# Programmatic Environmental Assessment of the Research Programs on Spiny and Slipper Lobster, Bottomfish, and Deepwater Shrimp at the Pacific Islands Fisheries Science Center
## Honolulu, Hawaii

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## August 2007


**Lead Agency:** National Oceanic and Atmospheric Administration
National Marine Fisheries Service (NMFS)
Pacific Islands Fisheries Science Center

**Responsible Official:** Samuel Pooley, PhD.
Director, Pacific Islands Fisheries Science Center

**For Further Information Contact:** **Gerard DiNardo**
Program Leader, Stock Assessment Program
National Marine Fisheries Service
Pacific Islands Fisheries Science Center
2570 Dole Street
Honolulu, Hawaii 96822
(808) 983-5733

# Executive Summary

This programmatic Environmental Assessment provides the detailed descriptions of existing and proposed National Oceanic and Atmospheric Administration research conducted by the Pacific Island Fisheries Science Center (PIFSC) for continuing the long-term studies on population dynamics of spiny and slipper lobsters in the Northwestern Hawaiian Islands (NWHI) and bottomfish in the Hawaiian Archipelago, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI). It also includes possible basic research on age and growth population characteristics of several species of deepwater shrimp species (*Heterocarpus* spp.) The purpose of such research is to determine the stock status and population dynamics of lobster, bottomfish, and shrimp species to support management of the commercial fisheries for these species. These stock assessments inform estimates of overall ecosystem health and also are required under the Magnuson-Stevens Fishery Conservation and Management Act.

**Lobsters**

Approximately 50 non-tagged lobsters from each bank sampled in the NWHI during the tagging cruise are processed, retained and brought back to PIFSC annually for further analysis. The same number of lobster samples are collected and returned to PIFSC during the annual lobster survey, resulting in a total sample size of 100 lobsters per bank. This research sample size, even if collected every year as planned, is a small fraction of what could be safely removed annually from each bank. Therefore, this number of removals will have no detectable impact on the sustainability of lobster stocks, either annually or cumulatively. Bycatch associated with these lobster trapping research operations is extremely low and historical research efforts have not significantly affected bycatch species.

**Bottomfish**

Fewer than 200 bottomfish (approximately 14,000 lbs) will be collected from the NWHI annually. This represents 3% of the total allowable catch and therefore does not pose a significant impact on bottomfish populations. Data collection in the main Hawaiian Islands (MHI) will be constrained to purchasing fish from commercial fishermen conducting normal fishing operations. Therefore, no additional fish would be taken from the MHI populations over that already routinely taken as part of the commercial fishery.

Bycatch in the NWHI commercial bottomfish fishery is low. Of 2,700 fish caught in 2004, 2,000 were released alive. Of those released, 1,800 were species that do not experience barotraumas and have excellent chance of survival. No data exist for bycatch in the commercial bottomfish fishery for the MHI, but it is assumed that bycatch is similar to that for the NWHI.

**Deepwater Shrimp**

The limited existing deepwater shrimp fishery in the waters of Hawaii and the CNMI is not currently known to be depleting the populations, although little information is available. Lacking basic information on population characteristics, including growth and age, recruitment, and age at sexual maturity, results in the inability to actually estimate biological reference points, including total allowable catch levels. However, the existing limited fisheries are not known to adversely affect proposed essential fish habitat for *Heterocarpus* species. As exploited populations appear to rebound in a relatively short period of time, taking limited numbers of individuals necessary for obtaining a sufficient sample size for basic population evaluation for stock assessments would not adversely impact any populations.

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# 1 Purpose and Need

## *1.1 Need for Action*

To meet the requirements of the Magnuson-Stevens Fishery Conservation and Management Act (Public Law 94-265 (1976), as amended by Public Law 109-479 (2006))(Magnuson-Stevens Act), fishery managers rely in part on stock assessments. A stock assessment describes the past and current status of a fish stock, and makes predictions about how a stock will respond to current and future management options. In essence, stock assessments provide decision makers with much of the information necessary to make informed choices regarding acceptable levels of fishing pressure and effective management options. These choices generally become regulations and rules governing a fishery, which implement the provisions contained in the governing Fishery Management Plan (FMP). Such regulations are codified within the Code of Federal Regulations, and can cover a variety of species and fishing gears (e.g., tunas and billfish that are harvested using longline and trolling gears).

Within the Pacific Islands Region, FMPs are developed by the Western Pacific Regional Fishery Management Council (WPRFMC) whose jurisdiction includes Hawaii, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands (CNMI). The Bottomfish FMP covers 15 species of snappers, groupers, and jacks. The Crustaceans FMP covers 8 species of lobsters, crabs, and shrimp. While stock assessments are conducted regularly to assess stock status and support management decisions, recent reviews of the stock assessments have recommended the collection of new data to advance current assessment methodology and re-estimate key parameters in the assessment models. This document describes the types of data needed to advance current assessment methods and potential ways to collect these data.

## *1.2 Scope of Analysis*

### 1.2.1 Temporal Scope and Use of Categorical Exclusions

This programmatic Environmental Assessment (PEA) provides the detailed descriptions of existing and proposed research conducted by the National Marine Fisheries Service (NMFS), Pacific Island Fisheries Science Center (PIFSC) for continuing the long-term studies on population dynamics of spiny and slipper lobsters in the Northwestern Hawaiian Islands (NWHI) and bottomfish in the Hawaiian Archipelago, Guam, American Samoa, and CNMI. It also includes possible basic research on age, growth, and population characteristics of several species of deepwater shrimp species (*Heterocarpus* spp.) within the same geographic scope as the bottomfish for contribution to stock assessments. Such work would occur if Amendment 13 to the FMP for Crustaceans in the Western Pacific Ocean were adopted, which would establish a management regime for this fishery and mandate stock assessments for deepwater shrimp species.

This PEA is intended to provide the basis for long-term continuation and potential expansion of existing research and provide the foundation for additional research. As long as individual research projects are conducted as described in Sections 2.1, 3.1, and 4.1; the actual impacts associated with implementation remain within the range of impacts as identified in Sections 2.3, 3.3, and 4.3 of the PEA; and no new information is available that could change the conclusions

about the scope or severity of impacts, this document will remain current. Per National Oceanic and Atmospheric Administration (NOAA) policy, the Finding of No Significant Impact (FONSI) for this PEA will be reviewed for consistency and appropriateness at least every 5 years.

Any individual projects implemented within the described program and documented as consistent with this PEA and its associated decision can be implemented without further National Environmental Policy Act (NEPA) analysis.

However, any site-specific and/or project-specific actions that would be added to the program long-term, not specifically covered under this PEA, and that would potentially have environmental considerations (issues or adverse impacts) not evaluated in this PEA will need additional appropriate NEPA analysis in a supplement to this PEA (40 CFR 1502.9). Any supplement to this PEA shall not affect the analysis or decisions in this original PEA nor any other proposed research project consistent with this PEA unless specifically stated in the supplement.

