Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Conference Report

Action Agency:	National Marine Fisheries Service, Pacific Islands Fisheries Science Center, NMFS Office of Protected Resources, Permits and Conservation Division
Federal Action:	Conference Report and Supplement to the Biological Opinion on the 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
NMFS File No. (ECO):	PIRO-2024-03346
PIRO Reference No.:	I-PI-24-2423-DG
Approved By:	MALLOY.SARAH.JOAN.1262526743 Digitally signed by MALLOY.SARAH.JOAN.1262526743 Date: 2025.03.24 14:05:06 -10'00' Sarah Malloy Regional Administrator, Pacific Islands Region
Date Issued:	March 24, 2025

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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. The ESA requires federal action agencies to consult with National Marine Fisheries Service (NMFS) when the action may affect a listed species or its designated critical habitat under our jurisdiction (50 CFR 402.14(a)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, we provide a biological opinion (opinion) stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If we determine that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, in accordance with the ESA section 7(b)(3)(A), we provide a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If incidental take[1] is reasonably certain to occur, section 7(b)(4) requires us 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.

We prepared this opinion and ITS in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR part 402. We completed pre-dissemination review of this document 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). Following signature and finalization, this document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome].

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act. 89 Fed. Reg. at 24268; 84 Fed. Reg. at 45015. We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations. For the purpose of this consultation, we considered whether the additional collection of fragments from three ESA-listed corals would jeopardize the

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[1] Under the ESA, the term "take" is defined by the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. We further define "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" (Application and Interpretation of the Term Harass Pursuant to the Endangered Species Act: NMFS Guidance Memo May 2, 2016). NMFS defines harm as "an act which actually kills or injures fish or wildlife." 50 C.F.R. 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.

continued existence of those species. We also added evaluations of the action on proposed giant clam species and proposed critical habitats for three distinct populations of green sea turtles.

1.1 Consultation History

The Pacific Islands Fisheries Science Center (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 17, 2021, PR1 clarified through email that these takings under MMPA constitute likely to adversely affect determinations under the ESA. All of these takes of false killer whales and Hawaiian monk seals described under the MMPA permit were level B harassment from sounds generated by the action. The definitions of take from MMPA and ESA, described in the above footnote, are different. We determined that the effects from sound generated may cause harassment under the MMPA but did not rise to the level of harm or harassment as defined under the ESA, and not likely to adversely affect false killer whales and Hawaiian monk seals.

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 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.

Additionally, PRD described current records of ESA-listed coral species in the U.S. Pacific Islands (NMFS 2021) for our evaluation of proposed coral critical habitat (85 FR 76262 [withdrawn and reproposed in November 2023 – 88 FR 26051). Based on this evaluation, PRD has confirmed that *Acropora jacquelineae* and *Seriatopora aculeata* did not occur in any U.S. territorial waters (NMFS 2021). 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 *A. jacquelineae* and *S. aculeata* from further analysis and provided clarification that research longline sets will replicate the DSLL fishery only. Lastly, PIFSC 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. All take associated with sampling would be covered under these existing consultations, and not increase the amount of exposures to ESA-listed species.

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 21, 2022, NMFS submitted a biological opinion to PIFSC and concluded formal 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.

On November 26, 2024, we received a letter from PIFSC requesting re-initiation of their existing formal consultation. The PIFSC is proposing to increase the amount of individuals affected by action from an estimated ten per species to 76 per species for *Acropora globiceps, Acropora retusa*, and *Isopora crateriformis*. Per 50 CFR 401.16(2) and (3), PIFSC is reinitiating consultation because the amount of anticipated incidental take in the existing consultation will be exceeded. No other re-initiation triggers have been met and therefore the current biological opinion will supplement the 2022 biological opinion with new information and analyses on three coral species.

On December 2, 2024, PIFSC requested that we add conferences on giant clams, and proposed critical habitat for three DPSs of green sea turtle. The 2022 biological opinion remains valid for all other ESA-listed species under NMFS jurisdiction occurring in the action area. Furthermore, effects to three proposed giant clam species and proposed green sea turtle critical habitat that were not considered for the existing consultation are considered here.

1.2 Proposed Federal Action

Under the ESA (50 CFR 402.02), the term "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas (see 50 CFR 402.02).

The PIFSC is conducting and funding all research activities, and is the action agency for this project. 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 Cooperation Branch (ICB). 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 1998, 2007, Seminoff et al. 2015), corals (Brainard et al. 2009), and giant clams (Rippe et al. 2024), and other sources of information as cited herein. The PIFSC is proposing to conduct research throughout the Pacific Islands Region as described in the BA (PIFSC, 2021), and PIFSC's November 25, 2024 reinitiation letter.

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. PIFSC (2021) provides a full description of PIFSC's entire action, and our 2022 biological opinion provides the description of all activities in their program, statuses of species, and evaluations of effects to species and critical habitats not included in this supplement. This supplement address the proposed changes to the action, and conference of proposed listed species and proposed critical habitat.

In addition to the coral sampling that was evaluated in the existing consultation for PIFSC' research program, PIFSC is proposing to collect additional samples from up to 66 colonies of each species throughout Tutuila, American Samoa. This brings the total number of colonies affected by PIFSC's research program to 76 colonies each of *A. globiceps, A. retusa*, and *I. crateriformis*. These additional samples will be used to support research on the distribution and thermal adaptive capacity of those species.

All proposed activities that could affect the listed corals, proposed giant clams, and proposed green sea turtle critical habitat 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 the effects of these particular activities 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.

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.

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.)
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

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.)
Marine Debris Research and Removal	Surface and midwater plankton tows to quantify floating micro-plastic 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
Marine Debris Research and Removal	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
Marine Debris Research and Removal	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
Marine Debris Research and Removal	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
Marine Debris Research and Removal	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.	

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 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
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
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 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 coral skeletons to generate new BMUs to measure bio erosion rates, and study bio erosion.

