent with the enforceable policies of the CNMI's coastal management program. Should you have any questions or require further information, please contact (670) 664-8308 or fedcon@dcrm.gov.mp.

Sincerely,

JANICE E. CASTRO
Director
Division of Coastal Resources Management

cc: Hoku Johnson, PIFSC Supervisory Natural Resource Management Specialist

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National Marine Sanctuaries Act Consultation

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
National Ocean Service
Office of National Marine Sanctuaries

Pacific Islands Region
726 S. Kihei Rd. | NOAA/DKIRC/NOS/PIR
Kihei, HI 96799 | 1845 Wasp Blvdl, Bldg 176
Honolulu, HI 96818
http://sanctuaries.noaa.gov/about/pacific.html

Date: August 30, 2016

MEMORANDUM FOR: Michael P. Seki, PhD
Director
NOAA Pacific Islands Fisheries Center

FROM: Allen Tom
Regional Director
NOAA Office of National Marine Sanctuaries

SUBJECT: National Marine Sanctuaries Act Section 304 (d) Recommended Alternatives on the *Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center, November 2015*

I. INTRODUCTION:

Thank you for requesting initiation of the national marine sanctuary consultation process pursuant to section 304(d) of the National Marine Sanctuaries Act (NMSA; letter dated March 3, 2016). The Office of National Marine Sanctuaries (ONMS) has reviewed the *Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center (PIFSC), November 2015* (DPEA). PIFSC activities, as proposed, would take place in two national marine sanctuaries in the Pacific Islands Region (PIR): Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) and National Marine Sanctuary of American Samoa (NMSAS).[1]

NMSA 304(d) consultation is required for federal actions that are "likely to destroy, cause loss or, or injure a sanctuary resource". The PIR concurs that the research and fisheries actions proposed to be conducted by PIFSC are likely to injure sanctuary resources. Accordingly, through this memorandum, ONMS is providing PIFSC with five total recommended alternatives, two for HIHWNMS and three for NMSAS, which may protect sanctuary resources.

[1] As noted in our sufficiency letter (letter dated July 18, 2016), if the proposed PIFSC actions may impact objects protected by Papahānaumokuākea Marine National Monument (PMNM) (see Presidential Proclamation 8031 (June 15, 2006)), comments from PMNM on the DPEA may be submitted to you separate and apart from this consultation under the NMSA; therefore, PMNM is not included in this memorandum.

II. BACKGROUND:

Staffs at both HIHWNMS and NMSAS are familiar with PIFSC research surveys and cruises and the use of these findings and reports on ecosystem status and trends are extremely useful for ONMS. ONMS recognizes the significant contributions that PIFSC research activities make to further our understanding of ONMS sites in the Pacific. Accordingly, it is not ONMS's intention to impede PIFSC's research efforts; instead we would like to encourage PIFSC to continue to collaborate with ONMS on research projects that can meet both ONMS's and NMFS's scientific needs and mandates. We are, however, obligated by the NMSA to ensure that PIFSC research activities (as with all other federal agencies) minimize impacts to the sanctuary resources that ONMS is tasked to protect. Therefore, the recommended alternatives below are offered in the spirit of collaboration and enhanced communication to address both ONMS's and PIFSC's concerns about operational efficiency and scientific integrity.

An analysis of PIFSC activities that may injure sanctuary resources and accompanying recommended alternatives is organized by site, which have different federal mandates for protection.

III. PIFSC ACTIVITIES ANALYSIS AND RECOMMENDED ALTERNATIVES BY SITE

A. Analysis of PIFSC Activities Affecting HIHWNMS Resources:

HIHWNMS would like to share some observations about how PIFSC's activities may impact sanctuary resources, as well as enhance the understanding of those resources. HIHWNMS believes that, based on the specifications presented in the DPEA and with subsequent clarifying conversations with PIFSC, the proposed mitigation will adequately address the site's interest in eliminating or minimizing acoustic, entanglement, and collision-related injuries to humpback whales within the sanctuary; however, we are putting forth two recommended alternatives in order to further our awareness of and the protection of humpback whales in the sanctuary. First, we ask that PIFSC notify HIHWNMS in the event of certain incidents. Second, we highly encourage PIFSC to implement additional best management practices for the operation of several of its research projects within the sanctuary (listed below). While acknowledging PIFSC's request for the take of two animals across all operating fields as entanglement-related take resulting from the DPEA's proposed activities, we highly encourage fastidious vigilance to prevent this situation.

B. Recommended Alternatives for HIHWNMS:

(1) Record and notify ONMS about:

a. Any "close calls" or near miss incidents of vessel collision or entanglement with a humpback whale;

b. The deployment of unattended and/or moored gear (including buoys and autonomous underwater vehicles) within and adjacent to the sanctuary from November to April;

c. Instances of missing, deployed, or unattended gear within and adjacent to the sanctuary; and

d. The use of active acoustic equipment that generates noise in the 22 kilohertz or lower range.

(2) For all PIFSC operations within the sanctuary, follow safe and best management practices for: vessel operations; interactions with humpback whales; use of unmanned aircraft systems; and unattended gear deployment.

a. For vessel operations:

i. Follow *SOP 9-18-09: ONMS Standing Orders for Operations Around Marine Mammals* (attached as an appendix);

ii. Use vessels with inbound motors or prop guards on vessels with outboard motors; and

iii. Report all marine animals observed in distress to the appropriate hotline for the animal when observed, including distresses not related to PIFSC's activities.

b. For interactions with humpback whales:

i. Establish monitoring protocols and procedures for humpback whales that are tagged, including but not limited to, assessments of animal health that monitor the healing of animals with lacerations that result from biopsy and penetrating tag research.

c. For unmanned aircraft systems:

i. Comply with NOAA policy, *UAS 220-1-5: Unmanned Aircraft Systems (UAS) Operations* (or the current, equivalent version), for the use of any unmanned aircraft systems (attached as an appendix).

d. For unattended gear deployment:

i. Evaluate options to design unattended gear that is "whale safe" by including features such as weak links, timed releases, and monitoring via telemetry.

C. Analysis of PIFSC Activities Affecting NMSAS Resources:

Section 4.2 of the draft programmatic environmental assessment (DPEA) summarizes the impacts to national marine sanctuary (NMS) resources anticipated by the Pacific Islands Fisheries Science Center (PIFSC). According to this section, the primary effects are potential adverse interactions with protected species and the risk of accidental spills or contamination from vessel operations. Impacts to benthic habitats are minimized as mobile bottom-contact survey equipment is not used; however stationary equipment (cameras and acoustic arrays) may impact benthic habitats. Moreover, the DPEA states that extractive sampling of fish or invertebrates from the water column will not occur within sanctuary boundaries. Two of the NMSAS management units, Fagatele Bay and the Aunu'u Research Zone, have restrictions on taking fish and these units are used as reference sites for comparison to adjacent units where takes are allowed. We emphasize the need to avoid extractive sampling within these units. Site selection for the Pacific reef assessments and monitoring program (RAMP) surveys is random and could potentially include areas within NMSAS boundaries. These surveys are primarily visual encounters; however extractive sampling of corals may occur. According to the DPEA, PIFSC anticipates that they might use near-surface and mid-water trawl gear, as well as other plankton nets and water sampling equipment within sanctuary boundaries, with the degree of impact consistent with that reported for individual species in the environmental effects section.

All survey activities have the potential for adverse interactions with protected species, especially marine mammals, through disturbance or incidental take; however, these impacts will be minimized by the mitigation measures for protected species outlined in section 2.3.1 which include gear modification, personnel training, and operational procedures, such as leaving an area during active fishing efforts if marine mammals are spotted. While an accidental spill may still occur, the likelihood of this is minimized through adherence to the International Convention for the Prevention of Pollution from Ships, 1973 (modified in 1978).

D. Recommended Alternatives for NMSAS:

Based on the information contained in the DPEA and its appendices, Table 1 provided below lists the surveys proposed as part of the preferred alternative that are likely to injure NMSAS resources if they are conducted within the sanctuary. In general, we concur with PIFSC that the impacts to NMSAS will be minimal, especially given the mitigation procedures noted in the aforementioned analysis. To better understand the potential impacts of PIFSC research on NMSAS resources, ONMS recommends that PIFSC:

(1) Record and report annually to ONMS the actual biomass removal for all fish and invertebrate species taken at sampling stations within the sanctuary management areas. In addition, record and report annually any interactions with marine mammals, sea turtles, sea birds, and historic and cultural resources.

(2) Test and calibrate less invasive sampling methodologies for all PIFSC research activities to eventually transition to non-extractive sampling methods, whenever possible, within sanctuary management areas.

(3) Do not conduct the insular fish life history survey and studies within Fagatele Bay and the Aunu'u Research Zone.

Table 1. This table summarizes the surveys identified in the preferred alternative of the *Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center* (November 2015) that have the potential to injure National Marine Sanctuary of American Samoa resources, and the recommended alternatives to minimize those impacts (Note: The numbers under "Recommended Alternatives" correspond to the actions identified above).

Survey	Potential Impacts	Sanctuary Areas Potentially Impacted	Recommended Alternatives
Sampling pelagic stages of insular fish species (3-200 nautical miles (nm) from shore)	• Takes of juvenile pelagic stage snapper, grouper, and coral reef fish • Disturbance from vessel traffic • Potential for injury /mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill	Muliava	1, 2
Spawning dynamics of highly migratory species (1-5 nm from shore)	• Egg and larvae collections from surface waters • Disturbance from vessel traffic • Potential for injury/mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill	Aunu'u, Ta'u, Swains Island, Muliava	1, 2
Cetacean ecology	• Vessel traffic in conjunction with visual and acoustic surveys • Potential for injury/mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Small amount of sound transmission for calibration purposes • Potential for contaminant spill	All	1
Coral reef benthic mapping	• Disturbance from vessel traffic • Potential for injury/mortality from interaction with research	All	1

	gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill		
Deep coral and sponge research	• Collection of coral and sponge samples for genetics, growth, and reproductive work • Disturbance from vessel traffic • Potential for injury/mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill	All	1, 2
Insular fish life history survey and studies	• Specimens of bottom fish collected for sex-specific growth curves, longevity, and age at reproductive maturity • Disturbance from vessel traffic • Potential for injury/mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill	All	1, 2, 3
Pacific reef assessment and monitoring program (RAMP)	• Disturbance from small boats/snorkel/tow board/divers • Small amount of specimen collection • Disturbance from vessel traffic • Potential for injury/mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill	All	1, 2
Insular fish abundance estimation comparison surveys	• Biological disturbance from baited underwater camera systems • Physical disturbance of bottom habitat from housing frames • Disturbance from vessel traffic	All	1

	• Potential for injury/mortality from interaction with research gear/vessel strike (marine mammals and turtles) • Potential for contaminant spill	

IV. CONCLUSION:

ONMS sincerely appreciates PIFSC's efforts to engage in national marine sanctuary consultation pursuant to NMSA section 304(d). Accordingly, we encourage PIFSC to discuss these recommended alternatives with ONMS. Next, PIFSC should provide ONMS with a written statement letting us know the extent to which the aforementioned recommended alternatives have been accepted or declined, in whole or part, and an accompanying rationale to explain those decisions. ONMS welcomes an opportunity to discuss and assist PIFSC in the incorporation of these recommended alternatives into its plans.

Furthermore, PIFSC should reinitiate sanctuary consultation with ONMS if, at a minimum:

(1) The nature or scope of PIFSC's actions are subsequently modified in a manner that would then trigger NMSA 304(d) consultation;

(2) New information reveals that the effects to sanctuary resources are different in a manner or to an extent that were not previously considered; or

(3) Changes occur to the environment in which PIFSC activities occur.

Lastly, the five recommended alternatives provided in this memorandum are intended to further protect and better inform ONMS about sanctuary resources. Regardless, neither initiating this consultation, nor PIFSC's acceptance, in whole or part, of any or all of the above recommended alternatives preclude the need for an ONMS permits should PIFSC engage in any activity that is otherwise prohibited by sanctuary regulations. Please reach out to HIHWNMS and NMSAS prior to conducting any activity within sanctuary boundaries in order to ascertain individual permit requirements at 15 C.F.R. pt. 922 or under other applicable laws and regulations.

Please feel free to contact me at 808-879-2919 ext. 225 or Allen.Tom@noaa.gov with any questions. Again, I thank you for the opportunity to work with you on this consultation.

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 • Honolulu, Hawaii 96818
(808) 725-5300

November 3, 2016

MEMORANDUM TO: John Armor, Director, Office of National Marine Sanctuaries
Allen Tom, Pacific Islands Regional Director, Office of National Marine Sanctuaries

FROM: Michael P. Seki, Ph.D., Director
NMFS Pacific Islands Fisheries Science Center

SUBJECT: Response to ONMS recommended alternatives for research conducted within national marine sanctuaries by the Pacific Islands Fisheries Science Center

This letter responds to a memorandum dated August 30, 2016 sent by the Office of National Marine Sanctuaries (ONMS) to the Pacific Islands Fisheries Science Center (PIFSC) as part of the National Marine Sanctuaries Act (NMSA) 304(d) consultation process initiated by PIFSC on March 3, 2016. This consultation was initiated for the draft Programmatic Environmental Assessment (PEA) for Fisheries and Ecosystem Research Conducted and Funded by PIFSC. The consultation process was initiated pursuant to the provisions of section 304(d) of the National Marine Sanctuaries Act (NMSA) that require interagency consultation between ONMS and federal agencies taking actions that are "likely to destroy, cause the loss of, or injure a sanctuary resource."