Any site-specific or project-specific actions that are not covered in this PEA and that would not have any additional environmental considerations can be addressed in the research project implementation plan and protocol for the specific research project. Possible examples include computer modeling, visual or camera surveys that do not involve capturing or handling animals, and data analysis.

### 1.2.2 Spatial Scope and Species Included (Similar Actions)

This PEA does <u>not</u> include conducting research in the following geographic areas:

- Waters within the US possessions in the Western Pacific Region, including Johnston Atoll, Kingman Reef, and Palmyra, Jarvis, Howland, Baker, Midway, and Wake Islands.
- Waters within the jurisdiction of the State of Hawaii per the Coastal Zone Management Act and state law (within 3 nm of the high tide mark) within the *NWHI* where the majority of the habitat of the species of interest occurs outside the 3 nm jurisdictional boundary. However, in cooperation with the State of Hawaii, research and data collection may be conducted in state waters within the *Main Hawaiian Islands* (MHI) because the majority of the habitat of species of interest occurs within the 3 nm jurisdictional boundary.
- Waters within the jurisdiction of the Department of Interior, US Fish and Wildlife Service from the shore to the 10 fathom (60 foot) depth, including within the Midway National Wildlife Refuge and the Hawaiian Islands National Wildlife Refuge because none of the species are characteristically shallow water species and all are found in waters deeper than 10 fathoms (60 feet depth).
- International waters outside the US Exclusive Economic Zone (EEZ) (200 nm).

This PEA covers only spiny lobster stocks of the Family Palinuridae and slipper lobster stocks of the Family Scyllaridae within the Hawaiian Archipelago. It includes seventeen species of bottomfish, considered as a group, but no species of seamount groundfish (alfonsin - *Berys splendens*, raftfish/butterfish - *Hyperoglyphe japonica*, and armorhead - *Pseudopentaceros richardsoni*). This PEA does not include any crustacean species included in the Crustaceans

FMP except the spiny lobster, the slipper lobster, and deepwater shrimp of the genus *Heterocarpus*.

Spiny and slipper lobster and bottomfish are considered as "similar actions" within the definition of 40 CFR 1508.25 because research activities in the NWHI are often carried out simultaneously during the same cruises of the NMFS research vessel. Bottomfish populations located outside of the NWHI within areas of US jurisdiction are included because the research would be conducted in the same way as that in the NWHI and the impacts would therefore be the same. Initiating research for *Heterocarpus* spp. is also included as a similar action because it is possible that such research may become a priority in the future and it is under consideration for inclusion in the Crustaceans FMP. Although it is a species covered under the Crustaceans FMP, Kona crab (*Ranita ranita*) is not included within the scope of this PEA because there has never been any commercial or recreational fishing for this species in the NWHI and the MHI fishery is small-scale and entirely located within state waters. If research is determined appropriate in the future, this PEA can be supplemented per 40 CFR 1502.9(c).

The scope of this environmental assessment (EA) is limited to assessment of the potential environmental effects of conducting research related to pertinent population dynamics considerations that may ultimately be used to assist in determination of maximum sustainable yield (MSY) and associated management strategies for bottomfish and *Heterocarpus* spp. fisheries in areas under US jurisdiction in the Western Pacific and lobsters in the MHI as described in Chapter 2, and for ecological evaluations for lobster in the NWHI. It is not intended to and does not address the potential environmental or economic effects of any actual fishing activities at levels determined using any of the data obtained from the research.

### 1.2.3 Actions Not Included

Because samples from the NWHI are inherently difficult and costly to acquire, PIFSC often receives requests from non-NMFS researchers to collect specimens or tissue samples from individuals of targeted and nontargeted species for research projects unrelated to the NMFS research objectives. For instance, researchers at the Hawaii Institute for Marine Biology have requested tissue samples from species that are caught as bycatch in lobster traps during normal lobster trapping operations such as lobsters, crabs, reef fish, eels and sharks for an ongoing study to analyze genetic population structure of these species found throughout the Hawaiian Archipelago in general and in the Papahanaumokuakea Marine National Monument (Monument) in particular. Algae specimens for taxonomic study are also collected for researchers at the University of Hawaii, Department of Botany. However, as these requests for sampling are outside the scope of the NMFS lobster and bottomfish research objectives, these actions will not be considered in this PEA. Any future requests may require appropriate analysis pursuant to NEPA and to determine whether a Monument permit is appropriate.

## *1.3 Scope of Decisions to be Made*

### 1.3.1 Scope of Decisions

The Responsible Program Manager (RPM; the Director of PIFSC) will use this PEA to make the following decisions:

1. Might the current and proposed research activities as described have significant impacts requiring analysis in an Environmental Impact Statement?

2. Should PIFSC continue to conduct existing and expanded research programs on spiny and slipper lobsters in the NWHI for ecological considerations and in the MHI for stock assessment purposes and, if not, should the program in the NWHI for ecological purposes be stopped?

3. Should PIFSC continue to conduct existing and expanded research programs on bottomfish within the identified geographic areas (NWHI and MHI, Guam, American Samoa, and CNMI) in support of Magnuson-Stevens Act requirements?

4. Should PIFSC expand its research program to initiate research actions for *Heterocarpus* spp. (deepwater shrimp) in support of determining sustainable fishing levels pursuant to the Magnuson-Stevens Act if Amendment 13 of the Crustaceans FMP is approved and if funding, staff, and other requirements are available?

### 1.3.2 Scope of Alternatives

Because this PEA evaluates ongoing research programs for lobster and bottomfish, the No Action alternative descriptions for these ongoing programs include the current research programs and reasonably foreseeable future research activities/actions similar to those presently conducted. The No Action alternative for these research actions also includes the fisheries and associated data collection as currently conducted and as conducted under known future regulatory requirements.

The alternatives for spiny and slipper lobster studies include:

1. Continue current research (no action alternative)
2. Cease data collection
3. Expand sampling to the MHI

The alternatives for bottomfish studies include:

1. Continue current research (no action alternative)
2. Expand sampling to the MHI
3. Expand sampling to Guam, American Samoa, and CNMI

The alternatives for *Heterocarpus* spp. Include:

1. Continue to not conduct any research on *Heterocarpus* spp (no action alternative).
2. Initiate and conduct the proposed research in the waters off Hawaii and the Western Pacific Ocean under the jurisdiction of the United States if Amendment 13 to the Crustaceans FMP is approved.

Age and growth and relative abundance data collection for *Heterocarpus* spp. may only be initiated if Amendment 13 of the Crustaceans FMP is approved and priorities and funding support such data collection. Therefore, the No Action Alternative for this research is the current approach of not conducting such data collection. If the Amendment is not approved and Essential Fish Habitat (EFH) is not designated per the amendment, then the No Action alternative must be selected until further action by the WPRFMC. If the final amendment is

different from the draft amendment used for this PEA, then a supplement per 40 CFR 1502.9(c) is required only if the changes have environmental relevance.