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.)
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	Active acoustics: will vary by vessel (Multi-beam: Reson8101 ER; split-beam: Simrad EK60)	38-200 kHz	Continuous
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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.
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	ADCP	Nortek Aquadopp Sideseeing Profiler, 2 megahertz (MHz) down to 30 m	Continuous during transects
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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

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.)
Pacific Reef Assessment and Monitoring Program (RAMP)	See above.	See above.	See above.	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
Pacific Reef Assessment and Monitoring Program (RAMP)	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
Pacific Reef Assessment and Monitoring Program (RAMP)	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.		
Pacific Reef Assessment and Monitoring Program (RAMP)	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
Pacific Reef Assessment and Monitoring Program (RAMP)	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
Pacific Reef Assessment and Monitoring Program (RAMP)	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

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 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
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; 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
West Hawaii Integrated Ecosystem Assessment Cruise	See above.	See above.	See above.	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, Fre-quency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
West Hawaii Integrated Ecosystem Assessment Cruise	See above.	See above.	See above.	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)
West Hawaii Integrated Ecosystem Assessment Cruise	See above.	See above.	See above.	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.
West Hawaii Integrated Ecosystem Assessment Cruise	See above.	See above.	See above.	ADCP (RD Instruments Ocean Surveyor 75)	75 kHz	Intermittent continuous during surveys
West Hawaii Integrated Ecosystem Assessment Cruise	See above.	See above.	See above.	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.)
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
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)
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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

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.)
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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)
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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)
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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)
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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)
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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
Insular fish Abundance Estimation Comparison Surveys	See above.	See above.	See above.	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.)
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 Oʻahu)	Year-round, up to 15 DAS Day and night	Nets, lines, instruments Calibration of Simrad EK60	38-200 kHz	Intermittent for 24-48 hours
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
Mariana Resource Survey	See above.	See above.	See above.	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.)
Mariana Resource Survey	See above.	See above.	See above.	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
Mariana Resource Survey	See above.	See above.	See above.	Simrad split-beam EK60, OES Netmind	38-200 kHz	Intermittent continuous during surveys
Mariana Resource Survey	See above.	See above.	See above.	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
Mariana Resource Survey	See above.	See above.	See above.	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.)
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
Lagoon Ecosystem Characterization	See above.	See above.	See above.	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
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.			Small-mesh 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

Survey Name	Survey Description	General Area of Operation*	Season, Fre-quency& Yearly Days at Sea (DAS)	Gear Used	Gear Details (Approx.)	Total Number of Samples (Approx.)
Coastal Pelagic Ecology, Coastal Fishery Oceanog-raphy, Opelu Koas	See above.			CTD profiler (portable unit)	15-30 min cast duration	60 casts per year
Coastal Pelagic Ecology, Coastal Fishery Oceanog-raphy, Opelu Koas	See above.			360 degree video camera	Less than 1 hour duration	Up to 20 deployments per year
Coastal Pelagic Ecology, Coastal Fishery Oceanog-raphy, Opelu Koas	See above.			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.
Coastal Pelagic Ecology, Coastal Fishery Oceanog-raphy, Opelu Koas	See above.			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 de-canted into 10 L carboys for pro-cessing.	60 casts per year
Coastal Pelagic Ecology, Coastal Fishery Oceanog-raphy, Opelu Koas	See above.			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 de-canted into 10 L carboys for pro-cessing.	60 casts per year

Table 2. Proposed Mitigation and Monitoring Measures.

Proposed Activities	Mitigation and Monitoring Measures
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

Proposed Activities	Mitigation and Monitoring Measures
	8. 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 9. 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) 10. 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, and up to 76 for three species in American Samoa. 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* • 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.

Proposed Activities	Mitigation and Monitoring Measures
	• 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. Sea Turtles and Hawaiian Monk Seals • 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

Proposed Activities	Mitigation and Monitoring Measures
	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 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 Un-manned 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.
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 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 for the proposed activities encompasses the full extent of the action's modifications to land, water, and air. For this action, the full extent of direct and indirect effects 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 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 Large Marine Ecosystem boundary. The Insular Pacific-Hawaiian Large Marine Ecosystem has a surface area of approximately one million km^2, 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.

1.4 Analytical Approach

The PIFSC determined the proposed action is not likely to adversely affect *Hippopus hippopus, Tridacna gigas,* and *T. derasa*, or proposed critical habitat for the Central West Pacific green sea turtle, Central North Pacific green sea turtle, and Central South Pacific green sea turtle. Our concurrence is documented in the Not Likely to Adversely Affect Determinations section (Section 9).

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of jeopardize the continued existence of a listed species, which is "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). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of destruction or adverse modification, which "means 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). Therefore, the adverse modification analysis considers how federal actions affect the quantity, quality, and availability of the physical or biological features of the designated critical habitat.