The NMSA (16 U.S.C. 1431) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archaeological, educational, or esthetic qualities as national marine sanctuaries. The primary objective is to protect marine resources, including coral reefs, sunken historical vessels and unique habitats.

The NMSA requires that agencies conducting actions that would be likely to injure any sanctuary resource initiate consultation with ONMS through the submission of a sanctuary resource statement. On March 3, 2016 PIFSC submitted its draft programmatic environmental assessment (DPEA) as the sanctuary resource statement describing the proposed research activities and their potential effects on sanctuary resources. On July 18, 2016 ONMS responded to PIFSC with a letter of sufficiency that stated the ONMS Pacific Islands Regional office found that the information contained in the PIFSC sanctuary resource statement was sufficient to evaluate the likelihood that the actions would destroy, cause the loss of, or injure sanctuary resources, and to develop any necessary reasonable and prudent alternatives to the action described in the resource statement. On August 30, the Office of National Marine Sanctuaries provided five recommended alternatives to PIFSC which contain (1) additional mitigation measures to implement when working within sanctuary boundaries, or conducting research activities outside sanctuary boundaries that may affect resources within those boundaries (e.g. acoustic research); (2) recommended areas to avoid when conducting fisheries life history research within the National Marine Sanctuary of American Samoa; and (3) reporting and notification procedures to follow when conducting research within sanctuary boundaries.

As outlined in Attachment 1, most of ONMS' recommended alternatives will be incorporated into the final PEA; PIFSC will also investigate the implementation of other recommended alternatives against PIFSC's operational mission to better understand their feasibility and their impact on the overall scientific mission. Additionally, some of the recommended alternatives are already part of PIFSC standard operating procedures and will be included as mitigation in the PEA.

PIFSC will continue to obtain sanctuary permits as appropriate for research conducted within national marine sanctuaries. Additionally, PIFSC will reinitiate sanctuary consultation with ONMS if (1) the nature or scope of PIFSC's actions are subsequently modified in a manner that would then trigger NMSA 304(d) consultation; (2) new information reveals that the effects to sanctuary resources are different in a manner or to an extent that were not previously considered; or (3) changes occur to the environment in which PIFSC activities occur.

Please feel free to contact Ms. Hoku Johnson of my staff at (808) 725-5323 or hoku.johnson@noaa.gov if you have any questions. Thank you for working with PIFSC on this consultation.

Attachment 1: PIFSC Response to ONMS Recommended Alternatives

Recommended Alternatives for the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS)	
ONMS Recommended Alternatives	**PIFSC Response**
(1) Record and notify ONMS about: a. Any "close calls" or near miss incidents of vessel collision or entanglement with a humpback whale; b. The deployment of unattended and/or moored gear (including buoys and autonomous underwater vehicles) within and adjacent to the sanctuary from November to April; c. Instances of missing, deployed, or unattended gear within and adjacent to the sanctuary; and d. The use of active acoustic equipment that generates noise in the 22 kilohertz or lower range.	PIFSC will record and notify ONMS about any close calls or near miss incidents of vessel collision or entanglement with a humpback whale, deployment of or any missing unattended and/or moored gear within/adjacent to the sanctuary and the use of active acoustic information that generates noise in the 22 kHz or lower range.
(2) For all PIFSC operations within the sanctuary, follow safe and best management practices for: vessel operations; interactions with humpback whales; use of unmanned aircraft systems; and unattended gear deployment.	
a. For vessel operations: i. Follow SOP 9-18-09: ONMS Standing Orders for Operations Around Marine Mammals.	Section 2.2.1.5 ("Small Boat and Diver Operations") in the Programmatic Environmental Assessment (PEA) discusses PIFSC best management practices (BMPs) for operating small boats. These BMP's are more restrictive than those discussed in the ONMS Standing Orders, including the following: • Vessel operators shall alter their course to remain at least 100 meters (m) from marine mammals and at least 50 m from sea turtles; • Reduce vessel speed to 10 km or less when piloting vessels in the proximity of marine mammals; • Unless specifically covered under a separate permit that allows activity in proximity to protected species, all in-water work will be postponed until whales are within 100 yards or other protected species are within 50 yards. Activity will commence only after the animal(s) depart the area; and • Constant vigilance shall be kept for the presence of protected species.

	In addition to vessel operations, when conducting midwater trawl operations (described on p. 2-13 of PEA), if marine mammals are sighted anywhere around the vessel in the 30 minutes before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear at the discretion of the officer on watch in consultation with the Chief Scientist.
i. Use vessels with inboard motors or prop guards on vessels with outboard motors	PIFSC will investigate the installation of propeller guards on vessels with outboard motors.
i. Report all marine animals observed in distress to the appropriate hotline for the animal when observed, including distresses not related to PIFSC's activities.	PIFSC will continue to contact the regional stranding response hotline at 1-888-256-9840 if any marine mammals are observed in distress, including those in distress not related to PIFSC research activities.
a. For interactions with humpback whales: ii. Establish monitoring protocols and procedures for humpback wales that are tagged, including but not limited to, assessments of animal health that monitor the healing of animals with lacerations that result from biopsy and penetrating tag research.	While this PEA covers passive acoustic research on cetaceans (e.g. hydrophones and High frequency Acoustic Recording Packages (HARPs)), it does not cover tagging or biopsy sampling on any protected species. The cetacean research program has a separate Endangered Species Act / Marine Mammal Protection Act Permit (#15240) and PEA that covers all tagging and biopsy research on cetaceans: (https://www.pifsc.noaa.gov/nepa/permit_15240_ea_cetacean_research_program.pdf). This permit expires in May, 2017 and PIFSC recently submitted a renewal application for this research (Application #20311).
a. For unmanned aircraft systems: iii. Comply with NOAA policy, UAS 220-1-5: Unmanned Aircraft Systems (UAS) Operations (or the current, equivalent version), for the use of any unmanned aircraft systems.	As part of its standard operating procedures, PIFSC currently complies with the aforementioned NOAA UAS policy and will specifically reference it in the PEA.
a. For unattended gear deployment: iv. Evaluate options to design unattended gear that is "whale safe" by including features such as weak links, timed releases, and monitoring via telemetry.	PIFSC is currently implementing some "whale safe" options for unattended gear including those described in section 2.3.1.1 in the PEA where personnel would alter the ratio of sinking and floating lines for deployed gear to reduce the risk of entanglements for all marine mammals and sea turtles in lines at the surface of the

	water. PIFSC also uses timed releases in its bottomfish survey research conducted directly off NOAA ships to minimize the time that unattended gear is left in the water. PIFSC will continue to evaluate design options for all of its gear and investigate the feasibility of including weak links and monitoring via telemetry.
Recommended Alternatives for the National Marine Sanctuary of American Samoa (NMSAS)	
ONMS Recommended Alternatives	**PIFSC Response**
(1) Record and report annually to ONMS the actual biomass removal for all fish and invertebrate species taken at sampling stations within the sanctuary management areas. In addition, record and report annually any interactions with marine mammals, sea turtles, sea birds, and historic and cultural resources.	PIFSC will submit an annual report to ONMS for all activities conducted within the boundaries of the NMSAS including the biomass removal of all fish and invertebrate species and any interactions with protected species, seabirds and historic and cultural resources.
(2) Test and calibrate less invasive sampling methodologies for all PIFSC research activities to eventually transition to non-extractive sampling methods, whenever possible, within sanctuary management areas.	PIFSC will continue to evaluate less invasive sampling methodologies for its research activities and the feasibility of implementing these while working within sanctuary management areas.
(3) Do not conduct the insular life history survey and studies within Fagatele Bay and the Aunuʻu Research Zone.	PIFSC does not conduct the insular life history survey within the Fagatele Bay and Aunuʻu Research Zones and has no plans to do so in the future.

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National Historic Preservation Act Consultation

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawaiʻi 96818
(808) 725-5300

November 1, 2021

Dr. Alan Downer
Administrator, State Historic Preservation Division
Kakuhihewa Building
601 Kamokila Blvd., Room 555
Kapolei, HI 96707

Dear Dr. Downer:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

<u>Background</u>
The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawaiʻi, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of

finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

Consultation History

In a April 2014 letter, PIFSC initiated coordination and consultation with the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (list enclosed) providing notification of our intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC.

In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawai‘i Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai‘i State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

Proposed Action and Best Management Practices (BMPs)

The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

Marine debris removal would be conducted along the shoreline up to the highest wash of the waves and to a depth of 30 m. Marine debris removal consists of surveys to (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear or “DFG”) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. The removal efforts are focused on DFG, which poses a potential entanglement risk to wildlife (e.g., endangered Hawaiian monk seals, cetaceans and sea turtles), and plastics. Team members would systematically survey the shoreline and reefs by walking below the highest wash of the waves and conducting swim surveys and towed diver surveys to locate submerged DFG in shallow water. Nets would be evaluated before removal actions to determine appropriate removal strategies and BMPs would be in place to avoid areas with known historic properties. Other research activities would be conducted offshore, away from known historic properties, and would involve diving, fishing, towing nets and mapping the seafloor.

The following BMPs would be carried out during marine debris removal activities to avoid impacts to historic properties.

- While in-water:
  - All DFG would be evaluated by divers before any removal activities take place.
  - During this evaluation, divers would look for historic properties that may be in the immediate vicinity (e.g., ship wrecks, fish ponds). If a potential historic property is located but is not attached to any DFG, the site would be avoided. If a potential historic property is located and it is attached to DFG then the DFG is treated as stable, a GPS location would be recorded and the appropriate historic preservation office would be notified. PIFSC would consult with the appropriate historic preservation office on DFG located on an historic property to determine the best way to remove entanglement hazards without affecting the site.

- Along the shoreline:
  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
  - DFG that is buried is often located under a surface layer of sand. Subsurface DFG can typically be removed by brushing off sand, lifting it from the shoreline and loading it into a small boat for proper disposal. If buried DFG is located and deep digging is required to remove it, the DFG would be left in place in order to avoid potential effects to historic properties.

<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

<u>Steps taken to identify historic properties</u>
In order to identify historic properties in the APE, PIFSC personnel reviewed the Nominated and Listed Properties on the Hawaiʻi and National Registers of Historic Places list,[1] the inventory and

[1] https://dlnr.hawaii.gov/shpd/files/2021/07/HistoricRegisters_26July021.xls

assessment of submerged cultural resources in Hawaii,[2] and an inventory of U.S. Navy Shipwrecks in Hawaiian Waters.[3] A number of fishponds, traditional fishing locations, one beach midden site, coastal national parks and archaeological complexes, a number of ships, vehicles, and plane wreck sites, and the islands of Nihoa and Mokumanamana (Necker Island) were identified in the general APE. In addition, two letters (discussed above) were sent to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties requesting assistance with identifying additional historic properties; no new historic properties were identified.

Determination

As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC’s activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

1. Map of PIFSC Research Areas
2. PIFSC Marine Debris Removal Protocols
3. Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center, October 2021. Electronic copy available at: https://media.fisheries.noaa.gov/2021-10/Draft-PEA-Oct-2021-PIFSC.pdf
4. List of interested parties and historic preservation offices sent consultation letters in 2014 and 2015

[2] https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/2017-021.pdf

[3] https://www.history.navy.mil/content/dam/nhhc/research/underwater-archaeology/PDF/UA_ResourcesMgt.pdf

[4] PIFSC marine debris survey and removal has occurred in Hawai‘i since 1996 and PIFSC (formerly known as the Honolulu Laboratory of the Southwest Fisheries Science Center) has conducted in-water research since 1957).

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
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(808) 725-5300

November 2, 2021

Letitia Peau
Executive Offices of the Governor
American Samoa Government Historic Preservation Office
Pago Pago, AS 96799

Dear Ms. Peau:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned

fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

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- Along the shoreline:
  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
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<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

<u>Steps taken to identify historic properties</u>
In order to identify historic properties in the APE, PIFSC personnel reviewed the Nominated and Listed Properties on the Hawai‘i and National Registers of Historic Places list,[1] the inventory and assessment of submerged cultural resources in Hawaii,[2] and an inventory of U.S. Navy

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[1] https://dlnr.hawaii.gov/shpd/files/2021/07/HistoricRegisters_26July021.xls

[2] https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/2017-021.pdf

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Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures
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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 2, 2021

Rita Chong-Dela Cruz
State Historic Preservation Officer
Dept. of Community and Cultural Affairs
P.O. Box 50090 CK
Airport Road
Saipan, MP 96950

Dear Ms. Chong-Dela Cruz:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

Background

The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

Consultation History

In a April 2014 letter, PIFSC initiated coordination and consultation with the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (list enclosed) providing notification of our intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC.

In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawai‘i Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai‘i State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

Proposed Action and Best Management Practices (BMPs)

The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

Marine debris removal would be conducted along the shoreline up to the highest wash of the waves and to a depth of 30 m. Marine debris removal consists of surveys to (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear or “DFG”) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. The removal efforts are focused on DFG, which poses a potential entanglement risk to wildlife (e.g., endangered Hawaiian monk seals, cetaceans and sea turtles), and plastics. Team members would systematically survey the shoreline and reefs by walking below the highest wash of the waves and conducting swim surveys and towed diver surveys to locate submerged DFG in shallow water. Nets would be evaluated before removal actions to determine appropriate removal strategies and BMPs would be in place to avoid areas with known historic properties. Other research activities would be conducted offshore, away from known historic properties, and would involve diving, fishing, towing nets and mapping the seafloor.