The RPM can, therefore, select the alternatives individually or in combination at this time. Any alternatives not selected at this time can be selected by the RPM in the future without further NEPA analysis, as long as alternative descriptions and associated impacts remain consistent with those predicted in this PEA.

### 1.3.3 Papahanaumokuakea Marine National Monument Findings

In June 2006, the Papahanaumokuakea Marine National Monument (Monument) was created by Presidential Proclamation under authority granted by the Antiquities Act of 1906. The Department of Commerce, NOAA; the Department of the Interior, Fish and Wildlife Service; and the State of Hawaii share jurisdictional authority for managing the Monument. Per the Proclamation, actions taken within the Monument must be permitted by NOAA prior to implementation, based on the impacts evaluated by the action entity and consideration of ten factors identified in the Presidential Proclamation. In addition to compliance with NEPA for granting funding for implementing the research described, this PEA also provides information and analysis for Monument decisionmakers to consider consistency of PIFSC actions proposed within the Monument with the identified factors prior to issuing a permit. Incorporating these analyses into this PEA supports efficiency in the Monument permitting process for PIFSC research. In this PEA, the analyses are conducted individually for spiny and slipper lobsters, bottomfish, and deepwater shrimp.

## *1.4 Issues Not Considered in Detail*

NEPA, Council on Environmental Quality regulations, and NOAA procedures for implementing NEPA specify that an EA should address only those resources or resource areas that are potentially subject to adverse impacts, and that the level of analysis should be commensurate with the anticipated level of environmental impact. Therefore, the following resource areas have not been carried forward for detailed analysis, as potential impacts were considered negligible or non-existent:

### 1.4.1 Archaeological, Social or Cultural Resources

The information in this paragraph is taken from the Northwestern Hawaiian Islands Proposed National Marine Sanctuary Draft Environmental Impact Statement and Management Plan (see reference in Chapter 6). In Hawaiian traditions, parts of the NWHI are considered a sacred place. Much of the information about the NWHI has been passed down in oral and written histories, genealogies, songs, dance, and archaeological resources. Nihoa and Mokumanamana Islands are recognized as culturally and historically significant and are listed on the National and State Register of Historic Places and protected by the US Fish and Wildlife Service in accordance with the National Wildlife Refuge System Administration Act of 1966, as amended. Archaeological surveys on Nihoa and Mokumanamana have documented numerous archaeological sites and cultural material. Nihoa Island, where there is significant soil development, hosts no fewer than 88 cultural sites, including ceremonial, residential, and agricultural features. On Mokumanamana, there are 52 recorded cultural sites, including ceremonial and temporary habitation features. Today, Native Hawaiians remain deeply connected to the NWHI on genealogical, cultural, and spiritual levels. Kauai and Niihau families

voyaged to these islands, indicating that they played a role in a larger network for subsistence practices into the 20th century. In recent years, Native Hawaiian cultural practitioners voyaged to the NWHI to honor their ancestors and perpetuate traditional practices. In addition, maritime activities following Western contact with the Hawaiian Islands have left behind the historical and archaeological traces of a unique past. Currently, there are over 60 known ship losses and/or confirmed sites among the NWHI, the earliest loss dating back to 1818. This, combined with 67 known aircraft crashes, gives a total of over 120 potential maritime heritage resource sites. Many of these sites, as defined by state and federal preservation laws (National Historic Preservation Act (NHPA); Archaeological Resources Protection Act (ARPA); Abandoned Shipwreck Act (ASA)), are of historical and national significance. Programmatic mandates have been established to ensure their preservation and protection. NOAA's Maritime Heritage Program focuses on the discovery and investigation of these heritage resources for the benefit of present and future generations. These sites are the physical record of past activities in the NWHI, and embody unique aspects of island and Pacific maritime history.

Importantly, implementation of the proposed action would have no adverse effect on the above resources. Because none of the proposed research would be conducted on land, none of the cultural resources associated with Native Hawaiian ancestry on NWHI lands would be affected. All research would be conducted in the deeper ocean, outside of shallow areas where shipwrecks or downed planes are typically found. As a result, the research would not have an adverse effect on Native Hawaiian or maritime heritage resource sites.

### 1.4.2 Public Health and Safety

The proposed action is to conduct focused research on population dynamics and ecological changes in deep ocean areas. Use of chartered commercial fishing vessels would involve actions in which the ship and her crew routinely are engaged, with the inherent challenges involved. These actions do not involve the public in any way and as such would have no effect on public health or safety, including that of low-income or minority populations.

### 1.4.3 National Marine Sanctuaries and Protected Areas

The proposed actions in the NWHI would not conflict with the Hawaii Coastal Zone Management Programs as no actions would be taken within the 3 nm Coastal Zone Management Act boundary in the NWHI. No actions would be taken in any waters under the jurisdiction of the US Department of the Interior, US Fish and Wildlife Service, including the Midway National Wildlife Refuge, Hawaiian Islands National Wildlife Refuge, and the Battle of Midway National Memorial. No actions would be taken with any waters under the jurisdiction of the Department of Defense. The analysis of consistency with the criteria for the Monument is evaluated for each species group in its appropriate section.

### 1.4.4 Cetaceans

Although six species of cetaceans listed under the Endangered Species Act (ESA) are in the Western Pacific Ocean, no reported or observed adverse interactions with lobster, bottomfish or deepwater shrimp (*Heterocarpus* spp.) have been observed or reported and no future adverse interactions are anticipated. Therefore, no impact to listed species of cetaceans would occur. The same is expected for the remaining 17 species protected under the Marine Mammal Protection Act (MMPA), despite observed dolphin stealing fish from bottomfish fishery hooks in

the MHI and NWHI with no observations of actual hooking (Kobayashi and Kawamoto 1995, Nitta and Henderson 1993).

### 1.4.5 Sea Turtles

No reported or observed interactions between trap fisheries (lobster and deepwater shrimp) and sea turtles, including the deep-diving but surface-feeding leatherback (*Dermochelys coriacea*), have occurred. Bottomfishing gear is highly selective and sea turtles have not been documented as bycatch in the bottomfishing industry (pers. comm., Kurt Kawamoto PIFSC 2007). Therefore, no impact to threatened or endangered sea turtles would occur.

### 1.4.6 Monk Seals

The Hawaiian monk seal was listed as endangered under the Endangered Species Act (ESA) in 1976 following a 50% decline in beach counts between the late 1950s and the mid-1970s (41 FR 33922). It is currently the second most endangered marine mammal after the North Atlantic right whale. In May 1988, NMFS designated critical habitat in ten areas of the NWHI, including all beach areas, sand spits and islets, including all beach crest vegetation to its deepest extent inland, lagoon waters, inner reef areas, and ocean waters out to 20 fathoms around Pearl and Hermes Reef, Kure Atoll, Midway Islands (except Sand Island and its harbor), Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island (53 FR 18990, May 26, 1988, 50 CFR 226.201). It was also designated as a depleted species under the MMPA in 1976.