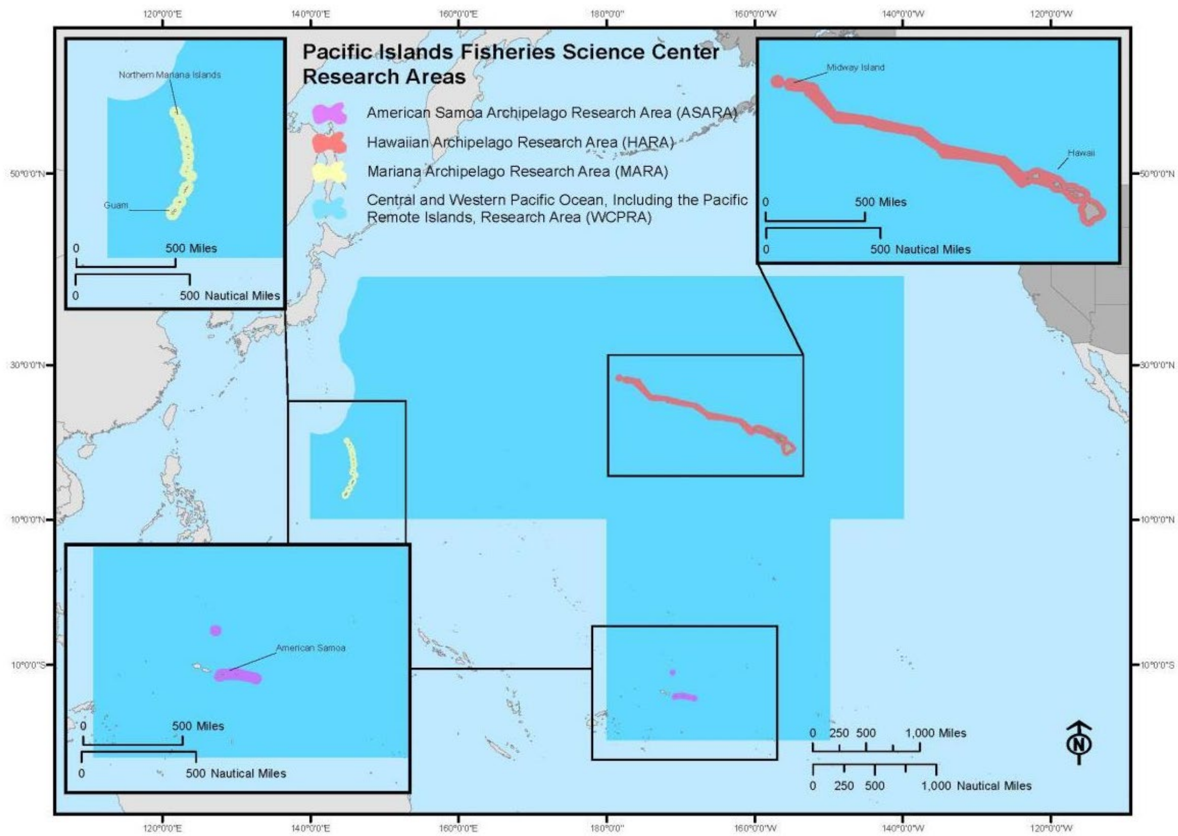

Figure 1. Pacific Islands Fisheries Science Center Research Areas.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action
- Evaluate the environmental baseline of the species and critical habitat
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach
- Evaluate cumulative effects
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly 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; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species
- If necessary, suggest a reasonable and prudent alternative to the proposed action

1.5 Conferencing

Under section 7(a)(4) of the ESA, each Federal agency shall confer with the Secretary on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed or result in the destruction or adverse modification of critical habitat proposed to be designated for such species. While consultations are required when the proposed action may affect listed species, a conference is required only when the proposed action is likely to jeopardize the continued existence of a proposed species or destroy or adversely modify the proposed critical habitat. However, Federal action agencies may request a conference on any proposed action that may affect proposed species or proposed critical habitat (USFWS & NMFS 1998).

2 Status of the Listed Resources

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' reproduction, numbers, or distribution for the jeopardy analysis.

2.1 Environmental Considerations

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/m^2 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 2 ºC presented in Table 3 (IPCC 2018, 2022). 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, 2022).

Table 2. Projections for certain climate parameters under Representative Concentration Pathway 8.5 (values from Table 2.1 IPCC 2014; see Figure 3.4 in IPCC 2022).

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)

In this assessment, we rely on systematic assessments of available and relevant information to incorporate climate change in a number of ways. We address the effects of climate, including changes in climate, in multiple sections of this assessment: Status of the Listed Resources (Section 2), Environmental Baseline (Section 3), and Integration and Synthesis (Section 6). 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.

2.2 Status of the Species

This section consists of narratives for the species occurring in the action area that may be adversely affected by PIFSC's action. These status summaries provide the point of reference for our analyses of whether or not the action's direct and indirect effects are likely to appreciably reduce a species' probability of surviving and recovering in the wild. Each 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 in abundance of the species and affected population(s) (which are relevant to the numbers criterion of the jeopardy standard)
3. Information on the reproduction of the species and affected population(s) (which is a representation of the reproduction criterion of the jeopardy standard)
4. Natural and anthropogenic threats to the species and/or affected population(s) (which helps explain our assessment of a species' likelihood of surviving and recovering in the wild)
5. Recent conservation activities for the species and/or affected population(s) (which also helps explain our assessment of a species' likelihood of surviving and recovering in the wild)

More detailed background information on the general biology and ecology of the species listed in Table 4 can be found in status reviews and recovery plans for the various species as well as the public scientific literature.

Table 3. 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
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)	*Isopora crateriformis*	Threatened	10/10/2014	79 FR 53852

2.2.1 Corals

We listed *A. globiceps*, *A. retusa*, and *I. crateriformis* as threatened on threatened on September 10, 2014) (79 FR 53851). The last 5-year review (NMFS 2023) reaffirmed the threatened listing.

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.

2.2.2 Coral Species

<u>Acropora globiceps</u>

Distribution and Population Structure
A. globiceps was listed as threatened on September 10, 2014 (79 FR 53852). *A. globiceps* is distributed from the oceanic west Pacific to the central Pacific as far east as the Pitcairn Islands. In the U.S., *A. globiceps* occurs in American Samoa, the Northern Mariana Islands, and the minor outlying islands (Figure 2).

Colonies of *A. 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, *A. 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 2. Range of *A. 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 *A. globiceps* by recognized experts, and light green indicates ecoregions where it is strongly predicted to occur by recognized experts.

Status and Trends of Abundance
Detecting changes in abundance over time of rare or uncommon Indo-Pacific reef-building coral species such as *A. 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 *A. 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 *A. globiceps* colonies from bleaching was higher than overall coral mortality from bleaching (Raymundo et al. 2019).

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, *A. 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 *A. 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 *A. 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 *A. globiceps* is uncommon, but ranges from rare to common, depending on the location.

Based on *A. globiceps*' distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *A. 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, *A. 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: *A. globiceps* is widely distributed on the reef slopes around Guam. For example, David Burdick reported *A. globiceps* from 22 sites around Guam (2015 personal communication reported in NMFS 2021), and the U.S. Department of Defense reported the species from 24 sites around Guam (Figure 4-14; Navy 2019).