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  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
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<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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November 2, 2021

Patrick Lujan
Guam State Historic Preservation Officer
490 Chalan Palasyo
Agana Heights, Guam 96910

Dear Mr. Lujan:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 1, 2021

Mr. Hailama Farden
President
Association of Hawaiian Civic Clubs
P.O. Box 1135
Honolulu, HI 96807

Dear Mr. Farden:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
  - DFG that is buried is often located under a surface layer of sand. Subsurface DFG can typically be removed by brushing off sand, lifting it from the shoreline and loading it into a small boat for proper disposal. If buried DFG is located and deep digging is required to remove it, the DFG would be left in place in order to avoid potential effects to historic properties.

The Area of Potential Effect (APE)

The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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Determination

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Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

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NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawaiʻi 96818
(808) 725-5300

November 1, 2021

Mr. Kanekoa Kukea-Shultz
Executive Director
Kakoʻo Oiwi
46-005 Kawa Street #104
Kaneohe, HI 96744

Dear Mr. Kukea-Shultz:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

<u>Background</u>
The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawaiʻi, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of

finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

Consultation History

In a April 2014 letter, PIFSC initiated coordination and consultation with the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (list enclosed) providing notification of our intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC.

In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawai‘i Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai‘i State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

Proposed Action and Best Management Practices (BMPs)

The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

Marine debris removal would be conducted along the shoreline up to the highest wash of the waves and to a depth of 30 m. Marine debris removal consists of surveys to (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear or “DFG”) in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. The removal efforts are focused on DFG, which poses a potential entanglement risk to wildlife (e.g., endangered Hawaiian monk seals, cetaceans and sea turtles), and plastics. Team members would systematically survey the shoreline and reefs by walking below the highest wash of the waves and conducting swim surveys and towed diver surveys to locate submerged DFG in shallow water. Nets would be evaluated before removal actions to determine appropriate removal strategies and BMPs would be in place to avoid areas with known historic properties. Other research activities would be conducted offshore, away from known historic properties, and would involve diving, fishing, towing nets and mapping the seafloor.

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November 1, 2021

Mr. Dwight Victor
President
Kalaeloa Heritage and Legacy Foundation
P.O. Box 75447
Kapolei, HI 96707

Dear Mr. Victor:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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November 1, 2021

Ms. Leimomi Khan
President
Kalihi Palama Hawaiian Civic Club
c/o 1288 Kapiolani Blvd. Unit 1905
Honolulu, HI 96814

Dear Ms. Khan:

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Proposed Action and Best Management Practices (BMPs)

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- Along the shoreline:
  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
  - DFG that is buried is often located under a surface layer of sand. Subsurface DFG can typically be removed by brushing off sand, lifting it from the shoreline and loading it into a small boat for proper disposal. If buried DFG is located and deep digging is required to remove it, the DFG would be left in place in order to avoid potential effects to historic properties.

<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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Determination

As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC's activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures
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2. PIFSC Marine Debris Removal Protocols
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Reference

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NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 1, 2021

Mr. Thomas Kamealoha
Cultural Monitor
Kamealoha
84-1035 Kaulaili Rd. #A
Waianae, HI 96795

Dear Mr. Kamealoha:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

Background

The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of

finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

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November 1, 2021

Ms. Vivian L. Ainoa
President
Kamiloloa One Alii Homestead Association
P. O. Box 1349
Kaunakakai, HI 96748

Dear Ms. Ainoa:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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November 1, 2021

Ms. Taffi Wise
Executive Director
Kanu o ka Aina Learning ʻOhana
P.O. Box 6511
Kamuela, HI 96743

Dear Ms. Wise:

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The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of

finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

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The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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Determination

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If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

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National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 1, 2021

Mr. Scott Abrigo
President
Kapolei Community Devlpmnt Corp.
P.O. Box 75658
Kapolei, HI 96707

Dear Mr. Abrigo:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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(808) 725-5300

November 1, 2021

Mr. Thomas T. Shirai Jr.
Po'o
Kawaihapai Ohana
P.O. Box 601
Waialua, HI 96791

Dear Mr. Shirai:

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 1, 2021

Ms. Mahealani Cypher
Secretary
Ko'olau Foundation
P.O. Box 4749
Kaneohe, HI 96744

Dear Ms. Cypher:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

Background

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The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of

finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

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Proposed Action and Best Management Practices (BMPs)

The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

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<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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Determination

As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC’s activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

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November 1, 2021

Mr. Glen Kila
Program Director
Koa Ike
89-530 Mokiawe Street
Waianae, HI 96792-3840

Dear Mr. Kila:

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November 1, 2021

Ms. Lani Ma'a Lapilio
Ma'a Ohana
c/o Aukahi, P.O. Box 6087
Kaneohe, HI 96744-9998

Dear Ms. Lapilio:

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Shipwrecks in Hawaiian Waters.[3] A number of fishponds, traditional fishing locations, one beach midden site, coastal national parks and archaeological complexes, a number of ships, vehicles, and plane wreck sites, and the islands of Nihoa and Mokumanamana (Necker Island) were identified in the general APE. In addition, two letters (discussed above) were sent to the Hawai'i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties requesting assistance with identifying additional historic properties; no new historic properties were identified.

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Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

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2. PIFSC Marine Debris Removal Protocols
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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawaiʻi 96818
(808) 725-5300

November 1, 2021

Ms. Keona Mark
Mahu Ohana
P.O. Box 2
Haleiwa, HI 96712

Dear Ms. Mark:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

<u>Background</u>
The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawaiʻi, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned

fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

<u>Consultation History</u>
In a April 2014 letter, PIFSC initiated coordination and consultation with the Hawaiʻi, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (list enclosed) providing notification of our intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC.

In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawaiʻi, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawaiʻi Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawaiʻi State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

<u>Proposed Action and Best Management Practices (BMPs)</u>
The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

Marine debris removal would be conducted along the shoreline up to the highest wash of the waves and to a depth of 30 m. Marine debris removal consists of surveys to (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear or "DFG") in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. The removal efforts are focused on DFG, which poses a potential entanglement risk to wildlife (e.g., endangered Hawaiian monk seals, cetaceans and sea turtles), and plastics. Team members would systematically survey the shoreline and reefs by walking below the highest wash of the waves and conducting swim surveys and towed diver surveys to locate submerged DFG in shallow water. Nets would be evaluated before removal actions to determine appropriate removal strategies and BMPs would be in place to avoid areas with known historic properties. Other research activities would be conducted offshore, away from known historic properties, and would involve diving, fishing, towing nets and mapping the seafloor.

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<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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(808) 725-5300

November 1, 2021

Ms. Lu Faborito
Makaha Hawaiian Civic Club
P.O. Box 305
Waianae, HI 96792

Dear Ms. Faborito:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai‘i 96818
(808) 725-5300

November 1, 2021

Ms. Paula K. Kekahuna
President
Maku‘u Farmers Association
15-2131 Keaau Pahoa Hwy
Pahoa, HI 96778

Dear Ms. Kekahuna:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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  - DFG that is buried is often located under a surface layer of sand. Subsurface DFG can typically be removed by brushing off sand, lifting it from the shoreline and loading it into a small boat for proper disposal. If buried DFG is located and deep digging is required to remove it, the DFG would be left in place in order to avoid potential effects to historic properties.

<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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assessment of submerged cultural resources in Hawaii,[2] and an inventory of U.S. Navy Shipwrecks in Hawaiian Waters.[3] A number of fishponds, traditional fishing locations, one beach midden site, coastal national parks and archaeological complexes, a number of ships, vehicles, and plane wreck sites, and the islands of Nihoa and Mokumanamana (Necker Island) were identified in the general APE. In addition, two letters (discussed above) were sent to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties requesting assistance with identifying additional historic properties; no new historic properties were identified.

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As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC's activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures
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2. PIFSC Marine Debris Removal Protocols
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1845 Wasp Blvd. Bldg. 176 Honolulu, Hawaiʻi 96818
(808) 725-5300

November 1, 2021

Ms. Homelani Schaedel
President
Maluʻohai Residents Association
P.O. Box 700911
Kapolei, HI 96709

Dear Ms. Schaedel:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

<u>Background</u>
The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawaiʻi, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of

finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

Consultation History

In a April 2014 letter, PIFSC initiated coordination and consultation with the Hawai'i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (list enclosed) providing notification of our intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC.

In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawai'i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawai'i Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai'i State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

Proposed Action and Best Management Practices (BMPs)

The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

Marine debris removal would be conducted along the shoreline up to the highest wash of the waves and to a depth of 30 m. Marine debris removal consists of surveys to (1) identify and assess the types and locations of marine debris (e.g., derelict fishing gear or "DFG") in the marine environment and along the shoreline; and (2) conduct targeted removals at high-priority sites. The removal efforts are focused on DFG, which poses a potential entanglement risk to wildlife (e.g., endangered Hawaiian monk seals, cetaceans and sea turtles), and plastics. Team members would systematically survey the shoreline and reefs by walking below the highest wash of the waves and conducting swim surveys and towed diver surveys to locate submerged DFG in shallow water. Nets would be evaluated before removal actions to determine appropriate removal strategies and BMPs would be in place to avoid areas with known historic properties. Other research activities would be conducted offshore, away from known historic properties, and would involve diving, fishing, towing nets and mapping the seafloor.

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November 1, 2021

Ms. Jade Alohalani Smith
Moku o Kaupo
P.O. Box 1269
Kula, HI 96790

Dear Ms. Smith:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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November 1, 2021

Ms. Uilani Kapu
Treasurer
Na Aikane O Maui
562A Front Street
Lahaina, HI 96761

Dear Ms. Kapu:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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- Along the shoreline:
  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
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<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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assessment of submerged cultural resources in Hawaii,[2] and an inventory of U.S. Navy Shipwrecks in Hawaiian Waters.[3] A number of fishponds, traditional fishing locations, one beach midden site, coastal national parks and archaeological complexes, a number of ships, vehicles, and plane wreck sites, and the islands of Nihoa and Mokumanamana (Necker Island) were identified in the general APE. In addition, two letters (discussed above) were sent to the Hawaiʻi, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties requesting assistance with identifying additional historic properties; no new historic properties were identified.

Determination

As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC's activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

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2. PIFSC Marine Debris Removal Protocols
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Reference

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 1, 2021

Ms. Donna Kaliko Santos
Na Kuleana o Kanaka ‘Oiwi
P.O. Box 1541
Lihue, HI 96766

Dear Ms. Santos:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

Background

The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned

fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

Consultation History
In a April 2014 letter, PIFSC initiated coordination and consultation with the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (list enclosed) providing notification of our intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC.

In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawai‘i Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai‘i State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

Proposed Action and Best Management Practices (BMPs)
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November 1, 2021

Mr. Kaleo Patterson
President
Native Hawaiian Church
1127 Bethel Street, Ste. 16
Honolulu, HI 96813

Dear Mr. Patterson:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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(808) 725-5300

November 1, 2021

Ms. Maraea K. Nekaifes
Nekaifes Ohana
212 Hiipali Loop
Kula, HI 96790-7273

Dear Ms. Nekaifes:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

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<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

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Determination

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Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawaiʻi 96818
(808) 725-5300

November 1, 2021

Ms. Sylvia M. Hussey
CEO
Office of Hawaiian Affairs
560 N. Nimitz Hwy., Suite 200
Honolulu, HI 96817

Dear Ms. Hussey:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

Background
The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawaiʻi, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

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November 1, 2021

Mr. William W. Moekahi Steiner
Pacific Agricultural Land Management Syst.
P.O. Box 4565
Hilo, HI 96720

Dear Mr. Steiner:

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National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Fisheries Science Center
1845 Wasp Blvd. Bldg. 176 Honolulu, Hawai'i 96818
(808) 725-5300

November 1, 2021

Ms. Sheri-Ann Daniels
Executive Director
Papa Ola Lokahi
894 Queen Street
Honolulu, HI 96813

Dear Ms. Daniels:

This letter follows up on our previous letter dated November 19, 2015 continuing the Section 106 consultation process under the National Historic Preservation Act for the National Oceanic and Atmospheric Administration (NOAA), Pacific Islands Fisheries Science Center's (PIFSC) proposed fisheries and ecosystem research activities in the Pacific Islands Region (map of research areas within the Pacific Islands Region enclosed). Based on our analysis in the draft Programmatic Environmental Assessment (October 2021), and as explained in more detail below, we do not expect our research activities to have impacts on historic properties. Further, PIFSC would implement and follow several Best Management Practices (BMPs) while conducting activities within the Hawaiian Archipelago Research Area to avoid any impacts. These BMPs are discussed herein.

Background

The U.S. Department of Commerce NOAA's National Marine Fisheries Service is conducting a review of its fisheries and ecosystem research programs across the country to ensure they are in compliance with applicable laws. PIFSC conducts research on living marine resources in the coastal oceans around the State of Hawai'i, the Commonwealth of the Northern Mariana Islands (CNMI), the Territories of Guam and American Samoa, and the U.S. Pacific Remote Island Areas (together these island areas comprise the US Pacific Islands Region or PIR).