The Hawaiian monk seal breeds only in the Hawaiian archipelago, with most monk seals inhabiting the remote largely uninhabited atolls, islands, and surrounding waters of the NWHI. More than 90% of all pups are born at French Frigate Shoals, Laysan Island, Pearl and Hermes Reef, Lisianski Island, Kure Island and Midway Atoll. A few births also occur at Necker, Nihoa, and Niihau Islands, and, since 1990, increasingly in the MHI (HMSRT 1999, Johanos et al. 2000). Monk seals have also been observed at Gardner Pinnacles and Maro Reef.

One monk seal became entangled in the bridle rope of a lobster trap in 1986 and died (NMFS, unpub. data, 1986). Since monk seal protective measures were implemented in an amendment to the Crustaceans FMP, no subsequent reports of interactions have occurred. Also, PIFSC ongoing food habits research (evaluating fatty acids in seal blubber) indicates that lobsters are an extremely minor component of monk seal diet (NMFS unpublished information 2006). Therefore, no impact to the endangered Hawaiian monk seal from lobster research in the NWHI would occur.

Although Nitta and Henderson (1993) reported observations of two monk seals with bottomfish hooks in their mouths (technicians removed one and the other apparently detached itself with no observable effects), actual monk seal hooking by bottomfishing gear has not been verified. Where hooks have been removed from monk seals and examined, they have been determined to be shore casting hooks, not bottomfishing hooks. Furthermore, bottomfish observer programs conducted in the early 1990s and again in the early 2000s have reported no monk seal interactions other than taking fish off lines (Kobayashi and Kawamoto 1995). Therefore, no impact to the endangered monk seal in the NWHI or MHI from bottomfishing research would occur.

No evidence exists that Hawaiian monk seals feed on *Heterocarpus* spp. shrimp and no reports of monk seal interactions with shrimp gear in the Western Pacific exist. No expectations of interactions between monk seals and shrimp fishing gear exist and therefore, no impact to the endangered Hawaiian monk seal in the NWHI or MHI from *Heterocarpus* research would occur.

### 1.4.7 Domestic and Foreign Economic Resources

Because economic analyses under NEPA are focused on U.S. economies, principal weight is given to analysis of potential economic effects on domestic fisheries, including fisheries in Guam, American Samoa, and CNMI. The lobster fishery in the Monument is permanently closed and the bottomfish fishery in the same area will be closed by 2011 per Presidential Proclamation. Remaining fisheries within the scope of this PEA may be modified in the future based on data collected during the research, but this research will not directly result in any major adverse impacts to domestic fisheries. Data collection would not involve foreign fisheries in any way.

### 1.4.8 Air and Water Quality

Due to the nature of the proposed actions, there would not be any adverse effects on air or water quality. All vessels used for NMFS research follow local, federal, and international laws, regulations, and requirements for discharge of waste. The research vessel, R/V *Oscar Elton Sette*, has wastewater treatment capabilities and releases the treated wastewater outside of the Resource Preservation Areas (RPAs) of the Monument. Vessels chartered for in this research by NMFS typically do not have treatment capabilities. Each night the chartered vessel transits to a minimum of 914 meters depth and outside of the Monument and, while traveling at a speed of no less than 6 knots, the holding tank is emptied. Speed was demonstrated to be a factor in increasing the rate of dilution of discharge from ships as described in Loehr et al. (2006). Given the number of people on board (fewer than 8), the depth and the speed of the discharge any impacts are in compliance with Monument requirements and local, federal, and international laws.

### 1.4.9 Geology and Soils

Due to the nature of the proposed research, there would not be any effects on geology or soils.

## *1.5 Format of this Programmatic Environmental Assessment*

This PEA includes descriptions and analyses of three PIFSC research programs, each independent of the other, but related sufficiently to be included within the scope of the same PEA. In order to provide for ease of use of this document for decision makers, for PIFSC research staff, and for interested and affected agencies and the public, this PEA will combine the descriptions of the No Action alternative, alternatives considered in detail, and alternatives not considered in detail; the affected environment; the impact analyses; the analyses necessary for the Monument staff to make the findings required by Presidential proclamation for issuing permits for use of the Monument; and the literature cited for each species group (spiny and slipper lobster, bottomfish, and deepwater shrimp) in its own chapter. Therefore, each species group will be treated concisely in its own part of the document, with lobsters in Chapter 2, bottomfish in Chapter 3, and deepwater shrimp in Chapter 4. A cumulative impact analysis is

included in Chapter 5. The list of citations to the literature used to develop this chapter appears in Chapter 6 at the end of the PEA. The List of Preparers of this PEA is Chapter 7.

# 2 Spiny and Slipper Lobster Research and Studies

For spiny and slipper lobsters, this chapter incorporates:

- Description of the No Action alternative,
- Description of the action alternatives,
- Descriptions of the alternatives not considered in detail with rationale,
- Description of the affected environment,
- Impact analyses,
- Analyses considering the factors for permitting the actions within the Monument, and
- Literature cited.

It is worth noting that the closure of the NWHI commercial lobster fishery in 2000 prompted a change in the focus of lobster research at PIFSC. In particular, the objectives of the annual NWHI lobster resource survey conducted by PIFSC since the mid 1980s have been broadened to monitor ecosystem vagaries. Prior to 2000, the survey was primarily used to provide requisite data to compute harvest guidelines (allowable catch level) for the fishery, and to assess the impacts of fishing. Since 2000, the survey has been used to monitor changes in the NWHI ecosystem, focusing on lobster populations, and associated bycatch from the survey, as indicators of ecosystem health.

## *2.1 Description of Alternatives*

### 2.1.1 Alternative 1: Current Program (No Action Alternative and Preferred Alternative)

Lobster research at PIFSC focuses on the Hawaiian spiny lobster (*Panulirus marginatus*) and common slipper lobster (*Scyllares squammosus*) in the NWHI and is implemented using two field projects:

1) lobster community resource survey (1 annual cruise)

2) cooperative research lobster tagging project (2 annual cruises)

#### 2.1.1.1 Lobster Community Resource Survey

**Objectives**

The PIFSC lobster community resource survey, using federal research vessels as the research platform, has been ongoing in the NWHI since 1985. The temporal scope of this time series was initiated in the mid-1980s and has continued to more recent years when the fishery was closed due to uncertainty with stock assessment models and official closure due to Presidential decisions. The survey is now conducted to further evaluate ecological and population health and assessment to further the objectives of the Monument. Although the survey targets spiny and slipper lobsters, the catch of all species encountered has been monitored.

Project objectives are:

- Collect data on abundance and species composition of trap-captured lobsters in the NWHI with those of previous years. Current operations are limited to only two banks in the NWHI (Necker Island and Maro Reef), but the long-term goal is to expand the geographical scope to include other banks.
- Obtain length-frequency data on spiny and slipper lobsters to compare with those of previous years.
- Record capture and release locations of all tagged lobsters.
- Identify all organisms collected in lobster traps to species, collecting representative specimens for taxonomic identification on the rare occurrence where necessary.