CNMI: *A. 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 (2021) reports *A. globiceps* from Anatahan, Pagan, and Maug. In addition, *A. globiceps* has been reported from Farallon de Medinilla (Carilli et al. 2020), an islet between CNMI's southern and northern islands.

American Samoa: *A. globiceps* is widely distributed on the reef slopes around Tutuila and Aunuʻu, 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, Taʻu, and Rose Atoll. Swains Island is the most isolated island of American Samoa. It has occasionally been surveyed for corals, but *A. 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 *A. globiceps* on Palmyra Atoll, while Kenyon et al. (2011) and Doug Fenner (2017 personal communication reported in NMFS 2021) reported it from Kingman Reef and Wake Atoll, respectively, and Tony Montgomery reported it from Johnston Atoll (2019 personal communication reported in NMFS 2021). The species has not been reported on Baker Island, Howland Island, or Jarvis Island.

NWHI (Papahānaumokuākea Marine National Monument): *A. 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 *A. globiceps*.

Reproduction
Like other *Acropora* species, *A. 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 *A. 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.

Acropora retusa

Distribution and Population Structure
A. retusa was listed as threatened on September 10, 2014 (79 FR 53852). *A. retusa* is either confirmed or strongly predicted from the South Africa to French Polynesia (Veron et al. 2016). In addition, *A. retusa* has been confirmed in the Chagos Archipelago (NMFS 2021; Figure 3).

Figure 3. Range of *A. retusa*, modified from the map in Veron et al. (2016). Dark green indicates ecoregions with confirmed observations of *A. retusa* by recognized experts, and light green indicates ecoregions where it is strongly predicted to occur by recognized experts.

Colonies of *A. 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, *A. 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 *A. retusa* successfully compete for space, but susceptibility to threats such as warming-induced bleaching is high (79 FR 53851-54123).

A. 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 2021).

A. 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. *A. 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. *A. retusa*'s abundance is considered rare overall.

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.

Status and Trends of Abundance
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, *A. 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)), *A. 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 *A. retusa* to be rare to common, depending on the location.

Based on *A. retusa*'s distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *A. retusa* to be at least millions of colonies. Dietzel et al. (2021) estimated its absolute abundance at 540 million colonies. Within U.S. waters, *A. retusa* occurs in Guam, CNMI, American Samoa, and PRIA, as described in more detail below.

Guam: Wallace et al. (2012) reported a sample of *A. 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 2021). The U.S. Department of Defense reported the species from 2 sites on Guam (Department of Defense 2019).

CNMI: Within CNMI, *A. 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 2021).

American Samoa: *A. 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 *A. 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 2021), while Kenyon et al. (2011) reported finding *A. retusa* on Rose Atoll. The species has not been reported from Swains Island.

PRIA: Kenyon et al. (2011) reported *A. retusa* from Johnston Atoll, Howland Island, and Kingman Reef, while Doug Fenner reported it from Wake Atoll (2017 personal communication reported in NMFS 2021), and Venegas et al. (2019) reported it from Jarvis Island. The species has not been reported from Palmyra Atoll or Baker Island.

Reproduction

A. retusa is similar in structure and reproductive strategy as *A. globiceps* and others in the genus. *A. 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 *A. 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.

Isopora crateriformis

Distribution and Population Structure
I. 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 *I. crateriformis* (Wallace et al. 2012; Veron et al. 2016), which is accepted by the World Register of Marine Species (Hoeksma and Cairns 2021).

I. 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). *I. crateriformis* has been either confirmed or strongly predicted in 30 ecoregions from the Coral Triangle to Tonga (Figure 4).

I. 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 *I. 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).

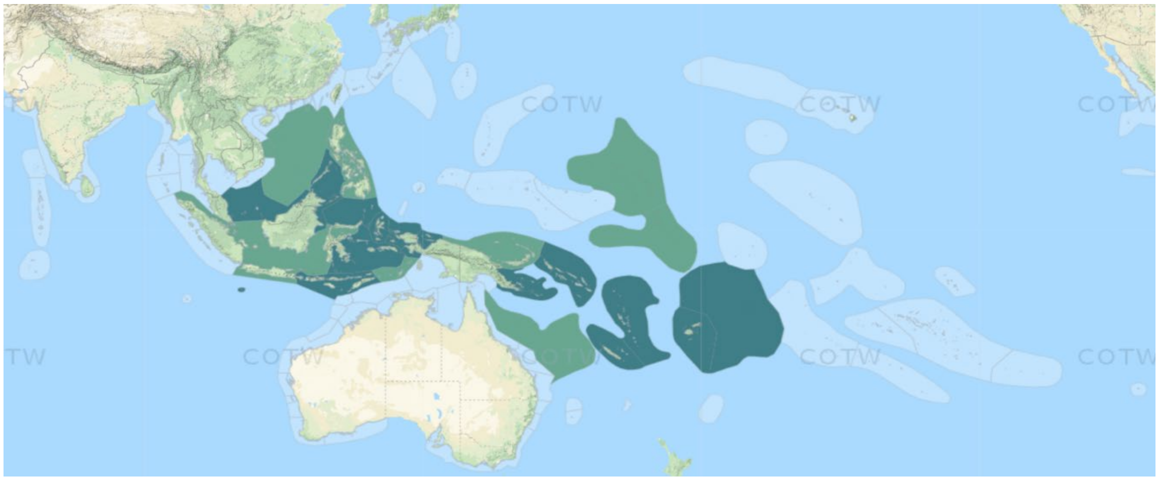

Figure 4. Range of *I. crateriformis* (Veron et al. 2016). Dark green indicates ecoregions with confirmed observations of *I. crateriformis* by recognized experts, and light green indicates ecoregions where it is strongly predicted to occur by recognized experts.

Status and Trends of Abundance

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 *I. 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 *I. crateriformis*'s abundance has been in decline for decades, and that the rate of its decline has accelerated in recent years.

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, *I. 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 *I. 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 *I. 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 *I. 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 *I. crateriformis* to be rare to common, depending on the location. Within U.S. waters, *I. crateriformis* has only been observed in American Samoa, and not in the Mariana Islands or any PRIA.