The purpose of these research activities is to improve our understanding of ocean ecosystems and support NOAA's mission of science, service and stewardship. Our research activities are mandated by a number of federal laws including the Magnuson-Stevens Fisheries Conservation and Management Act, Coral Reef Conservation Act, Endangered Species Act, and Marine Mammal Protection Act. We have conducted various aspects of this research for over 60 years and have worked with a broad range of partners, including governmental, academic, and private organizations. The scientific data collected and analyzed by PIFSC are provided to domestic and international partners to support decisions by fisheries management organizations, such as the NMFS' Pacific Islands Regional Office and the Western Pacific Fishery Management Council. These data and analyses are also published in reports, memoranda, and scientific journals. To ensure these activities are compliant with applicable laws, we are currently in the process of finalizing a draft Programmatic Environmental Assessment (DPEA) for the aforementioned

fisheries and ecosystem research activities. Please find the link to the DPEA in the list of enclosures below.

The fisheries and ecosystem research activities discussed in the DPEA are broken into two categories for the purpose of this consultation: (1) marine debris survey and removal occurring from the shoreline (up to the highest wash of the waves) to a depth of 30 meters (m), and (2) research activities occurring at depths between 10-2,000 m (including coral reef assessment surveys; life history and abundance studies of reef, bottom, and pelagic fishes; oceanographic studies; and fishery bycatch reduction research). Additional information on PIFSC research programs is available at www.fisheries.noaa.gov/about/pacific-islands-fisheries-science-center and in the DPEA. Given the large geographic area being studied, these activities generally occur infrequently (e.g., once every 1-3 years) at any given location.

<u>Consultation History</u>
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In November 2015, PIFSC continued our Section 106 consultation obligations in a follow up letter to the Hawai‘i, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on the PIFSC website. PIFSC received five public comments from the following organizations: State of Hawai‘i Department of Land and Natural Resources, Office of Hawaiian Affairs, U.S. Fish and Wildlife Service, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawai‘i State Historic Preservation Division, nor did PIFSC receive any comments regarding cultural properties or impacts to such properties from the research activities in the area of potential effects.

<u>Proposed Action and Best Management Practices (BMPs)</u>
The proposed action is the implementation of PIFSC fisheries and ecosystem research activities for the next five years (as described in section 2.3 of the DPEA), or longer if the activities continue to be implemented as described in the document and the analysis of the environmental effects remain consistent and applicable with those activities.

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  - During this evaluation, divers would look for historic properties that may be in the immediate vicinity (e.g., ship wrecks, fish ponds). If a potential historic property is located but is not attached to any DFG, the site would be avoided. If a potential historic property is located and it is attached to DFG then the DFG is treated as stable, a GPS location would be recorded and the appropriate historic preservation office would be notified. PIFSC would consult with the appropriate historic preservation office on DFG located on an historic property to determine the best way to remove entanglement hazards without affecting the site.

- Along the shoreline:
  - For the purposes of this consultation, shoreline survey and removal efforts would be conducted within the dynamic zone of the shoreline up to the highest wash of the waves on all islands visited. This dynamic zone is characterized by frequent wave and tidal action that can deposit, or wash away, marine debris as well as sand. Because survey and removal efforts would not take place in uplands or other vegetated areas, divers would avoid impacts to upland historic properties (e.g., burial mounds, if any). Most DFG (primarily fishing nets) and plastics are found to rest on the surface of the shoreline and require no excavation of the subsurface, thereby avoiding impacts to buried historic properties.
  - DFG that is buried is often located under a surface layer of sand. Subsurface DFG can typically be removed by brushing off sand, lifting it from the shoreline and loading it into a small boat for proper disposal. If buried DFG is located and deep digging is required to remove it, the DFG would be left in place in order to avoid potential effects to historic properties.

<u>The Area of Potential Effect (APE)</u>
The APE for the proposed action encompasses the marine waters of the PIR (i.e., state and territorial seas around the PIR, including the high seas outlined in Section 3.1 of the DPEA). Specifically, for the purposes of this consultation, this includes the open ocean waters between these islands as well as nearshore waters, including the dynamic zone of the shoreline up to the highest wash of the waves of these islands. The APE does not include any uplands or beach areas above the highest wash of the waves as none of the research activities described in the DPEA takes place in these areas (see Tables 2.2-1 and 2.3-1 in the DPEA). For example, the activities of the marine debris research and removal survey primarily target derelict fishing gear in the water and attached to the reef, though it can include marine debris that has washed ashore but is located below the high tide line.

<u>Steps taken to identify historic properties</u>
In order to identify historic properties in the APE, PIFSC personnel reviewed the Nominated and Listed Properties on the Hawai‘i and National Registers of Historic Places list,[1] the inventory and assessment of submerged cultural resources in Hawaii,[2] and an inventory of U.S. Navy

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Determination

As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC's activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

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November 1, 2021

Ms. Olinda Aiwohi
Paukukalo Hawaiian Homes Community
Association
781 Kawananakoa Street
Wailuku, HI 96793

Dear Ms. Aiwohi:

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November 1, 2021

Mr. Jordan Lee Loy
Piihonua Hawaiian Homestead
Community Association
37 Waiea Place
Hilo, HI 96720

Dear Mr. Loy:

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As noted above, in-water research by the PIFSC has been ongoing for over 60 years, and marine debris surveys and removal activities have been conducted by PIFSC for a number of years (Dameron et al 2007).[4] During both the research and marine debris surveys and removal actions, no historic properties were reported to have been affected by PIFSC's activities. PIFSC recognizes that a number of historic properties have been identified in the APE, but marine debris survey and removal and in-water research activities would not occur at these sites, if encountered.

Based on the information available, the PIFSC has determined that the type of undertaking described herein and in the DPEA would not have the potential to cause effects on historic properties, even assuming such were present in the area of activity. NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change.

If you have any questions or wish to discuss this matter further, please contact: Justin Rivera, PIFSC Environmental Scientist at the address above (electronic mail Justin.Rivera@noaa.gov).

Sincerely,

Michael P. Seki Ph.D.

Enclosures

1. Map of PIFSC Research Areas
2. PIFSC Marine Debris Removal Protocols
3. Draft Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by the Pacific Islands Fisheries Science Center, October 2021. Electronic copy available at: https://media.fisheries.noaa.gov/2021-10/Draft-PEA-Oct-2021-PIFSC.pdf
4. List of interested parties and historic preservation offices sent consultation letters in 2014 and 2015

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[2] https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/2017-021.pdf

[3] https://www.history.navy.mil/content/dam/nhhc/research/underwater-archaeology/PDF/UA_ResourcesMgt.pdf

[4] PIFSC marine debris survey and removal has occurred in Hawai'i since 1996 and PIFSC (formerly known as the Honolulu Laboratory of the Southwest Fisheries Science Center) has conducted in-water research since 1957).

Reference

Dameron, O. J., M. Parke, M. A. Albins, R. Brainard. 2007.
Marine debris accumulation in the Northwestern Hawaiian Islands: an examination of rates and processes. Marine Pollution Bulletin 54(4):423–433.

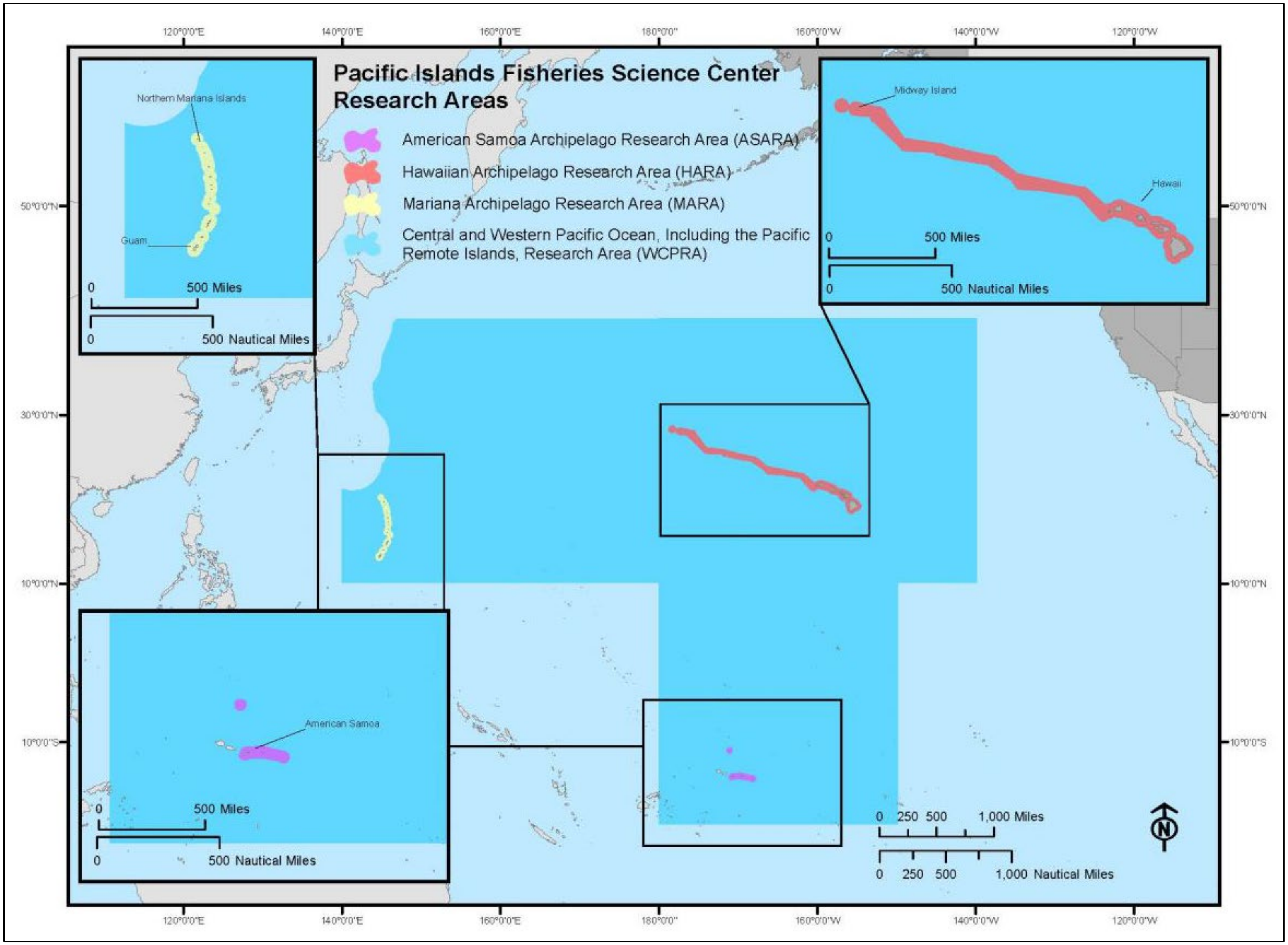
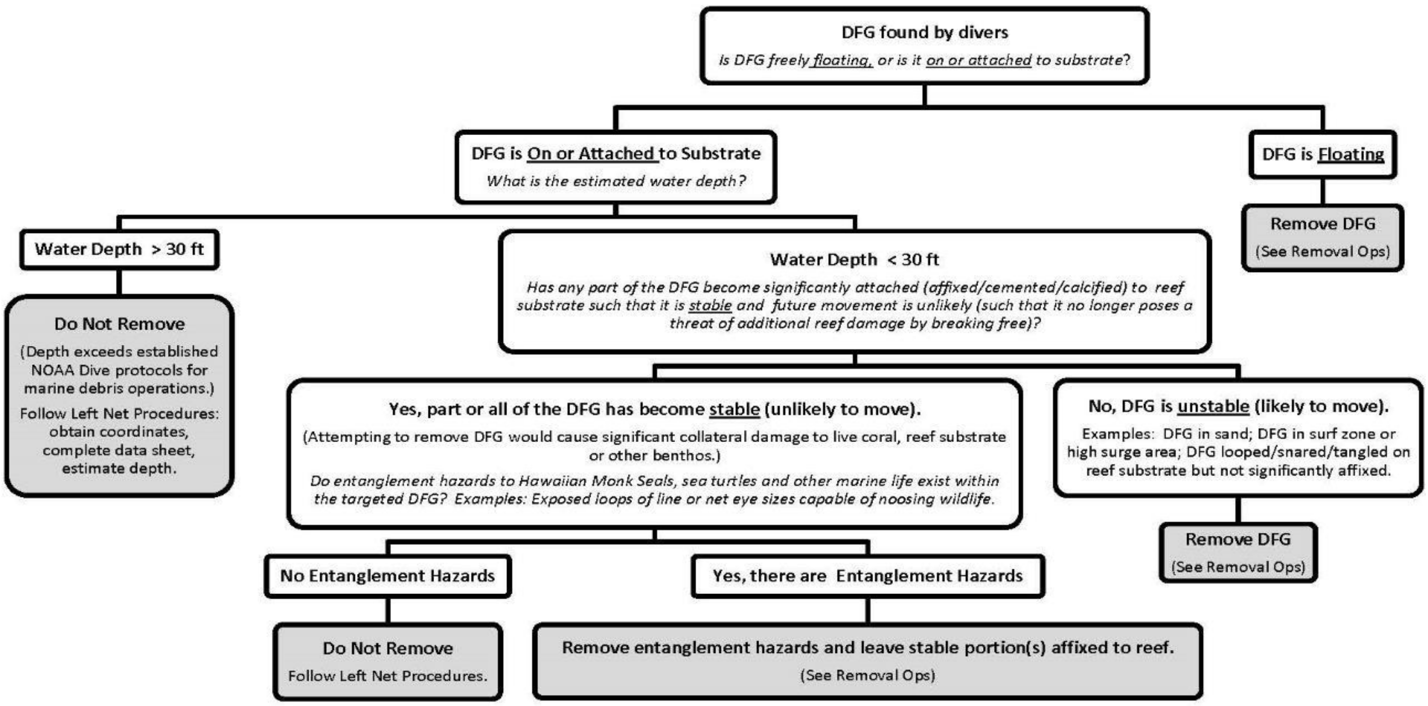