The lobster community resource survey is expected to continue contingent on adequate funding.

**Methods**

Standardized lobster trapping methods will be used on this project allowing direct comparison of collected data with previous years. Approximately 160 molded plastic lobster traps will be baited with 1.5 to 2 pounds of Pacific mackerel and soaked overnight at selected sites at Necker Island and Maro Reef. All organisms captured will be identified to species level, counted, and recorded from each trap at a geo-referenced station. Carapace length, sex, and reproductive status will be recorded for all lobsters. Tagged lobsters will be recorded and measured. The catch per unit effort (CPUE) and age, growth, and size at sexual maturity data (as measured by pleopod length; DeMartini et al. 2005) collected in this study will continue to add to the 20-year time series of lobster population monitoring data in the NWHI.

Approximately 50 non-tagged lobsters from each bank will be retained and transported back to PIFSC for further data collection, including stage of sexual maturity, morphometric ratio analysis, and stock structure determination (connectivity) via genetic profiling. On rare occasions, a small representative sample of unidentified or unique specimens will be processed and retained and brought back to PIFSC for further analysis and identification. Immediately following the collection of information from individual lobsters, all lobsters intended for release will be held in a specially-designed release cage in a covered container of circulating sea water and released on the seafloor via the release cage (cage is lowered to the seafloor, inverted, and opened) in the immediate vicinity of capture to minimize predation, reduce animal stress, and ensure suitable habitat.

### 2.1.1.2 Lobster Tagging Research

**Objectives**

The PIFSC has conducted annual research lobster tagging cruises to the NWHI since 2002. To date, over 47,000 spiny lobsters and 23,000 slipper lobsters have been tagged at Necker Island, Gardner Pinnacles, Maro Reef, and Laysan Island. The original intent of the tag/recapture program was to provide estimates of fishing mortality. Subsequently, as a result of the fishery closure, data collection was expanded to include vital life history parameter estimates, including growth rates, mortality, density, size structure, and movement information, for population modeling and ecosystem health assessment to further the objectives of the Monument.

The tagging research will be conducted to understand meta-population dynamics of lobster populations in the NWHI while advancing knowledge of ecosystem dynamics in the Hawaiian Archipelago. This research also assists in understand important aspects of the NWHI benthic ecosystem by examining lobster population dynamics and lobster life history parameters as well as documenting naturally-occurring spatial and temporal changes at different banks within the archipelago. This research will continue as long as funds are available and is intended to be expanded to other banks in the NWHI.

Because the NWHI extends approximately 1,800 km over more than five degrees of latitude and different oceanic regimes, lobster life history parameters such as growth and natural mortality are expected to vary naturally among groups of banks. Also, environmental fluctuations may affect one area of the archipelago and not another. Therefore, tagging and the life history parameters estimated from the recaptures at banks at the southern end of the NWHI may not be applicable to banks at the northern end and vice-versa. In order to understand natural variations in lobster growth because of spatial differences or environmental shifts, the program will continue tag/recapture efforts at four banks (Necker Island, Gardner Pinnacles, Maro Reef, and Laysan Island) within the NWHI, and will correlate the spatial and temporal growth rates to climate data. These correlations may provide insight into the impact of environmental change on other ecosystem components such as coral, reef fish, and bottomfish communities.

Large-scale environmental shifts could be affecting lobsters in several ways, including starvation. A nutritional index, developed for Necker Island spiny lobsters based upon glycogen levels in lobster muscle (Martinelli 1993) can provide insight into variation in lobster nutritional health and growth, especially if the environment is primary responsible for the observed variation in growth rates. This index was applied to spiny lobsters at Necker Island in 1991 and 1994-95 (Parrish and Martinelli-Liedtke 1999). The glycogen levels from the sampled lobsters were less than half the level measured in captive lobster fed to satiation in the previous study. However, no tagging program was in operation at that time, so no estimate exists of the effect of the reduced glycogen level on growth or mortality rates.

**Methods**

Standardized lobster trapping methods will be used on this cruise to allow direct comparison of collected data with previous years. Trapping locations will be a mix of pre-selected sites and random sites (picked by vessel). Molded plastic lobster traps will be used. Approximately 300 traps will be baited with 1.5 to 2 pounds of Pacific mackerel and soaked overnight at sites at Necker Island, Maro Reef, Laysan Island, and Gardner Pinnacle. Pertinent data (carapace length, sex, reproductive status, tag number of recaptured lobsters) will be recorded for all lobsters. A passive integrated transponder (PIT) tag will be injected into the final segment of all captured untagged lobsters' tail via a sterile needle. Approximately 50 untagged lobsters from each bank will be processed, retained, and transported back to PIFSC for additional studies including nutritional studies. Immediately following the tagging process all lobsters to be released will be held in a specially designed release cage in a covered container of circulating sea water. All lobsters will be released on the seafloor in the immediate vicinity of capture via the release cage (cage is lowered to the seafloor, inverted and opened) to minimize predation, reduce animal stress, and ensure suitable habitat.

### 2.1.2 Alternative 2: Cease the Program

This alternative would cease the program, ending all data collection in the NWHI and continuing no data collection in the MHI. Ceasing data collection will bring an end to one of the longest marine resource time series in the NWHI. In the latest report of the Monk Seal Recovery Team and in a recent letter from the U.S. Marine Mammal Commission (June 2006), continuation of lobster research was strongly recommended to further endangered monk seal research objectives. Ceasing data collection will also preclude estimation of population recovery rates from segments of this population, as well as ecological community structures, which are all vital to assessing ecosystem carrying capacities and biodiversity. Finally, ceasing data collection will have no positive impact on lobster population sizes since the small number of lobsters removed from populations have been determined to have no adverse impact (see section 2.3.1). There would be no impact to the resources of the Monument, but the ability of Monument managers to make informed ecological and resource management decisions could be substantially diminished over the long term.

Commercial and recreational lobster fishing would continue in the MHI in federal and state waters unless future federal or state decisions change the management direction.

### 2.1.3 Alternative 3: Expand Sampling to the MHI

Limited research has been conducted on the spiny lobster populations in the MHI (pers. comm., G. DiNardo PIFSC 2007). Some short-lived commercial fisheries occurred in the 1980s, and current state regulations have made it illegal to keep any female spiny lobsters or spiny lobsters below a minimum legal size. Additionally, state regulations control season of fishing in state waters and type of gear. Therefore, these measures and low abundance levels have contributed to extremely small-scale commercial lobster fisheries in the MHI. However, recreational take by divers occurs, although no data exist on the extent and volume/level of take.

This alternative continues sampling in the NWHI (Alternative 1) and expands sampling to the MHI. Because sampling in the NWHI is unchanged, no impact to this area is expected.