American Samoa: *I. crateriformis* is relatively abundant locally throughout American Samoa.

Based on *I. crateriformis*'s distribution and relative abundance, NMFS (2014) estimated the absolute abundance of *I. crateriformis* to be at least millions of colonies. Dietzel et al. (2021) estimated its absolute abundance at 69.6 million colonies.

Reproduction
The *Isopora* genus is similar to *Acropora* with one notable exception. While *Acropora* corals are broadcast spawners which broadcast both male and female gametes into the water column, *Isopora* corals are brooding spawners. In brooding species, only male gametes are broadcast into the water column while fertilization and larval development occur within the polyps of colony. This life history strategy would require colonies to be relatively close to each other to recruit sperm into the nearby colonies to exchange genetic diversity. Similar to most reef building corals, *I. crateriformis* can also asexually reproduce through budding and skeletal growth, and fragmentation.

3 ENVIRONMENTAL BASELINE

The environmental baseline is defined by regulation (50 CFR 402.02). 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 environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone completed formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Increasing water temperatures, ocean acidification, rising sea levels, changes in intensity and frequency of large storm events, and other changes associated with climate change largely affect corals and coral communities which includes giant clams. These are discussed in detail in the Status of the Listed Resources section of this document.

Fisheries, 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., contact and debris from fishing activities, 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.

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.

Military training occurs throughout the region except for American Samoa and most PRIAs. The nearshore activities could affect coral, giant clam, and sea turtle habitat. We completed consultations with the Navy on all training in the Mariana Archipelago (NMFS No. FRP-2014-9070) and Hawaiian Archipelago (NMFS No. FPR-2018-9275) and the effects are considered part of the environmental baseline.

4 EFFECTS OF THE ACTION

Under the ESA regulations (50 CFR 402.02), 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 but that are not part of the 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. For this proposed action, we determined it will not cause any other activities.

We use a stepwise approach to analyze effects to species and critical habitats:

1. Identify those physical, chemical, or biotic effects of the proposed action that directly or indirectly affect the action area (hereafter using the term stressors).
2. Identify the species and/or critical habitats likely to co-occur with these stressors in space and time (exposure).
    a. For species, estimate the number, age or life stage, and other pertinent characteristics (e.g., sex) of the individuals and the populations or subpopulations those individuals represent.
        i. If estimating the number is not possible, use a habitat-based analysis.
    b. For critical habitat, if applicable, identify the physical or biological features exposed.
3. Determine if/how exposed species and critical habitats will likely respond to the exposure.
    a. For species, determine the individual's probable response and if it is likely to have consequences on its fitness (growth, survival, annual reproductive success, etc.).
        i. If using a habitat-based analysis, explain the changes in habitat and the consequences to individuals.
        ii. Determine what consequences the effects on individuals have on the populations those individuals represent (changes in the population'

abundance, reproduction, spatial structure and connectivity, growth rates, etc.).

b. For critical habitat, if applicable, examine the relationships between the habitat changes and physical and biological features and overall value of the affected area.

4.1 Stressors

We determined that the following stressors are not likely to adversely affect any species (See Appendix A for more details):

1. Direct take of coral specimens;
2. Interactions with corals and giant clams during spearfishing and survey activities;
3. Changes in food availability;
4. Anchoring;
5. Potential injuries or behavioral changes from sound sources;
6. Interaction with, including capture of non-target species, such as listed species, or their prey;
7. Interaction with derelict gear;
8. Introduction of oily discharges, cardboard, plastics, and other waste into marine waters;
9. Collisions with vessels;
10. Vessel groundings; and
11. Vessel emissions.

We determined that stressors 2 through 11 are not likely to adversely affect any listed species or designated critical habitats. The rationale for those determinations is documented in Section 9.1. As a result, in this section we focus on the stressors likely to adversely affect listed species and/or proposed critical habitats.

4.2 *A. globiceps*, *A. retusa*, and *I. crateriformis*

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.

4.2.1 Exposure

Coral specimen collection

The proposed action would include the directed take of voucher specimens of *A. globiceps, A. retusa,* and *I. crateriformis*. The RAMP Surveys collect 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. 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.

The PIFSC informed us that they proposed to revise their action to include more sampling of three ESA-listed corals, *A. globiceps, A. retusa,* and *I. crateriformis* from reefs in Tutuila, American Samoa. The PIFSC is planning to collect fragments in two phases. In the first phase, the PIFSC will collect up to 30 fragments (2cm x 2cm) per species for taxonomic verification during visual surveys of randomly stratified sites within two depth strata (0-6 meters, and 6-18 meters). From these surveys and collections, the PIFSC will identify six locations on Tutuila where they will collect 30 fragments from six colonies of each species of each site. In summary, up to 66 colonies of each of the three species could be affected by collection of fragments. Sixty-six is the maximum number of colonies, which would assume none of the fragments taken in phase 2 would be taken from same colonies in phase 1. In no case will specimens be collected if it is judged that doing so might inhibit the capacity of the taxon to replenish itself. The PIFSC will avoid collecting fragments from colonies with poor health or too immature to handle fragment removal, and will select only robust colonies to collect fragments from, especially in phase 2. This will reduce the probability of mortality to the colonies.

4.2.2 Response

Coral specimen collection

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). *A. 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). *A. 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, *A. 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 *A. 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 *A. 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. 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, 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) from the random sampling. Additionally, 66 more colonies of *A. globiceps*, *A. retusa*, and *I. crateriformis* around Tutuila, American Samoa will be affected by the proposed increased sampling for a total of 76 colonies per each of those three species.

Some of these species are locally common (*I. crateriformis*), and others are widespread (*A. globiceps*, *A. retusa*). Total global population for these species range from the 10,000s to millions. The loss of up to 76 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 three species in the Action Area, and across their global range.

5 CUMULATIVE EFFECTS

Cumulative effects 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). A conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available. 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.