Figure 1.1 – PIFSC Research Areas

Marine Debris Removal Protocols

**The decision to remove marine debris (primarily derelict fishing gear – DFG) is based upon its disposition, depth, and potential for additional damage and entanglement.*



List of Interested Parties and Historic Preservation Offices Sent Consultation Letters in 2014 and 2015

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Ms. Vivian L. Ainoa
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List of Interested Parties and Historic Preservation Offices Sent Consultation Letters in 2014 and 2015

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Finding of No Significant Impact (FONSI)

Authorization for

Fisheries and Ecosystem Research Conducted and Funded by the

Pacific Islands Fisheries Science Center

National Marine Fisheries Service

March 2023

Background

Proposed Action

The Pacific Islands Fisheries Science Center (PIFSC) prepared a draft Programmatic Environmental Assessment (PEA) that analyzed potential impacts on the human environment of PIFSC fisheries and ecosystem research activities entitled, "Programmatic Environmental Assessment for Fisheries and Ecosystem Research Conducted and Funded by PIFSC" (NMFS 2022). That document supports this Finding of No Significant Impact.

PIFSC conducts research and provides scientific advice to managers of fisheries and protected resources for the State of Hawaiʻi, Territory of American Samoa, Territory of Guam, the Commonwealth of the Northern Mariana Islands (CNMI) and the Pacific Remote Island Areas. They conduct work in four different research areas: 1) Hawaiian Archipelago Research Area (HARA); 2) Mariana Archipelago Research Area (MARA); 3) American Samoa Archipelago Research Area (ASARA); and 4) Western and Central Pacific including the Pacific Remote Islands Research Area (WCPRA). The purpose of PIFSC fisheries and ecosystem research is to produce scientific information necessary for the management and conservation of living marine resources in the National Marine Fisheries Service (NMFS) Pacific Islands Region. PIFSC's research is needed to promote both the long-term sustainability of the resource and the recovery of certain species, while generating social and economic opportunities and benefits from their use.

Alternatives Evaluated in the Environmental Assessment

After screening potential alternatives against criteria to meet the purpose of the action, NMFS identified four alternatives for analysis in the PEA: a No-Action/Status Quo Alternative, two Action alternatives, and a No Research Alternative that considers no federal funding for fisheries research activities. The No-Action/Status Quo Alternative is used as the baseline for comparison of the other alternatives. Three of the alternatives include fisheries and ecosystem research projects conducted or funded by PIFSC as the primary federal action. These three alternatives also include suites of mitigation measures intended to avoid and minimize potentially adverse interactions with protected species. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the MBTA.

Alternative 1 - The Status Quo/No Action Alternative, *Conduct Federal Fisheries and Ecosystem Research with Scope and Protocols Similar to Past Effort* (PEA Section 2.2) includes fisheries and ecosystem research using the same protocols as were implemented from 2008 through 2021. These federal research activities are necessary to fulfill NMFS mission to provide science-based management, conservation, and protection of living marine resources in the four research areas: 1) HARA; 2) MARA; 3) ASARA; and 4) WCPRA. Under the Status Quo/No Action Alternative, PIFSC would conduct the same scope of research as in recent years and use the current mitigation measures for protected species.

Under the Status Quo Alternative, PIFSC would administer and conduct extensive, fishery-independent and industry-associated research and survey programs. These surveys utilize a wide range of research equipment and fishing gear to capture fish and invertebrates for stock assessment or other research purposes, collect plankton and larval life stages of organisms to facilitate ecosystem studies, and gather oceanographic and acoustic data to characterize the marine environment. The main gear types of concern for potential interactions with protected species under this alternative include pelagic trawls (surface and midwater), various hook-and-line gears, and instruments deployed on lines from vessels or moorings that may result in entanglement. In addition, the use of active acoustic instruments and the presence of researchers may lead to behavioral harassment of marine mammals. The scope of past research activities is considered as the basis for analysis of future activities under the Status Quo/No Action Alternative.

Alternative 2 - The Preferred Alternative, *Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Mitigation for Marine Mammal Protection Act (MMPA) and Endangered Species Act (ESA) Compliance* (PEA Section 2.3) is comprised of a combination of research activities continued from the past and additional, new research surveys and projects. The Preferred Alternative would not include several of the projects described under the Status Quo/No Action Alternative including:

- The Northwestern Hawaiian Islands Lobster Survey
- The Northwestern Hawaiian Islands Bottomfish Survey
- Pelagic Longline Hook Trials
- Longline Gear Research Surveys
- Marlin Longline Surveys

Under the Preferred Alternative, the Cetacean Ecological Assessment surveys would include increased levels of effort relative to the Status Quo/No Action Alternative, and would be expanded to include all four of the research areas within the Pacific Islands Region. Several new research surveys and projects that were not included in the Status Quo/No Action Alternative would occur under the Preferred Alternative, and other existing research projects would be modified. In compliance with the MMPA, PIFSC would apply to NMFS Office of Protected Resources (OPR) to promulgate regulations governing the issuance of LOAs for incidental take of marine mammals. PIFSC would also conduct informal or formal ESA section 7 consultations with NMFS Pacific Islands Regional Office (PIRO), and U.S. Fish and Wildlife Service (USFWS), as appropriate, for species that are listed as threatened or endangered.

Alternative 3 – Modified Research Alternative, *Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Additional Mitigation* (PEA Section 2.4). Under this alternative, PIFSC would conduct and fund the same scope of fisheries research as described for the Preferred Alternative and would include all of the same mitigation measures considered under the Preferred Alternative. Under this alternative, PIFSC would also apply for authorizations under the MMPA for incidental take of protected species during these research activities and initiate section 7 consultations regarding ESA-listed species. The key difference between the Modified Research Alternative and the Preferred Alternative is that the Modified Research Alternative includes a number of additional mitigation measures derived from sources including: 1) comments submitted from the public on potential mitigation of commercial fisheries impacts; 2) discussions within NMFS OPR as part of the proposed rulemaking process under the MMPA; and 3) a literature review of past and current research into potential mitigation measures. These measures include changes to visual monitoring methods for protected species (e.g., dedicated Protected

Species Observers [PSOs] and technological methods to improve detection under poor visibility conditions), operational restrictions on where and when research may be conducted, and adoption of alternative methodologies and equipment for sampling.

Some of the mitigation measures considered under the Modified Research Alternative (e.g., no night fishing or broad spatial/temporal restrictions on research activities) would not allow survey protocols to remain consistent with previous data sets and would essentially prevent PIFSC from collecting data required to provide for fisheries management purposes under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Some research surveys necessarily target fish species that are preyed upon by protected species with an inherent risk of interactions during these surveys. PIFSC acknowledges the inherent risk of these, and it has implemented a variety of measures to mitigate that risk. PIFSC currently has no viable alternatives to collecting the data derived from these surveys and does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of night surveys or elimination of pelagic trawl gear use.

Alternative 4 – No Research Alternative, *No Fieldwork for Federal Fisheries and Ecosystem Research Conducted or Funded by PIFSC* (PEA Section 2.5). Under the No Research Alternative PIFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research in marine waters of the HARA, MARA, ASARA, and WCPRA. This moratorium on fieldwork would not extend to directed research studies on marine mammals and ESA-listed species that are authorized under separate research permits (i.e., MMPA section 10 permits). However, these research activities may not be authorized for the continued use of active acoustic equipment or fishing gears that could result in incidental takes of marine mammals. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S. Under this alternative, organizations that have participated in joint research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without PIFSC funding, direct control of program design, or operational oversight.

Measures to Reduce Impacts

The Status Quo/No Action Alternative research activities include a suite of mitigation measures (PEA Section 2.2.1) that were developed to minimize the risk of ship strikes and entanglements/captures/hookings of protected species in fishing gear (i.e., marine mammal monitoring and the "move-on" rule). The following mitigation measures have been implemented on all PIFSC surveys prior to 2014:

- Visual monitoring for protected species prior to deployment of gear;
- Use of the "move-on" rule if marine mammals are sighted from the vessel prior to deployment of trawl, longline, or any other fishing gear that may pose a risk of interactions with protected species and if the animals appear to be at risk of interaction with the gear as determined by the professional judgment of the Chief Scientist or officer on watch; and

- Short tow times and set times to reduce exposure of protected species to research gear.

The Preferred Alternative includes the same suite of mitigation measures as the Status Quo/No Action Alternative to reduce the risk of adverse interactions with protected species. In addition, under the Preferred Alternative PIFSC would make changes to their gear configurations for instrument deployment, specifically altering the ratio of sinking and floating lines to reduce the risk of entanglements in lines at the surface of the water. PIFSC would also continue providing the mitigation and monitoring training program for Chief Scientists and crew responsible for implementing appropriate responses to protected species interactions. This program includes opportunities for Chief Scientists and Captains to share information on protected species avoidance practices and to help standardize such decision-making protocols. Under the Preferred Alternative, these mitigation measures would be implemented during the LOA authorization period and are intended to reduce the effects of PIFSC fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA.

Public and Agency Comments Received on the Draft PEA (PEA Section 1.5)

A Notice of Availability (NOA) for the draft PEA was published in the Federal Register on December 4, 2015 (80 FR 75856). The public comment period closed on January 4, 2016. One public comment letter was received from the Humane Society of the United States (HSUS). Agency comment letters were received from the State of Hawaii, Department of Land and Natural Resources (DLNR) and from USFWS, Pacific Islands Fish and Wildlife Office. Substantive comments were considered by PIFSC and, if necessary, addressed in the PEA.

The HSUS comments focused on Alternatives 1-3. They commented that the alternatives provided in the DPEA were inappropriately narrow, and believed that NMFS should choose a modified Alternative 2 that incorporates the additional feasible mitigation measures in Alternative 3. HSUS also requested to include Level A takes for humpback whales due to entanglement in trawl gear and for bottlenose dolphins due to hook and line gear. HSUS stated that the cumulative effects analysis covered too broad of action area and minimized the effects of acoustic harassment.

Comments from the DLNR focused on where and to what extent Essential Fish Habitat (EFH) exists, reviewing and refining methods for calculating Potential Biological Removal (PBR) to produce a number that is more accurate and effective, reviewing and refining critical habitat determinations, and including a description of albacore and bluefin tuna in Chapter 3.

Comments from USFWS focused on questions about gear and the use of UAS, attraction of birds to research vessels at night, and missing descriptions and impact analyses of ESA-listed birds. The missing birds have been added to the PEA and other USFWS comments have been addressed in the final PEA text.

Consultations

Endangered Species Act

An ESA consultation is required when an agency conducts or authorizes an action (such as through a permit or MMPA authorization) that may affect a listed species or designated critical habitat. On December 14, 2016, PIFSC requested concurrence and informal consultation with USFWS Pacific Islands Fish and Wildlife office based on determinations that proposed research *may affect but is not likely to adversely affect* the ESA-listed marine and terrestrial species in the action area including: Central North, Central West and Central South Pacific Distinct Population Segments (DPS) of green sea turtles; hawksbill sea turtles; leatherback sea turtles; North and South Pacific Ocean DPSs of loggerhead sea turtles; olive ridley sea turtles; Short-tailed albatross; Hawaiian petrels; Newell's shearwaters; band-rumped storm petrels; Nihoa millerbirds; Nihoa finches; Laysan finches; and Laysan ducks. On February 21, 2017, USFWS responded with a Letter of Concurrence (LOC) for these species.

On September 11, 2018, PIFSC requested informal concurrence under section 7 of the ESA for fisheries and ecosystem research stating that proposed activities *may affect but are not likely to adversely affect* ESA-listed sea turtles (Central North Pacific, Central West Pacific, and Central South Pacific DPSs of green sea turtle; hawksbill sea turtle, leatherback sea turtle, North Pacific Ocean and South Pacific Ocean DPS of loggerhead sea turtle; and olive ridley sea turtle), the Indo-West pacific DPS of scalloped hammerhead shark; the oceanic white tip shark; the giant manta ray the chambered nautilus (proposed for listing) and seven species of giant clam (also proposed for listing at the time). PIFSC also requested concurrence on findings that proposed research is *not likely to adversely affect* false killer whale or Hawaiian monk seal critical habitat. On September 13, 2018 PIRO responded with a Letter of Concurrence (LOC) for the species requested plus seven threatened Pacific coral species. In the LOC PIRO concurred with the informal determinations and provided three conservation recommendations.