Expansion of sampling to the MHI will advance our stock assessment modeling capabilities by sampling the entire population of lobsters (archipelago-wide) rather than just a segment of the population, resulting in more effective resource management decision making throughout the archipelago. Expansion of sampling to the MHI will foster analyses on the connectivity of lobster populations in the NWHI and MHI, providing for sound ecosystem management decision making by the Monument. Finally, expanding data collection will have no negative impact on lobster population sizes since the small number of lobsters removed from populations have been determined to have no adverse impact (see section 2.3.1).

### 2.1.4 Alternatives Not Considered in Detail

#### 2.1.4.1 Movement Studies Using Electronic Transponder Tags

To complement information from the PIT tags and tagging research and to further describe lobster movement, researchers could tag lobsters with electronic transponder tags. This would allow estimates of daily, weekly and seasonal movements of individual lobsters. Lobsters would be captured via traps. The electronic transponder tag would be secured using marine epoxy. Two methods of tracking the individuals may be used including active relocation with a

hydrophone or placement of passive listening devises on the seafloor. This research will not be conducted because of cost and minimal contribution to lobster research objectives.

#### 2.1.4.2 Recruitment Studies of Lobster Larvae

To develop a recruitment index or to understand recruitment processes and connectivity, research involving the spatial and temporal aspects of phyllosomes (lobster larvae) could be undertaken (Polovina and Moffitt 1995). Because lobster phyllosomes are pelagic drifters, they would be captured using a mid-water trawl. This research will not be conducted because of cost and minimal contribution to lobster research objectives.

#### 2.1.4.3 Use of Poisons, Bottom Gill Nets, Bottom Trawl Gear, Explosives or Other Gear Not Included in the Alternatives

Due to lack of effectiveness in catching any of the three types of animals considered in this PEA and high potential for unacceptable impacts, these types of gear and methods of capture will not be used at any time.

#### 2.1.4.4 Translocating Lobsters from One Area to Another for Restocking Purposes

PIFSC does not intend to capture and translocate lobsters from banks in the Hawaiian Islands with expected higher levels of lobsters to those with lower levels or no lobsters. Lobster numbers are not currently sufficiently high to support such a project with unknown potential for success and could possibly transfer diseases and alter the natural genetic makeup of the populations.

#### 2.1.4.5 Diving in the NWHI

Sampling by underwater diving or surface snorkeling will not be conducted because it is an inefficient way of sampling.

## *2.2 Affected Environment*

This summary is taken from the draft Hawaii Archipelago Fishery Ecosystem Plan (2007). More information about the affected environment can be obtained by reviewing this document, available from the WPRFMC.

Crustaceans are harvested on small scales throughout the inhabited islands of the Western Pacific Region. The most common harvests include lobster species of the taxonomic groups *Palinuridae* (spiny lobsters) and *Scyllaridae* (slipper lobsters). Unlike many other species of *Panulirus*, the juveniles and adults of *P. marginatus*, the endemic Hawaiian spiny lobster, are not found in separate habitat apart from one another. Juvenile *P. marginatus* recruit directly to adult habitat; they do not utilize separate shallow-water nursery habitat apart from the adults as do many Palinurid lobsters. Juvenile and adult *P. marginatus* do utilize shelter differently from one another.

Spiny lobsters are non-clawed decapod crustaceans with slender walking legs of roughly equal size. Spiny lobsters have a large spiny carapace with two horns and antennae projecting forward of their eyes and a large abdomen terminating in a flexible tail fan. The two species of slipper lobsters (*S. squammosus* and *S. haanii)* are very similar in appearance and are easily confused. The appearance of the slipper lobster is notably different than that of the spiny lobster.

Very little is known about the planktonic phase of the phyllosoma larvae of *Panulirus marginatus*. After hatching, the "leaf-like" larvae (or phyllosoma) enter a planktonic phase. The duration of this planktonic phase varies depending on the species and geographic region; it may last from 6 months to 1 year from the time of the hatching of the eggs.

Fine-scale oceanographic features, such as eddies and currents, serve to retain lobster larvae within island areas. The relatively long pelagic larval phase for palinurids results in very wide dispersal of spiny lobster larvae; palinurid larvae are transported up to 2,000 miles by prevailing ocean currents.

The Hawaiian spiny lobster has been the principal target of the NWHI commercial trap fishery since the mid-to late-1970s. Landings and wholesale value have fluctuated greatly over the years, partly because of annual variation in trapping effort and a one-year fishery closure in 1993, but have generally been lower during the 1990s because of the declines in oceanic productivity, recruitment, and excessive exploitation. The fishery was closed in 2000 because of increasing uncertainty in the population models used to assess stock status. In December 2000, Executive Order 13178 and its later amendment Executive Order 13196 established the NWHI Coral Reef Ecosystem Reserve which prohibited commercial lobster fishing within the Reserve with a 5-year review cycle inferred if the Reserve had been converted to a Marine Sanctuary as required by the Executive Order. This fishery was later permanently closed in the NWHI with the creation of the Monument in June of 2006.

Prior to the closures, the Crustaceans FMP for the western Pacific crustaceans fisheries was prepared by the WPRFMC and implemented by NMFS in 1983. Lobster fishing permits were issued by the NMFS Regional Director, Southwest Region through the Pacific Islands Area Office in Honolulu. These permits allowed lobster fishing operations in the US EEZ from 3 nm to 200 nm offshore of American Samoa, Guam, and the NWHI. CNMI was added to the FMP in 2006. No federal permits or regulations were ever required for the MHI. A limited entry system was adopted for the NWHI in 1992 and the number of lobster fishing permits capped at 15. The number of active permit holders (actually fishing) significantly declined after 1990, and between 1996 and 1999 the number of active vessels in the fishery ranged from five to nine. No federal permits were issued for lobster vessels in the EEZs of American Samoa, Guam, or the CNMI since the approval of the Crustaceans FMP in 1983, although limited fishing attempts may have occurred.

Annual NMFS research surveys conducted in the NWHI have demonstrated a decline in spiny lobster densities, based on CPUE (defined in this instance as the catch of lobsters per trap haul and used as a measure of relative abundance) at Necker Island, one of the three sites at which spiny lobster has been heavily targeted by the commercial lobster fishery since the fishery began (DiNardo and Marshall 2001). In support of this finding, NMFS research indicates that spiny lobsters in the NWHI may have exhibited a compensatory response by reaching sexual maturity at much smaller sizes. These smaller sized lobsters may drive population egg production, since larger size females are so poorly represented in the population (DeMartini et al. 2003).

In 1993, a revised population model predicted that the July 1993 lobster abundance would be too low to allow a six-month fishery and still enable the stock to rebuild to the optimum level by July 1994. Therefore, a preliminary quota of zero was set and the fishery was closed. In 1994, a preliminary quota was calculated and the fishery re-opened. Catch rates in July were much lower than expected, and the initial harvest guideline was re-calculated and reduced

substantially. NMFS invoked an emergency closure of the fishery in August but the catch already had surpassed the final harvest guideline limit.