Population growth in the archipelagos vary ranging from decreasing populations (-10.5%) in American Samoa (U.S. Census 2020a), stable in Hawai'i (U.S. Census 2020b) to anticipated growth from Guam and CNMI military relocation. Increases in human populations will likely increase stressors associated with population growth from increased impervious surfaces, pollutant loading, and effects of recreational activities in the action area. These effects will likely intensify when population grows and may diminish with population decreases.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the Status of the Listed Resources section (Section 2.1).

6 INTEGRATION AND SYNTHESIS

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the Effects of the Action (Section 4) and the Cumulative Effects (Section 5) to the Environmental Baseline (Section 3), and in light of the Status of the Listed Resources (Section 2), formulate our opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of critical habitat as a whole for the conservation of the species.

Our analyses find that the proposed action, while it results in sublethal injuries or stress and occasional death to *A. globiceps, A. retusa*, and *I. crateriformis* has very small effects on the dynamics of the populations those individuals represent or the species those populations comprise. Despite their ESA-listing, all three species have widespread distribution and relatively large number of individuals. All three species show the same decreasing trends throughout their range from an identical array of effects.

We anticipate up to 76 ESA-listed coral colonies of each of the three species 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 *A. globiceps, A. retusa,* and *I. 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 (*A. globiceps, I. crateriformis*), and others are widespread (*A. globiceps, A. retusa*). The adjusted total number would change to 76 colonies each for *A. globiceps, A. retusa,* and *I. crateriformis* around Tutuila, American Samoa. Total global population for these species range from around 70 million to over 600 million colonies. With such similarities in population structures, distributions, vulnerabilities, and threats, the effects of this action to not only individuals but to their global populations of these three species are similar.

As described in the Effects of the Action section, we estimate that PIFSC will randomly and incidentally collect up to ten samples per year of all five of the ESA-listed coral colonies (total, not each) as described in the 2022 biological opinion. 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 ten random collections predicted would not be from one species. If we assume an even distribution among the ten samples among the five species, we can predict that two from each species could be collected.

In addition, as described in the November 25, 2024, reinitiation letter from PIFSC, PIFSC additionally proposes to collect fragments from up to 66 colonies of *A. globiceps*, *A. retusa*, and *I. crateriformis* from reefs throughout Tutuila. 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.

When added to the estimated ten samples from the original proposal, no more than 76 colonies each of *A. globiceps*, *A. retusa*, and *I. crateriformis* will be affected by this action. 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 three species are widely distributed (at least four eco-regions ranging thousands of miles and several archipelagos), and numbers range from at least millions (NMFS 2014) to around 70 million to more than 600 million colonies (Dietzel et al., 2021).

6.1 *Acropora globiceps*

A. globiceps is the most abundant of the ESA-listed species in U.S. waters with up to 654 million colonies worldwide, and is found in 13 ecoregions throughout the Indian and Pacific Oceans. Despite its large numbers and good distribution, their temperature and depth range where they live in the water column is limited and changing rapidly. These conditions make this species vulnerable to rapid declines in population during warming events. PIFSC is collecting these specimens to conduct controlled research on these species to learn about their temperature tolerance, and other factors. This research could inform us on how to better manage this species.

The PIFSC will collect specimens from healthy colonies that are most likely to survive from fragment removal. This maximizes the probability of colonies surviving. PIFSC will also select areas where there are several colonies of each species in the general area to provide for recruitment if the affected colonies die. This reduces the likelihood of *A. globiceps* from being extirpated from the sampled area due to PIFSC's action.

Considering the present abundance and distribution or the species throughout its range, the injuries associated with specimen collection and potential mortality of up to 76 colonies of *A. globiceps* would represent a miniscule portion of the global population. At least 76 of those collections would be around Tutuila where colonies are abundant at some locations. Only six colonies at each of the five sites would have multiple fragments taken from them.

PIFSC will select locations where there are multiple colonies of *A. globiceps* in the general area, so that losing one colony would not appreciably affect the ability of the species to re-recruit or settle. Therefore, if all 76 colonies were to die, *A. globiceps* would not be vulnerable to extirpation in those areas, which could otherwise affect their regional and global distribution.

This action will not measurably reduce the abundance, reproduction, spatial structure and connectivity, growth rates, or variance. Thus, the proposed action will not lead to an appreciable reduction in the likelihood of survival or recovery of *A. globiceps*.

6.2 *Acropora retusa*

A. retusa are locally common in some ecoregions but rare in others. *A. retusa* is relatively abundant with up to 580 million colonies worldwide, and is found in five ecoregions throughout the Indian and Pacific Oceans. *A. retusa* extends further west than *A. globiceps* and have populations near Madagascar and southern Africa. Despite its large numbers and good distribution, their temperature and depth range where they live in the water column is limited and changing rapidly. These conditions make this species vulnerable to rapid declines in population during warming events.

Collection sites should be selected where local populations of the species being collected are stable, ensuring continued existence at the sites and potential for repopulation or recruitment if colonies die. With these measures, it is unlikely that *A. retusa* would be extirpated from a site and lose their distribution. If all 76 colonies die, *A. retusa* would not be vulnerable to extirpation in those areas sampled, which could affect their regional and global distribution. With hundreds of millions of colonies among widely distributed species, this action will not measurably reduce the abundance, reproduction, spatial structure and connectivity, growth rates, or variance. Thus, the proposed action will not lead to an appreciable reduction in the likelihood of survival or recovery of *A. retusa*.

6.3 *Isopora crateriformis*

I. crateriformis is not as abundant as the two above *Acropora* species but is still estimated at up to 69.6 million colonies worldwide from five ecoregions. *I. crateriformis* is also not as widespread in distribution as the other two but it still spans over 6500 miles. Despite its large numbers and good distribution, their temperature and depth range limits their distribution among those ecoregions. These conditions make this species vulnerable to rapid declines in population during warming events.