Subsequently, on September 8, 202,1 PIFSC re-initiated ESA section 7 consultation with PIRO based on updates to proposed research presented in the PEA and other relevant updates to ESA-listed species in the action area. A Biological Assessment (BA) dated August 31, 2021, was prepared and provided to PIRO. The BA describes all listed species and critical habitat in the Pacific Islands Region that may be affected by fishery and ecosystem surveys over the 5-year period from 2021-2026. The formal ESA consultation process was initiated on November 22, 2021, and the Biological Opinion (BiOp) was completed on November 21, 2022. The BiOp concluded that the proposed action is not likely to adversely affect Central North Pacific, Central South Pacific, and Central West Pacific green sea turtle, hawksbill sea turtle, Leatherback sea turtle, North Pacific loggerhead sea turtle, olive ridley sea turtle, blue whale, fin whale, sei whale, sperm whale, Hawaiian monk seal, MHI insular false killer whale, North Pacific right whale, and chambered nautilus; and that the action is not likely to adversely affect critical habitats of the Hawaiian monk seal and MHI insular false killer whale, and is not likely to adversely modify or destroy proposed critical habitat of Pacific Ocean corals. A summary on the conclusions of the BiOp on the threatened giant manta ray, threatened Indo-West Pacific scalloped hammerhead shark, threatened oceanic whitetip shark, and threatened corals is provided in question 9 below (ESA-listed fish and critical habitat, and ESA-listed invertebrates and critical habitat). All consultation letters are provided in Appendix C of the PEA.

Essential Fish Habitat

Under section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to federal and state agencies for actions that will adversely affect EFH. In the Pacific Islands, PIRO is responsible for providing EFH conservation recommendations to federal agencies for actions that will adversely affect EFH under section 305(b)(4)(A) of the MSA. PIFSC conducts individual project-specific consultations in accordance with the EFH consultation regulations at 50 CFR 600.920.

An EFH programmatic consultation was initiated between PIRO and PIFSC to address the potential adverse effects from numerous marine research activities on EFH. The scope of the EFH Programmatic Agreement, dated February 2020, was limited to activities that may adversely affect, but will not have a substantial adverse effect individually or cumulatively on EFH. The Programmatic Agreement (which is included in Appendix C of the PEA), requested conservation recommendations (CRs) for physical impacts to benthic habitat, invasive species, and sedimentation, turbidity, and chemicals.

Coastal Zone Management Act

In November and December of 2019, PIFSC initiated consultation with the Hawaii, Guam, CNMI, and American Samoa Coastal Management Programs. The State of Hawaii Office of Planning conditionally concurred with PIFSCs determination that the "proposed activity is consistent to the maximum extent practicable with the enforceable policies of the Hawaii Coastal Zone Management (CZM) program, and recommended conditions: mitigation measures for protected species must be fully implemented and if the take of regulated organisms results in cumulative effects on aquatic resources in state waters, then PIFSC must consider modifications to minimize cumulative effects."

The Hawaii CZM program solicited and received comments from the State of Hawaii Department of Land and Natural Resources (DLNR), who expressed support for Alternative 2 and provided specific concerns regarding collection of corals. DLNR requested assurance that protected species training is conducted prior to field work, the loss of all fishing gear is documented, and that steps to minimize impacts of bottom fishing surveys are implemented.

The Guam Coastal Management Program concurred with PIFSC but stated that concurrence does not preclude securing Government of Guam permits, clearance and approval prior to the start of research activities. The CNMI Division of Coastal Resources Management concurred with PIFSC's determination. The American Samoa Coastal Management Program did not respond, so we infer consistency consistent with 15 CFR 930.41. All CZM consultation documents are provided in Appendix C of the PEA.

National Marine Sanctuaries Act

On March 13, 2016, PIFSC requested that consultation be initiated with the Office of National Marine Sanctuaries (ONMS) for activities in the Hawaiian Islands Humpback Whale National Marine Sanctuary (HIWNMS) and the National Marine Sanctuary of American Samoa (NMSAS).To protect sanctuary resources, ONMS provided PIFSC with specific recommendations for each sanctuary. The recommendations for HIWNMS address notification of near misses with humpback whales, issues related to timing of and types of gear deployed, derelict or unattended gear, use of active acoustic equipment (must be 22 kilohertz or lower), monitoring protocols for humpback whales during vessel operations, and use of Uncrewed Aircraft Systems. For NMSAS, PIFSC must: annually report the actual biomass of all fish and invertebrate species taken from within the sanctuary, and any interactions with marine mammals, sea turtles, sea birds, and historic and cultural resources; test and calibrate less invasive sampling methodologies, and eventually transition to non-extractive sampling methods whenever possible; and not conduct the insular fish life history program within Fagatele Bay and the Aunuʻu Research Zone.

National Historic Preservation Act

In an April 2014 letter, PIFSC initiated coordination and consultation with the Hawaiʻi, CNMI, Guam and American Samoa historic preservation offices and 27 interested parties (Native Hawaiian Organizations listed in the U.S. Department of Interior Native Hawaiian Organization Notification List and identified as organizations with interests in natural resource management and conservation). The 2014 letter provided notification of the agency's intent to release the DPEA analyzing the effects of fisheries and ecosystem research conducted and funded by PIFSC. In November 2015, PIFSC continued Section 106 consultation obligations in a follow-up letter to the Hawaiʻi, CNMI, Guam and American Samoa historic preservation offices and the 27 interested parties, providing notice that the DPEA would be released for public comment in December 2015 and requesting assistance with identifying any additional historic properties not already identified in the DPEA. The letters included a link to the DPEA on PIFSC's website. PIFSC received five public comments from the following organizations: State of Hawaiʻi Department of Land and Natural Resources, Office of Hawaiian Affairs, USFWS, Guam Historic Preservation Office, and the Humane Society of the United States. Those comments were incorporated into the DPEA. No comments were received from the Hawaiʻi State Historic Preservation Division nor any other entities regarding cultural properties or impacts to such properties from the research activities in the area of potential effect.

On November 2, 2021 follow-up letters were sent to the historic preservation offices and 27 interested parties. The 2021 follow-up letters stated that: based on the analysis in the PEA (October 2021) and additional details in the follow-up letters, PIFSC does not expect research activities would have the potential to cause effects on historic properties, even assuming such were present in the area of activity. The letters also explained Best Management Practices (BMPs) to be followed while conducting activities within all research areas to avoid any impacts. The letters noted that: "NOAA will re-initiate consultation with the appropriate historic preservation offices and other interested parties should the circumstances represented in this consultation substantially change." The Guam Historic Preservation Office provided comments on December 12, 2021 requesting more information including a map of the Area of Potential Effects (APE) for Guam. On February 11, 2022, PIFSC provided a map showing the APE for Guam and submitted all additional information requested and no additional questions were received from the Guam Historic Preservation Office. No other historic preservation office or interested parties commented on PIFSC's follow up letter.

Significance Review

The Council on Environmental Quality (CEQ) regulations state that the significance of an action should be analyzed both in terms of "context" and "intensity" and lists ten criteria for intensity. The Companion Manual for NOAA Administrative Order 216-6A requires consideration of CEQ's context and intensity criteria (40 CFR 1508.27(a) and 40 CFR 1508.27(b)) along with six additional factors for determining whether the impacts of a proposed action are significant. Each criterion is discussed below with respect to the proposed action and is considered individually as well as in combination with the others.

1) **Can the proposed action reasonably be expected to cause both beneficial and adverse impacts that overall may result in a significant effect, even if the effect will be beneficial?**

   No. The analysis provided in Chapter 4 of the final PEA describes that the potential direct and indirect effects on the physical and biological resources under the proposed action (Alternative 2, the Preferred Alternative) would be minor to moderate adverse, and effects on the social and economic environment would be minor to moderate beneficial as described in the following subsections.

   Physical Environment

   As described in the PEA (PEA Section 4.3.1), Alternative 2 would have minor adverse effects on the physical environment due to physical damage to benthic habitats and changes in water quality from increased turbidity. Small areas (less than one percent of the total research area of 4.4 million square kilometers) would be impacted, and the areas of impact would be dispersed over a large geographic area. Low intensity impacts resulting from the disturbance of organisms that produce structure, such as corals, could persist for several months. However, impacts resulting in measurable changes to the physical environment would be temporary and the intensity of impacts would decrease with the passage of time. A minor long-term beneficial impact from continued removal of derelict fishing gear during the Marine Debris Research and Removal Surveys is noted.

   Special Resource Areas and EFH

   The overall effects of the Preferred Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, temporary or short-term in duration, and therefore be considered minor adverse or beneficial according to the impact criteria described in the PEA (PEA Section 4.1.1). Scientific data generated from PIFSC research activities would have beneficial effects on special resource areas, including MNMs, NMSs, and other MPAs through their contribution to science-based conservation management practices.

   Fish

   Potential effects of PIFSC research activities would include mortality from fisheries and ecosystem research activities, contamination from discharges, and potential disturbance and changes in behavior due to sound sources. The potential effects of the Preferred Alternative on fish species are considered minor adverse because of their relatively low magnitude and dispersal over time and space (PEA Section 4.3.3). The risk of contamination is very small and therefore, adverse effects would be minor. Three fish species in the project area are listed as threatened or endangered under the ESA: the scalloped hammerhead shark, the oceanic white tip shark, and the giant manta ray. Under the Preferred Alternative, PIFSC would tag, track, or biologically sample individuals of these species that may be caught as bycatch during commercial fishing operations. While research tagging activities are not expected to result in mortality or serious injury (M/SI), individuals would be exposed to stress from handling, tagging, and tissue sampling post-capture. Research would adversely affect a small number of individuals of each of these species though the effects would not cause long-term changes in fitness or survival.

In contrast to the potential adverse effects, PIFSC research provides long-term beneficial effects on managed fish species throughout the region through its contribution to sustainable fisheries management. Data from PIFSC fisheries and ecosystem research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks.

Marine Mammals

While some marine mammal species in PIFSC research areas may be exposed to sounds from active acoustic equipment used in PIFSC research, the number of individual animals exposed are expected to be relatively small. Additionally, many of the acoustic sources are not likely to be audible to many marine mammal species. For the marine mammals exposed to acoustic sources, the effects would likely be temporary and minor changes in behavior for nearby animals as the ships pass through any given area. The potential for a change in hearing threshold is low for high frequency cetaceans (beaked whales and dwarf and pygmy sperm whales) and very low to zero for other species. The potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and the short-term duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all species under the Preferred Alternative (PEA Section 4.3.4).

PIFSC has never caught, hooked, or had marine mammals entangled in fisheries research gear. Given the mitigation measures to be implemented under Preferred Alternative, the relatively small amount of effort involved in PIFSC research, and the lack of takes in the past, PIFSC anticipates a low level of risk that a M/SI take of marine mammals would occur. However, incidental takes of marine mammals have occurred in commercial and non-commercial fisheries in the same areas where PIFSC research occurs and using gears similar to those used in research. As such, M/SI takes due to research using longline gear, midwater trawl gear, instrument deployment and/or vessel encounters have been requested including one ESA-listed species (sperm whales) and 15 non-listed cetacean species. The overall impact of the potential takes of these species, if they were to occur, would be considered minor to moderate adverse according to the criteria described in the PEA.

PIFSC is requesting Level B harassment takes (i.e., harassment that has the potential to disturb) for ESA-listed Hawaiian monk seals due to the physical presence of researchers in nearshore waters and beaches. Given the existing protocols for monitoring and avoiding interactions with monk seals, these potential takes would likely result in only temporary behavioral disturbance of small numbers of monk seals and adverse impacts would be minor.

Regarding effects on marine mammal habitats and prey, given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse for the Preferred Alternative. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse for the Preferred Alternative.

Birds

There have been no known adverse interactions with seabirds during PIFSC research activities and there are no records of birds being hooked or caught in research gear or injured due to ship strikes. Fisheries research deploys sets for much shorter durations than commercial fisheries and no bait/offal is thrown overboard while research gear is in the water. Based on the historical lack of interactions between seabirds and PIFSC gear proposed under the Preferred Alternative, incidental take of seabirds in research gear is unlikely (PEA Section 4.3.5).

Outdoor lighting on research vessels could result in seabird disorientation, fallout, and injury or mortality. To minimize potential effects of research on seabirds during their breeding season, the use of lights and lighting intensity on vessels where PIFSC research activities are conducted would be minimized. Based on the history of minimal interactions/observations of seabirds and NOAA research and chartered vessels, the effects of artificial lighting on birds under the Preferred Alternative are expected to be negligible.

This PEA also considers the potential for fisheries research to affect the habitat quality of seabirds through removal of prey and contamination of seabird habitat and, as described above for marine mammals, concludes that these effects would be minor adverse for all species.

Sea Turtles

Under the Preferred Alternative, the PEA analyzes the same direct and indirect effects of PIFSC fisheries research on sea turtles as described for marine mammals (PEA Section 4.3.6). The potential for ship and small boat strikes, removal of prey, and contamination of marine habitat would be similar to the risks described for marine mammals; these effects are considered minor adverse for all species under all three research alternatives. The hearing range of sea turtles hearing is well below the frequencies of acoustic instruments used in fisheries research so turtles are unlikely to detect these sounds or be affected by them. PIFSC has no history of interactions with sea turtles in research gear and the potential for injury or mortality under all of the research alternatives is minimal. The overall effects of the Preferred Alternative would be considered minor adverse on all species of sea turtles.