In 1995, the fishery opened to only one vessel under an experimental fishing permit to assess conditions of the lobster stocks. In 1996, relatively normal operations were instituted with a larger allowable harvest. In 1997, for the first time, the actual catch and CPUE of slipper lobsters exceeded that of spiny lobsters, further supporting the findings of NMFS that spiny lobster populations in the NWHI were declining, with slipper lobsters filling habitat emptied of spiny lobsters (DiNardo and Marshall 2001; Moffitt et al. 2006). In 1998, NMFS adopted a spatial management regime, dividing the NWHI fishery into four management areas. This measure was adopted to ensure that the harvest guideline (allowable catch) was not taken from a single bank (Kawamoto and Pooley 2000).

## *2.3 Evaluation of Environmental Consequences*

The following impacts apply to the alternatives that involve conducting active research on lobsters in the NWHI and the MHI. Not conducting research would have no potential negative impacts on individual lobsters or lobster populations, except the continuation of the lobster fishery in the MHI with no stock assessment information potentially resulting in population declines from overfishing. However, this cannot be known without the collection of data necessary for stock assessment.

### 2.3.1 Impact of Lobster Take on Status and Sustainability of Populations

Approximately 50 non-tagged lobsters from each bank sampled in the NWHI during the tagging cruise are processed, retained, and brought back to PIFSC annually for further analysis. The same number of lobster samples are collected and returned to PIFSC during the annual lobster survey, resulting in a total sample size of 100 lobsters per bank. Based on best available scientific information, the allowable bank-specific catch levels, had there been a commercial fishery, are in excess of 10,000 lobsters (slipper and spiny combined) (NMFS unpublished data 2007). Thus, the research sample size, even if collected every year as planned, is a small fraction of the number that could be safely removed annually from each bank. Therefore, this number of removals will have no detectable impact on the sustainability of lobster stocks, either annually or cumulatively.

Within the MHI, the status of lobster stocks is unknown. A stock assessment has never been initiated in the MHI but anecdotal information, such as divers needing to fish deeper in order to find lobsters (pers. comm. G. DiNardo PIFSC 2007), suggests that lobster populations are likely stressed. To complete a stock assessment of the MHI lobster populations, basic biological parameters such as growth and age structure need to be estimated, requiring the collection of lobsters from the area. The removal of 50 animals annually is a minimum sample size for biological parameter estimation in most fish stocks (Murphy and Willis 1996). However, should data indicate an overfishing situation, including cumulatively, continuing lethal collections will be re-evaluated and NMFS will notify the State of Hawaii and cooperate to address this concern. Therefore, collection of basic population data from a limited number of lobsters is necessary for determining the status of these species within the MHI and for ensuring proper and sustainable management in cooperation with the State of Hawaii and would therefore not contribute to a long-term concern with population sustainability. Under Alternatives 1 and 2, no collections of lobsters would be made in the MHI and therefore the status of stocks would remain unknown,

which could be a concern if current non-NMFS take is stressing the populations and is allowed to continue.

### 2.3.2 Impacts of Bycatch Take on Status and Sustainability of Populations

Bycatch associated with lobster trapping is low and population abundances of non-targeted species have not shown declines over the 20-year time series of data (Moffitt et al. 2006). Lobster traps have proven to be target-species specific. Over the 20-year research period, only 26,798 individuals of all species (mostly hermit crabs, which were released alive) were caught as bycatch and 74,185 individual target lobsters were caught. Between 1976 and 1991, data indicate that spiny and slipper lobster made up over 90% of the catch using wire mesh traps. From 1986 through 2003, spiny and slipper lobsters made up over 73% of the catch in plastic traps. Using wire traps from 1976 through 1991, the primary bycatch included hermit crabs (*Dardanus gemmatus* and *D. brachyops),* making up approximately 5% of the catch; moray eels (*Gymnothorax steindachneri*), making up approximately 1% of the catch; bottomfish (*Pristipomoides filamentosus* and *Pseudocaranx dentex*), making up approximately 1% of the catch; and a few small reef fishes (*Melichthys niger*). In plastic traps from 1986 through 2003, the primary bycatch included hermit crabs, making up approximately 10% of the catch; box, Kona, and swimming crabs (*Calappa calappa*, *Ranina ranina*, and *Charybdis hawaiensis*), making up approximately 5% of the catch; moray eels, making up approximately 1% of the catch; and reef fishes (*Heniochus diphreutes* and *Pervagor spilosoma*), making up approximately 2% of the catch. All invertebrates (target and non-target) captured are released alive at the site of capture via a specially-designed cage that releases animals on or near the seafloor to reduce potential for predation and animal stress. All fish are released alive at the surface.

### 2.3.3 Impact on Individual Lobsters of Capture, Taking Biological Samples and Attaching Physical Tags

Researchers are very aware of the way tagging could potentially negatively affect lobsters and even result in mortality, and have taken all steps to reduce these impacts in order to further support research objectives of working toward healthy lobster populations.

**a.** ***Exposure to air and direct sunlight.*** Studies have documented a negative impact of long-term (>1 hour) exposure to air and direct sunlight on lobster vision (Meyer-Rochow 1994, Vermeer 1987, Chapman et al. 2000, DiNardo et al. 2001). Several actions are taken as standard operating procedures during lobster handling, data collection, and tagging to reduce exposure to air and direct sunlight, including:

- Ensuring that the working area for holding and handling lobsters is located in an enclosed and covered area on the vessel.
- Prior to the collection of data from and tagging individuals, lobsters are held in enclosed containers in the wet lab area onboard the vessel or in an area protected from direct sunlight and with a constant spray of fresh seawater. During the actual tagging process each individual lobster is directly exposed to air for less than 2 minutes.
- Post examination and/or tagging, all lobsters are held in a specially designed release cage in a covered container of circulating sea water until it is time to release them. All lobsters are then released on the seafloor in the immediate vicinity of capture via the release cage (cage is lowered to the seafloor, inverted and opened).

***b. Tagging.*** Preliminary investigation of recapture information reveals recaptures of lobsters one day and three years after original capture, mark, and release. Recaptures after one day demonstrate rapid recovery from the tagging process because the tagged lobsters returned to their natural behavior of foraging for food and seeking shelter, and were sufficiently healthy to be recaught. Recapture after three years demonstrates the long-term recovery from the tagging process (NMFS unpublished data 2006).

***c. Collecting biological samples.*** Collecting biological samples involves removing the toe from one leg of individual lobsters. As lobsters regrow lost limbs naturally, including entire legs, removal of a toe from one leg will not harm individual lobsters.

### 2.3.4 Potential for the Trapping or Tagging Process to Negatively Affect Growth of Lobsters

To address the potential concern of interruption of the natural growth pattern due to tagging, 25 live spiny and 25 live slipper lobsters from Necker Island were retained from the 2006 tagging cruise and held in aquarium tanks. This study is still ongoing and will allow assessment of the impact of tagging through comparison of growth rates between tagged and untagged lobsters. Preliminary data does not indicate any negative impacts of tagging on growth of either species (NMFS unpublished data 2007).