I. crateriformis is locally abundant in some areas around Tutuila where it is the dominant species within that reef or appear "weedy". Collection sites should be selected where local populations of the species being collected are stable, ensuring continued existence at the sites and potential for repopulation or recruitment if colonies die. With these measures, it is unlikely *that I. crateriformis* would be extirpated from a site and lose their distribution. If all 76 colonies die, *I. crateriformis* would not be vulnerable to extirpation in those areas sampled, which could affect their regional and global distribution. With hundreds of millions of colonies among widely distributed species, this action will not measurably reduce the abundance, reproduction, spatial structure and connectivity, growth rates, or variance. Thus, the proposed action will not lead to an appreciable reduction in the likelihood of survival or recovery of *I. crateriformis*.

7 CONCLUSION

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of *A. globiceps*, *A. retusa*, and *I. crateriformis*.

8 INCIDENTAL TAKE STATEMENT

Section 9(a) of the ESA prohibits taking of endangered species. In the case of threatened species, section 4(d) of the ESA leaves it to the Secretary's discretion whether and to what extent to extend the statutory 9(a) take prohibitions, and directs the agency to issue regulations it considers necessary and advisable for the conservation of the species.

The term "incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR 402.02). The proposed action results in the incidental take of *A. globiceps*, *A. retusa*, and *I. crateriformis*. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of this incidental take statement (ITS).

We have not yet promulgated an ESA section 4(d) rule prohibiting take of *A. globiceps*, *A. retusa*, and *I. crateriformis*, so an exemption from the take prohibitions of section 9 of the ESA is neither necessary nor appropriate for these species.

Consistent with the decision in *Center for Biological Diversity v. Salazar*, 695 F.3d 893 (9th Cir. 2012), we have included an incidental take statement to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger if the level of take analyzed in the biological opinion is exceeded. In addition, 50 CFR 402.14(i)(3), without regard to 9(a) prohibitions, 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."

8.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of incidental taking as the amount or extent of such taking (50 C.F.R. §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions. In the biological opinion, NMFS determined that incidental take is reasonably certain to occur is described in Table 5.

We expect up to 76 colonies of *A. globiceps*, *A. retusa*, and *I. crateriformis* each will be taken and harmed by collection of fragments in the proposed action.

Table 4. Estimated Amount of Incidental Take.

Species	Type of Take	Amount
A. globiceps	Harm (wound, capture)	76
A. retusa	Harm (wound, capture)	76
I. crateriformis	Harm (wound, capture)	76

8.2 Reasonable and Prudent Measures

Reasonable and prudent measures refer to those actions the Director considers necessary or appropriate to minimize the impacts of the incidental take on the species (50 CFR 402.02). We determine 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 the proposed action on threatened and endangered species and to monitor the level and nature of any incidental takes.

1. PIFSC shall minimize the severity of incidental take from coral specimen collection by reducing the probability of extirpating local populations of *A. globiceps*, *A. retusa*, and *I. crateriformis* from sample collection in Tutuila.
2. PIFSC shall ensure the proposed action has a monitoring and reporting program sufficient to confirm the amounts and extents of take are not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

8.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action may lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
    a. PIFSC researchers shall use their specialized expertise and experience to select locations to collect coral specimens where populations of the species being sampled are robust and stable.
2. The following terms and conditions implement reasonable and prudent measure 2:
    a. 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. PIFSC shall provide annual reports to NMFS by the end of December of each year that detail the results of the monitoring above for the previous calendar year.

8.4 Reinitiation of Consultation

This concludes formal consultation for Supplement to the 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 PIFSC. Under 50 CFR 402.16(a), reinitiation of consultation is required and shall be requested by the Federal agency, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

1. If the amount or extent of taking specified in the incidental take statement is exceeded;
2. If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

3. If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or
4. If a new species is listed or critical habitat designated that may be affected by the identified action.

9 NOT LIKELY TO ADVERSELY AFFECT DETERMINATIONS

9.1 Stressors Not Likely to Adversely Affect Listed or Proposed Resources

The applicable standard for a "not likely to adversely affect" determination is being reasonably certain to be discountable, insignificant, or completely beneficial (USFWS & NMFS 1998). Discountable effects are those extremely unlikely to occur. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Beneficial effects are contemporaneous positive effects without any adverse effects. We determined the following stressors are not likely to adversely affect any listed species or designated critical habitats.

Table 5. Proposed resources within the Action Area that are not likely to be adversely affected by the proposed action.

Species	Scientific Name	Proposal Date	Federal Register Reference
Critical Habitat for: Central North Pacific Green Sea Turtle, Central South Pacific, Green Sea Turtle Central West Pacific Green Sea Turtle	*Chelonia mydas*	07/19/2023	88 FR 465572
Horse's Hoof Clam	*Hippopus hippopus*	07/25/2024	89 FR 60498
True Giant Clam	*Tridacna gigas*	07/25/2024	89 FR 60498
Smooth Giant Clam	*Tridacna derasa*	07/25/2024	89 FR 60498

9.1.1 Sound Exposure

PIFSC will expose listed species to other man-made sound through various sources including, active acoustics, echo locators, vocal playbacks, vessel engines, 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.

PIFSC 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. 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).

While corals and giant clams have exoskeletons that could break from intense sounds and shock waves, none of the sounds generated from this action are loud enough to break exoskeletons or hard substrates where coral colonies or giant clams are settled. Corals and giant clams are simple organisms that do not use hearing like reptiles or other marine species. We do not expect sounds to have hearing loss or behavioral effects corals or giant clams. We are reasonably certain that corals or clams will not detect or react to sounds generated from this action. Therefore effects from sound exposure are discountable.

9.1.2 Vessel Collision

The proposed action would expose all ESA-listed marine species under NMFS' jurisdiction 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 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.

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 in 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 *A. globiceps* has been documented (i.e. NWHI; NMFS 2021).

Similarly, giant clams have exoskeletons and are sessile invertebrate animals like corals. While they do not support a colony of polyps like coral and will not regrow fragments that are broken, they share the same habitat, have many of the same ecological needs, and face the same threats as corals. We do not expect vessel damage from PIFSC's proposed action because they are expected to use established transportation channels or be in deep enough water to avoid contact with reefs and hard substrates where giant clams live.

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 or giant clam 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 do not 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 trips compared to fishing fleets in the above studies.

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 research activities, is extremely unlikely, and therefore discountable on the ESA-listed resources in Table 4 and Table 6.