Invertebrates

For all invertebrate species targeted by commercial fisheries and managed under regional Fishery Ecosystem Plans (FEPs), such as corals and lobsters, mortality due to PIFSC fisheries and ecosystem research surveys under the Preferred Alternative is less than two percent of commercial and recreational harvest and is considered to be minor in magnitude for all species. Mortality for all invertebrate species would be distributed across a wide geographic area rather than concentrated in particular localities and the risk of altering benthic community structure would be minimal. Disturbance of invertebrates and benthic habitats from research activities would be temporary and minor in magnitude for all species. The overall direct and indirect effects of the Preferred Alternative on invertebrates would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration (Section 4.3.7). Therefore, effects on invertebrates would be minor adverse according to the impact criteria in the PEA.

Chambered nautilus were listed as threatened in 2018 (83 FR 48976). PIFSC research may, but is not likely to incidentally catch chambered nautilus due to the low volume of research, short duration and dispersive nature of surveys. Therefore, potential effects of the Preferred Alternative would be minor adverse. Additional discussion of ESA-listed invertebrates is provided under #9, below.

Under the Preferred Alternative, the Northwestern Hawaiian Islands Lobster Survey is not carried forward. The elimination of this survey would substantially reduce the total mortality of lobsters from PIFSC research activities. Modified surveys include a midwater trawl added to the Cetacean Ecology Assessment Survey and increased geographic scope of the Insular Fish Abundance Estimation Comparison Surveys. These stationary bottom-contact gears have very small footprints and therefore the potential to crush, bury, remove, or expose invertebrates is also very small. New research under the Preferred Alternative would result only in minor, temporary effects (if any) on invertebrates. The overall effects of the Preferred Alternative on invertebrates would likely be minor adverse due to their low magnitude, distribution over a wide geographic area, and temporary or short-term in duration.

The Pacific Reef Assessment and Monitoring Program (RAMP) survey under the Preferred Alternative would potentially collect samples of ESA-listed corals, which is considered an adverse effect for those individuals collected. However, overall no population-level effects on coral species would occur as a result of collecting such a small number of samples. To the contrary, by collecting coral samples, research aims to contribute towards improved conservation measures for coral species. Additional discussion of ESA-listed corals is provided under #9 and #14, below.

In addition to these minor adverse effects, each of the Preferred Alternative would contribute to long-term beneficial effects on invertebrate species. Specifically, the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing and planning conservation strategies, and detecting ecosystem shifts.

2) Can the proposed action reasonably be expected to significantly affect public health or safety?

The proposed PIFSC research activities are not expected to impact public health or safety. Fisheries and ecosystem research programs, including the removal of small amounts of fish, would pose no threats to humans.

3) Can the proposed action reasonably be expected to result in significant impacts to unique characteristics of the geographic area, such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?

The research programs occur at sea. Therefore, prime farmlands, wetlands, and wild and scenic rivers do not apply. Additionally, research activities under the Preferred Alternative would be conducted away from known historic and cultural resource sites.

A limited amount of coral reef surveys may be conducted on submerged National Park Service lands (e.g. The War in the Pacific National Historical Park in Guam, American Memorial Park in the Northern Mariana Islands, Puʻuhonua o Hōnaunau National Historical Park and Kaloko Honokohau National Historic Park in Hawaiʻi, National Park of American Samoa) to assess and monitor coral reef health. SCUBA operations related to these surveys could potentially result in accidental contact between divers (fins or other diver gear) and coral. However, the use of highly qualified divers, extensive dive training, and adherence to best practices designed to minimize unnecessary contact with live reef, diminish the likelihood of any potential incidental effects to coral. Additionally, this research would occur infrequently (approximately once every three years per location), and therefore would be considered minor adverse according to the impact criteria for this PEA (Section 4.1.1).

4) Are the proposed action's effects on the quality of the human environment likely to be highly controversial?

PIFSC has not identified any controversy about the potential effects of the proposed action on the quality of the human environment nor did we receive any public comments that indicated the analysis of the effects of the proposed action on the quality of the human environment is highly controversial. The potential direct and indirect effects of fisheries and ecosystem research on biological resources would continue to occur but would be mostly minor adverse, with the exception of effects on several fish and marine mammal species, which could be moderately adverse (PEA Sections 4.3.3 and 4.3.4 respectively). Effects would be small in magnitude and would be dispersed over a large geographical area.

Effects on the social and economic environment would be minor to moderately beneficial (PEA Section 4.3.8). The process of and need for conducting fisheries and ecosystem research to support and manage fisheries is generally viewed as a minor beneficial action that will contribute to improved fisheries management and opportunities for sustainable harvests of seafood products.

5) **Are the proposed action's effects on the human environment likely to be highly uncertain or involve unique or unknown risks?**

PIFSC considered the proposed actions effects on the human environment and found it does not involve highly uncertain or unknown effects. Research techniques have been developed over many years, are well understood, and are similar to but of much smaller scale than commercial fishing techniques employed to catch target species. The effects of commercial fishing activities on non-target species through direct capture and through exposure to active acoustic systems that aid in navigation and finding fish species of interest have been analyzed in the final PEA (PEA Sections 4.3.3.2 and 4.3.4 respectively). PIFSC fisheries and ecosystem research activities are much smaller in scale than commercial fishing efforts, and potential effects associated with conducting the research are relatively certain and do not pose unique or unknown risks.

6) **Can the proposed action reasonably be expected to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?**

PIFSC fisheries and ecosystem research program would not set a precedent for future actions with significant effects or represent a decision in principle about a future consideration. In the final PEA, PIFSC has conducted a thorough analysis of its fisheries and ecosystem research program, identified mitigation measures to reduce impacts, and has determined that the research activities would not result in a significant impact (PEA Section 4.3). As research needs and techniques change, NMFS would continue to evaluate any potential impacts to the physical, biological, and human environments. The finding that PIFSC's research program, including the associated mitigation measures, would not result in a significant impact will not set a precedent or prejudice the outcomes of future analyses of similar research programs.

7) **Is the proposed action related to other actions that when considered together will have individually insignificant but cumulatively significant impacts?**

PIFSC fisheries and ecosystem research activities under the Preferred Alternative are not expected to result in cumulatively significant adverse impacts when considered in relation to other separate actions with individually insignificant effects. In addition to PIFSC research efforts, the PEA describes many current and reasonably foreseeable activities that may contribute to cumulative effects on the marine environment including: other non-PIFSC scientific research activities; federal and state-managed fisheries; charter, private, or traditional fisheries; recreation and tourism; military operations; shipping and other vessel traffic; ocean disposal and discharges; dredging; coastal development; geophysical and geotechnical activities; marine mammal and sea turtle conservation measures; climate change; ocean acidification; and natural events such as tsunamis volcanic eruptions, earthquakes, and hurricanes. These actions can produce both adverse and beneficial effects that directly and indirectly affect ocean resources managed by NMFS and the social and economic environment of fishing communities that rely on them.

The contribution of PIFSC research activities to cumulative effects would range from no effect to minor or moderate adverse or beneficial effects on the various resource components of the physical and biological environments (PEA Sections 5.2 – 5.8). Because PIFSC research activities involve a small number of vessels compared to other vessel traffic and collect relatively small amounts of biomass compared to commercial and recreational fisheries, the contribution of the Preferred Alternative to cumulative adverse effects on fish, marine mammals, sea turtles, and invertebrates would be small under normal conditions. The Preferred Alternative would contribute substantially to the science that authenticates federal fishery management measures aimed at rebuilding and managing fish stocks in a sustainable manner. It would also contribute to understanding the nature of changes in the marine environment and adjusting resource management plans accordingly, and it would help meet international treaty research obligations.

8) Can the proposed action reasonably be expected to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places (NRHP) or may cause loss or destruction of significant scientific, cultural or historical resources?

The research programs take place at sea and would have no direct effect on terrestrial cultural or historic resources. Known locations of shipwrecks, burial mounds, and fish ponds are typically found onshore or in nearshore environments, and are avoided based on best available information. As described in the PEA, PIFSC research activities under the Preferred Alternative would occur primarily away from shorelines, with limited research activities occurring in the nearshore environment (PEA Section 2.3). As with current surveys, PIFSC research activities would avoid cultural or maritime heritage resources based on areas of known sites, including historic properties, shipwrecks, burial sites, and fish ponds. Therefore, the Preferred Alternative would have zero to negligible effects on archaeological or cultural resources listed or eligible for listing on the NRHP.

9) Can the proposed action reasonably be expected to have a significant impact on endangered or threatened species, or their critical habitat, as defined under the Endangered Species Act of 1973?

PIFSC fisheries and ecosystem research activities are not likely to significantly affect threatened and endangered species listed under the ESA. ESA-listed marine mammals, fish, birds, turtles, and invertebrates are found in areas covered by PIFSC research (PEA Section 4.3). Potential impacts of the Preferred Alternative on these species range from no effect to minor adverse. The final PEA evaluates the affected environment and potential effects of PIFSC fisheries and ecosystem research that could result in M/SI to protected species incidental to research activities as described in the following subsections.

ESA-Listed Fish and Critical Habitat

As described above under #1, three fish species in the project area listed are as threatened or endangered under the ESA: the scalloped hammerhead shark, the oceanic white tip shark and the giant manta ray. Critical habitat for these species has not been designated. Under the Preferred Alternative, PIFSC would tag, track or biologically sample individuals from these species that are caught as bycatch during commercial fishing operations. Approximately 50 scalloped hammerheads, up to 50 oceanic whitetip sharks, and about 30 giant manta rays would be affixed annually with satellite tags or undergo tissue sampling. Although not expected to cause mortality or serious injury, handling, tagging, and tissue sampling and returning to the water would cause stress in the selected individuals. The effects are not likely to cause long-term changes in fitness or survival and are likely to be minor adverse (PEA Section 4.3.3.1). The ESA Section 7 biological opinion concluded that PIFSC's fishery and ecosystem research activities in the Western and Central Pacific Ocean is not likely to jeopardize the continued existence of the threatened manta ray, threatened Indo-West Pacific scalloped hammerhead shark, and threatened oceanic whitetip shark

ESA-Listed Marine Mammals and Critical Habitat

The ESA-listed marine mammals that occur in PIFSC research areas include blue, fin, sei, sperm, and North Pacific right whales; MHI insular false killer whale DPS; and Hawaiian monk seals. As described under #1, PIFSC has never caught, hooked, or had marine mammals entangled in fisheries research gear. However, based on data from analogous commercial longline fisheries, one mortality and serious injury take over five years has been requested for sperm whales. PIFSC considers the risk of M/SI takes of sperm whales in research gear to be low, and potential effects on the species and all other ESA-listed marine mammals would be minor adverse (PEA Section 4.3.4.1). In addition, the potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and the short-term duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all ESA-listed marine mammal species under the Preferred Alternative.

Hawaiian monk seals could be disturbed due to the physical presence of researchers near haulouts (sandy beaches, rocky outcroppings, exposed reefs). During the RAMP coral reef monitoring surveys, PIFSC research involves nearshore diving, small boat work, and shallow water sampling. There are numerous locations where Hawaiian monk seals may be resting adjacent to vegetation, or just emerging from the water onto the beach, and would not be immediately visible and where the options for alternate passage may be limited. It is essentially impossible for researchers to completely avoid disturbing monk seals as they travel around to conduct research. As described in the PEA (PEA Section 4.3.4.1), only about one-third of the monk seal population is onshore at any particular time and researchers generally do not approach any particular beach more than once per year. PIFSC conservatively estimates that no more than one-third of the Hawaiian monk seal population (1,437 animals) might be approached per year (~500 animals). Researchers would minimize interactions and disturbance would be short-term. Therefore, PIFSC research may have a minor adverse effect on Hawaiian Monk seals though physical disturbance.

Of the ESA-listed marine mammals that occur in PIFSC research areas, critical habitat has been designated for North Pacific right whales, the MHI Insular DPS of false killer whales, and Hawaiian monk seals. As described in the PEA, under the Preferred Alternative PIFSC research does not take place in North Pacific right whale critical habitat and would not adversely affect false killer whale or Hawaiian monk seal critical habitat.

ESA-Listed Birds

As described in the PEA, there are eight species of ESA-listed birds that may occur in PIFSC research areas: short-tailed albatross, Hawaiian dark-rumped petrel, band-rumped petrel, Newell's shearwater, Nihoa millerbird, Nihoa finch, Laysan finch, and Laysan duck. As described for #1, there have been no known adverse interactions with seabirds during PIFSC research activities; there are no records of birds being hooked or caught in research gear or ship strikes. Under the Preferred Alternative, effects would be minor adverse for all ESA-listed bird species (PEA Section 4.3.5).

The USFWS concurred with PIFSC in a response letter dated February 21, 2017 that proposed research is not likely to adversely affect these ESA-listed bird species (Consultation No. 01EPIF00-2017-1-0073).

ESA-Listed Sea Turtles and Critical Habitat

Five species of ESA-listed sea turtles can be found within PIFSC research areas: leatherback, Olive ridley, green, loggerhead, and hawksbill sea turtles. Direct and indirect effects of PIFSC research activities on sea turtles under the Preferred Alternative may include: disturbances or changes in sea turtle behavior due to physical movements and sounds, injury or mortality due to ship strikes, gear interaction, changes in food availability, and contamination or degradation of sea turtle habitat.