9.1.4 Changes in Food Availability

While researchers may harvest plankton that ESA-listed species under NMFS' jurisdiction identified in Table 4 and Table 6 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). Giant clams similarly feed on plankton and can acquire nutrients from symbiotic algae (Soo and Todd 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 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 and clams 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 be 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.

ESA-listed corals and giant clams are benthic sessile animals and anchor lines would pose no threat of mid-water entanglement. 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 6 is extremely unlikely, and therefore discountable.

9.1.6 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 marine animals 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 placing instruments on clams 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 Conference Report

9.2.1 Proposed Species Not Likely Adversely Affected

We determined the following species are not likely to be adversely affected by the proposed action.

Proposed Giant Clams

Since all giant clam species in the action area have similar structure, share similar life history needs, and face identical threats, we are evaluating the effects to *Hippopus hippopus*, *Tridacna gigas,* and *Tridacna derasa* collectively as giant clams.

As described above, the probability of giant clams being exposed to injurious levels of sound, vessel collisions, anchoring, and vessel wastes, discharges, and gear loss are discountable. As described above, the level of plankton sampling on coral reefs where giant clams live will be too small to impact forage quantity or availability. Since the removal of some forage items through sampling would remove an immeasurable amount of forage for giant clams, it will not rise to the level of harm and is therefore insignificant. While giant clams will have no exposure to land surveys, they could be exposed to nearshore surveys. During surveys, they could be struck or hit divers or instruments. PIFSC scientific divers are highly experienced and will implement BMPs to avoid contact with giant clams. Giant clams instinctively respond to divers or any animals or objects casting a shadow. We do not consider this behavioral response to be significant or affect their ability to carry on important life history processes. We are reasonably certain the effects from nearshore or land-based surveys will not reach the scale where harm or harassment occur, and are therefore insignificant.

9.2.2 Proposed Critical Habitats Not Likely Adversely Affected

We determined the following proposed critical habitats are not likely adversely affected by the proposed action.

Proposed Critical Habitat for Central North Pacific, Central South Pacific, and Central West Pacific green sea turtle

In section 9.1, we described effects of the action that could expose individual marine animals including sea turtles to stressors that could harm and harass them. In this section, we will evaluate the effects of the action to proposed green sea turtle critical habitats. The essential features for green sea turtle critical habitats are all the same for the three DPSs affected by this action. Each of the DPSs in the Pacific Islands Region include:

Reproductive essential feature:

From the mean high water line to 20 m depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by USFWS (see https://www.regulations.gov, Docket No. FWS-R4-ES-2022-0164), to allow for the transit, mating, and internesting of reproductive individuals and the transit of post-hatchlings.

Benthic foraging/resting essential features:

From the mean high water line to 20 m depth, underwater refugia and food resources (i.e., seagrasses, macroalgae, and/or invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.

Effects associated with the action are not likely to measurably change the accessibility to, or reduce the quantity or quality of forage or resting areas, and waters adjacent to nesting beaches. We evaluated the effects of sound exposure, vessel collisions, wastes and discharges, changes in food availability, effects from fishing, anchoring, and disturbance from nearshore and land-based surveys.

Sound Exposure
Sound effects are described in detail in the section above. All sounds generated from all activities are intermittent and temporary and will cease once activities are complete. The most intense sound sources (scanner) in the action are being emitted far from proposed critical habitat and are at frequencies that are outside of the hearing range of sea turtles. Green sea turtles could hear sounds from vessel noise, divers, and other general activities near them but the sources are temporary in nature and are low in intensity. None of the sound sources generated in this action are intense enough, occur frequently enough, or are at durations that can exclude sea turtles from important habitat that supports forage, resting, or access to reproduction areas. Sound exposure is not reasonably certain to prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat.

Vessel Collision
The finite number of vessel transits during the action. Vessel traffic generated from all activities will cease at the conclusion of each session, and as tasks are completed, PIFSC will move to different sites. This decreases the likelihood of vessel collisions in the action areas that concurrently exist with proposed green sea turtle critical habitat. PIFSC's activities are not likely to create dangerous conditions in the habitat reducing its quality. PIFSC's activities are reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat.

Vessel wastes and discharges, gear loss, and vessel emissions.
We evaluated the effects of potential accidental spills and discharges, and vessel emissions to individuals in the above section. The pathway of exposure of this stressor is generally through exposure of pollutants in their habitat because direct exposure of pollutants onto individual animals is highly unlikely. Exposures are more likely to occur by pollutants entering the water (habitat) and animals swimming through or ingesting it. We determined that individuals have an extremely low probabilities of being exposed to spills and discharges, and effects of vessel emissions would be undetectable because PIFSC is incorporating BMPs which minimizes the potential for pollutants entering the water and isolating and cleaning it if it does. Therefore, the potential effects of vessel wastes and discharges, gear loss, and vessel emissions are reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage

and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat.

Changes in Food Availability

The PIFSC may temporary reduce food sources in the action area through sampling (plankton tows, mid-column trawl, nearshore sampling and trapping). However, the sampling activity is temporary and episodic, and the amount is minimal portion of the available forage at each sampling location. The nominal reduction of forage at sample sites will not measurably reduce the amount of forage at those locations and are reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat.

Anchoring

Anchoring could cause temporary disturbance to benthic habitat. The PIFSC will avoid hard substrate or damaging coral reefs from anchoring. Coral reefs and hard substrates generally support algae and other forage and often provide cover for refuge and resting for green sea turtles. Avoiding reefs and hard substrates minimizes effects to forage and refuge habitat. As mentioned in the section above, anchoring is not expected to create entanglement hazards that can harm animals in the habitat. Therefore, anchoring is reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat.

Nearshore and Land-based Surveys

Nearshore and land-based surveys will occur in green sea turtle critical habitat. This can cause temporary disruption or displacement which may disrupt feeding or resting while divers are in the area but will return to ambient conditions once the divers leave the area. None of the effects from these stressors would prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches. Therefore, nearshore and land-based surveys are reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat.

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