As described in the PEA, there have been no reported incidents of sea turtles being struck by PIFSC research vessels or becoming entangled in in research gear (PEA Section 4.3.6). Under the Preferred Alternative, the addition of several new surveys in the HARA, MARA, ASARA, and WCPRA would involve deployment of pelagic longline gear; plankton nets; conductivity, temperature and density sensors; sediment traps; and water sampling equipment, as well as collection of additional acoustic data and deployment of unmanned surface and underwater vehicles. These survey activities would pose a small risk of adverse effects to turtles and effects would be minimized by mitigation measures. PIFSC fisheries and ecosystem research activities proposed under the Preferred Alternative would be unlikely to have substantial effects on the availability of prey and forage species for sea turtles. In addition, no measurable changes in contamination or degradation of sea turtle habitat would result from PIFSC research activities.

Therefore, overall effects on any ESA-listed turtle species would be minor adverse based on criteria described in the PEA.

Although critical habitat has been designated for leatherback, loggerhead, green and hawksbill turtles, it does not overlap with PIFSC research activities as described under the Preferred Alternative. Therefore, there would be no effect of PIFSC research on sea turtle critical habitat.

ESA-Listed Invertebrates and Critical Habitat

Six ESA-listed coral species may occur in PIFSC research areas: *Acropora globiceps*, *A. retusa*, *A. speciosa*, *Euphyllia paradivisa*, and *Isopora craterifromis*. In addition to the ESA-listed coral species, the chambered nautilus was listed as threatened in 2018 (83 FR 48976).

As described for #1, The RAMP survey under The Preferred Alternative would potentially collect samples of ESA-listed corals. The Deep Coral and Sponge Research study does not collect ESA-listed corals. The RAMP survey collects up to 500 samples per year of corals (including ESA-listed species), coral products, algae and algal products, and sessile invertebrates. The fewest samples needed are collected for characterization of disease and confirmation of identity. Large numbers of ESA-taxa are not proposed to be sampled, but are required to confirm a suspected ESA sighting. The smallest possible fragments of corals are collected by gloved hands or by using small tools that are cleaned between each use. Each sample is intended to act as a skeletal and genomic voucher, and typically consist of 2 cm by 2 cm pieces. ESA coral taxa would be collected as sparingly as possible and would never exceed more than 10 samples per taxon per cruise. Mitigation measures enacted to protect coral reef habitats such as anchoring of small boats and collecting corals from only well-established colonies using gloved hands or hammer and chisel with tools bleached between uses.

In addition to directed collection of ESA-listed coral species, physical damage to corals may occur during numerous PIFSC surveys through SCUBA operations, water sampling instruments, deployment of stationary bottom-contact gear, hook-and-line bottomfishing, and marine debris removal. As described in the PEA, the overall effect of directed take of coral specimens and other PIFSC research activities under the Preferred Alternative may result in minor adverse effects on coral due to a small amount being collected. However, there would be no adverse effects on coral populations.

The ESA Section 7 BiOp concluded that PIFSC's fishery and ecosystem research activities in the Western and Central Pacific Ocean is not likely to jeopardize the continued existence of the following threatened coral species: *Acropora globiceps*, *A. retusa*, *A. speciosa*, *Euphyllia paradivisa*, and *Isopora craterifromis.*

Regarding critical habitat for ESA-listed coral species, on Nov. 27, 2020 NMFS proposed seventeen specific areas containing physical features essential to the conservation of these seven coral species in U.S. waters as critical habitat. The areas cover about 600 km^2 of marine habitat (85 FR 76262). On March 29, 2021, the public comment period on the proposed critical habitat designation for these corals was extended to May 26, 2021; and as of the date of this FONSI, critical habitat for these coral species has not been finalized. Given that the duration of the proposed action (5-years) may overlap with a final designation of the proposed coral critical habitat, the BiOp conferenced on the effects of PIFSC's fishery and ecosystem research on the proposed critical habitat to gain efficiencies in the process, and avoid disruption of the proposed action if the critical habitat is designated. The BiOp concluded that the action is not likely to adversely modify or destroy proposed critical habitat of Pacific Ocean corals.

PIFSC research may but is not likely to incidentally catch chambered nautilus due to the low volume of research, short duration and dispersive nature of surveys. Therefore, potential effects of the Preferred Alternative on chambered nautilus would be minor adverse. Critical habitat for the chambered nautilus has not been designated.

Importantly, the Preferred Alternative would contribute to long-term beneficial effects on invertebrate species throughout the Pacific Islands Region through the contribution of PIFSC fisheries and ecosystem research, especially through the removal of derelict fishing gear (PEA Section 4.37). Specifically, the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing and planning conservation strategies, and detecting ecosystem shifts.

10) Can the proposed action reasonably be expected to threaten a violation of Federal, state, or local law or requirements imposed for environmental protection?

Conducting PIFSC fisheries and ecosystem research activities would not violate any federal, state or local laws for environmental protection. PIFSC has consulted with appropriate federal, state, and local agencies as well as other entities during the development of the final PEA to ensure that the fisheries and ecosystem research program is compliant with applicable statutes including the MMPA, ESA, the National Environmental Policy Act (NEPA), and MSA. All applicable laws and Executive Orders (EOs) are summarized in Chapter 6 of the final PEA and consultation efforts are documented in Appendix C.

11) Can the proposed action reasonably be expected to adversely affect stocks of marine mammals as defined under the Marine Mammal Protection Act?

As described in the PEA, for the Preferred Alternative the potential direct and indirect effects on marine mammals through ship strikes, acoustic disturbance, potential changes in prey availability, and contamination or degradation of habitat would be considered minor adverse for all species with the exception of spinner dolphins (PEA Section 4.3.4).

PIFSC has never caught or had marine mammals entangled in fisheries research gear. Given the mitigation measures that would be implemented under the Preferred Alternative, including modification of instrument deployment gears to reduce the risk of entanglement in mooring lines relative to the status quo conditions, the relatively small amount of PIFSC effort, and the lack of takes in the past, PIFSC anticipates a low level of risk that a M/SI take would occur. However, incidental takes of marine mammals have occurred in commercial and non-commercial fisheries in the same areas as PIFSC research occurs and using gears similar to those used in research. PIFSC has used information on these analogous fisheries to estimate the number of marine mammals that may be incidentally taken during future fisheries and ecosystem research. Anticipated M/SI takes over 5 years under the Preferred Alternative include one ESA-listed species (sperm whale) and 15 non-listed cetacean species, primarily by research using longline gear but also including midwater trawls and instrument deployments (potential entanglement in mooring lines). For almost all stocks for which PBR has been determined, the requested takes, if they occurred, would represent less than ten percent of PBR and would be considered minor in magnitude. The exception is for spinner dolphins. If all of the requested takes for spinner dolphin occurred on the Oʻahu / "4-Islands Region" stock, the takes would be 12.1% of PBR for this stock and would be considered moderate in magnitude.

In addition to Level B harassment takes for many species through acoustic disturbance, PIFSC is requesting Level B harassment takes for Hawaiian monk seals due to the physical presence of researchers in nearshore waters and beaches. Given the protocols for monitoring and avoiding interactions with monk seals, these potential takes would likely result in only temporary disturbance of small numbers of monk seals and adverse impacts would be minor.

Very small amounts of fish and invertebrates would be removed from the ecosystem during scientific sampling, the sampling efforts are dispersal over large geographic areas, and sampling efforts would be of short duration. Therefore, there is no risk that research activities described under the Preferred Alternative would cause changes in prey availability for marine mammals in the research areas. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat or prey through contamination from accidental discharges into the marine environment would be negligible.

Overall, any adverse effects of the Preferred Alternative on marine mammals would be minor to moderate due to their low magnitude, dispersal over a large geographic area, and temporary or short-term duration.

12) Can the proposed action reasonably be expected to adversely affect managed fish species?

Most research activities conducted by PIFSC under the Preferred Alternative are multi-species surveys that cover large areas, involve minimal sampling, and do not target overfished species. As described in the PEA, for most species targeted by commercial fisheries and managed under FEPs, mortality due to research surveys and projects is much less than one percent of Annual Catch Limits (ACLs) or commercial harvest, and would be minor in magnitude for all species (PEA Section 4.3.3.2). For species where research catch exceeds one percent of ACLs or commercial harvest, the research catch would be small relative to the population of each species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. Furthermore, only life history studies retain fish for otoliths and gonads; all other fish are returned to the sea. Therefore, for all target species in the Pacific

Islands Region, mortality from PIFSC research activities would be considered a minor adverse effect. Also, under the Preferred Alternative, disturbance of fish and benthic habitats due to research activities would be temporary and minor in magnitude for all species. The potential for accidental contamination of fish habitat is considered minor in magnitude and temporary or short-term in duration. The overall effects of the Preferred Alternative on target fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria provided in the PEA.

In contrast to potential adverse effects, PIFSC research provides long-term beneficial effects on managed fish species throughout the Pacific Islands Region through its contribution to sustainable fisheries management. Data from PIFSC-affiliated research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by PIFSC research programs effects are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries and ecosystem research, provide the basis for monitoring changes to the marine environment important to fish populations.

13) Can the proposed action reasonably be expected to adversely affect essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act?

Under Preferred Alternative, PIFSC would conduct some fisheries and ecosystem research activities in areas of EFH; however, the research activities would be limited, minimally invasive, and extractive sampling would not occur to any considerable extent. These effects primarily involve potential minor adverse interactions with EFH. The risk of accidental spills or contamination from vessel operations is possible, although it would likely be limited in magnitude, rare, and localized as described in PEA Section 4.2.3. Near-surface and midwater trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment could result in temporary minor adverse impacts to pelagic habitat within EFH. Any research activities occurring within EFH would follow the relevant conservation recommendations as outlined in PIFSC's programmatic EFH agreement with PIRO to mitigate impacts to benthic habitat and from invasive species, sedimentation, turbidity, and chemicals.

14) Can the proposed action reasonably be expected to adversely affect vulnerable marine or coastal ecosystems, including but not limited to, deep coral ecosystems?

As described under #1 and #9, the RAMP survey under the Preferred Alternative would potentially collect a small number of samples of ESA-listed corals, which would result in an adverse effect for those individuals collected. However, overall no population-level effects on coral species would occur and the RAMP surveys support numerous management objectives, including monitoring ecosystem health, understanding the effects of climate change and ocean acidification, assessing ecological effects of fishing, prioritizing and planning conservation strategies, and detecting ecosystem shifts.

During marine debris removal surveys, derelict fishing gear is cut, pulled, or both, off coral colonies. The removal activities are designed to mitigate long-term adverse impacts to coral colonies. However, during removal activities, there are short-term and temporary adverse impacts when derelict fishing gear is removed. The impacts include breaking off pieces of coral that are sometimes impossibly entangled in nets and line, and then removing them from the marine ecosystem. The long-term beneficial impact of removing derelict fishing gear from the marine ecosystem is to provide the space and light necessary for the coral colonies to grow and avoid entangling other marine species in the future.

SCUBA operations related to surveys could potentially result in accidental contact between divers (fins or other diver gear) and coral. However, the use of highly qualified divers, extensive dive training, and adherence to best practices designed to minimize unnecessary contact with live reef, diminish the likelihood of any potential incidental effects to coral.

15) Can the proposed action reasonably be expected to adversely affect biodiversity or ecosystem functioning (e.g., benthic productivity, predator-prey relationships, etc.)?

To date, there have been no identified impacts to marine biodiversity and/or ecosystem function from PIFSC fisheries and ecosystem research activities. Actions associated with the Preferred Alternative are not expected to significantly adversely affect biodiversity or ecosystem function within the affected environment. The sampling and removal of species targeted by and incidental to research activities would be limited in scope and duration, and occur over large areas of open ocean. Ecosystem research studies are essential to the management of commercial fisheries. Long-term, predictable marine research provides information on changes and trends in the marine ecosystem to inform fisheries management. Development of ecosystem management methods is beneficial to overall ecosystem function.

16) Can the proposed action reasonably be expected to result in the introduction or spread of a nonindigenous species?

The proposed PIFSC research activities would not likely result in the spread or introduction of non-indigenous species. The research involves movement of vessels between water bodies. Ballast water management and other discharge processes for NOAA and charter vessel operations are bound by federal laws, regulations and EOs that are in place in order to prevent or minimize the potential for spread or introduction of non-indigenous species, including the Clean Water Act, National Invasive Species Act, Nonindigenous Aquatic Nuisance Prevention and Control Act, and EO13112. In addition, PIFSC follows procedures to disinfect and clean equipment, gear, and small boats used in the field and anti-fouling paint is applied to the hull and bottom of NOAA vessels every two years.

Determination

In view of the information presented in this document and the analysis contained in the supporting final PEA prepared for fisheries and ecosystem research conducted and funded by PIFSC, it is hereby determined that continuation of PIFSC fisheries and ecosystem research program would not significantly impact the quality of the human environment. In addition, all beneficial and adverse effects of PIFSC fisheries and ecosystem research program have been analyzed to reach the conclusion of no significant impacts. Accordingly, preparation of an Environmental Impact Statement for this action is not necessary.

03/26/23

Tia Brown, Acting Director
Pacific Islands Fisheries Science Center

Date