### 2.3.5 Essential Fish Habitat for Spiny and Slipper Lobster

EFH for juvenile and adult spiny and slipper lobsters is designated as bottom habitat from shoreline to a depth of 100 m and for planktonic eggs and larvae as the water column down to 150 m. HAPC include all the banks in the NWHI with summits less then 30 m tall. Trap fishing for lobsters would not adversely affect the hard bedrock bottom characteristic of lobster habitat. Therefore, no adverse impact to spiny or slipper lobster EFH would occur. In addition, because impacts to the environment are negligible, no adverse impact to EFH of other species is anticipated.

### 2.3.6 Potential for Habitat Damage from Lobster Trapping

Lobster trapping operations are generally conducted over low relief pavement (bedrock with little topographical relief) and sand bottoms either lacking or with extremely low abundance of coral and therefore do not typically damage living coral or other living biota on the ocean floor. The traps are not set in areas of high relief for a myriad of reasons, including low catch rates in these areas and gear damage and loss.

Trap loss on previous cruises has been minimal and studies have shown that “ghost fishing” by lost gear does not occur (Parrish and Kazama 1992).

### 2.3.7 Potential for Spread of Invasive Species

All research will comply with Monument rules regarding the control of invasive species. Further precautionary measures to minimize the spread of *Hypnea musciformis*, an invasive marine algae, in the NWHI were developed and implemented as part of the standard protocol for this survey, including placing traps in direct sunlight and visually inspecting traps and removing algae on traps. Prior to the 2006 lobster cruise, Dr. Isabella Abbott (University of Hawaii Dept. of Botany) was contacted by Robert Moffitt (PIFSC) via telephone and email regarding measures

that could be taken to reduce the possibility of spreading *Hypnea musciformis* within the NWHI via lobster traps. Dr. Abbott stated that visually inspecting the traps and removing and discarding on vessel (not overboard) all algae before transiting to a different bank should be sufficient to minimize spreading of *Hypnea*. In addition, all traps are placed in direct sunlight on deck during transit between banks and desiccation will likely destroy all algae propagules. Although the above measures to minimize the spreading of *Hypnea* were considered adequate by Dr. Abbott, the lobster tagging program has arranged its schedule so Necker Island, a bank with documented *Hypnea* densities, will be visited last. It is important to note that different traps will be used on each cruise and none of these traps has been used in the MHI, where *Hypnea* is widespread. Given these precautionary measures, it is highly unlikely that *Hypnea musciformis* will be spread to other banks via lobster tagging operations.

Also, prior to each cruise, the hull of the vessel is inspected and cleaned to ensure no invasive species are transported into the Monument. The vessel is also inspected to ensure no rodents are transported into the Monument.

## *2.4 Analyses for Monument Findings*

The Secretaries may not issue a permit unless the Secretaries find (a-j):

*a. The activity can be conducted with adequate safeguards for the resources and ecological integrity of the Monument.*

The objectives of the lobster community resource monitoring research cruises and tagging cruises have and will continue to be met using almost exclusively non-lethal and non-extractive methods. Fewer than 100 individuals are sacrificed from each bank each year. This number of removals will have no detectable impact on the sustainability of lobster stocks, either annually or cumulatively. Adequate safeguards for the resources and the ecological integrity of the Monument are incorporated into the scientific protocol. Impacts on the resources and ecological integrity of the Monument have been negligible in the past. The research projects have addressed, altered, and in some cases gone beyond what is adequate to ensure their research does not comprise the Monument.

*b. The activity will be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects.*

These research projects are conducted in a manner compatible with the management direction of the Monument proclamation because they neither diminish nor enhance Monument resources, qualities, and ecological integrity, nor have any indirect, secondary, or cumulative effects. They provide detailed population level and individual species-specific information in a mostly non-lethal and non-extractive manner with negligible impact to the NWHI ecosystem.

*c. There is no practicable alternative to conducting the activity within the Monument.*

There are several reasons why lobster research can not be conducted solely outside the Monument. First, lobster research is conducted in the NWHI because that is where the commercial fishery operated. Second, because the long time-series of data (particularly the lobster community resource monitoring research cruise) is site-specific, it cannot be

conducted outside of the Monument. Finally, because the NWHI extends approximately 1800 km over more than five degrees of latitude, lobster population dynamics is expected to vary naturally among groups of banks (MHI vs. NWHI). Also, environmental fluctuations may affect one area of the archipelago and not another.

*d. The end value of the activity outweighs its adverse impacts on Monument resources, qualities, and ecological integrity.*

High value end products will result because these research projects have negligible impacts on the Monument resources, qualities, and ecological integrity.

*e. The duration of the activity is no longer than necessary to achieve it stated purpose.*

This purpose of this research is to document spatial and temporal variability in lobster life history parameters and abundance. Temporal variability can occur at least on the same scale as large-scale environmental regimes, the research, therefore, must occur at the same time scale. The lobster community resource monitoring research project has been ongoing since 1985 and represents the longest research time series in the NWHI. This project will continue, although not necessarily on an annual basis, into the future.

Lobster tagging has been ongoing since 2002, and while spatial variability in growth has already been identified, no temporal variability has been detected yet. Recent research has shown that there can be significant time lag (years) before the affects of large-scale regime shifts begins to manifest in specific trophic levels (Baker et al., in review). If the NWHI continues to experience large-scale regime shifts, such as those that occurred in the late 1980s and early 1990s (Polovina et al., 1994), and no changes occur in lobster life history parameters, then the long term temporal component of the research will be complete and, at that point, the continuation of the lobster tagging project will be reevaluated.

Thirty day cruises are the minimal amount needed for statistically meaningful analysis of all the data collected on lobster research cruises.

*f. The applicant is qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.*

The chief scientists aboard all PIFSC lobster research cruises are more than adequately qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. All have acquired a minimum of a Bachelors of Science degree in a life science and many will have advanced degrees. PIFSC chief scientists also have vast at-sea experience, including experience on federal and commercially chartered vessels. The experience also typically includes other research activities beyond just lobster research and has occurred in places other than the NWHI. In addition, mitigation has been built into each cruise's scientific protocol.

*g. The applicant has adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.*

The PIFSC lobster research projects have more than adequate financial resources available to conduct and complete the proposed activity's goals in relation to their impacts to Monument resources, qualities and ecological integrity. It also continues with the financial support of PIFSC.

*h. The methods and procedures proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts on Monument resources, qualities, and ecological integrity*

Examination of past lobster community resource monitoring research cruises and tagging cruises data has proven that the methods and procedures proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument resources, qualities, and ecological integrity. They have resulted in high quality data that enable accurate descriptions of lobster populations that can be used in management decisions with confidence.

*i. The applicant's vessel has been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of this proclamation*

Both field components of PIFSC NWHI lobster research are conducted using either federal research vessels or chartered commercial vessels. The lobster community resource monitoring research project takes place on federal research vessels that are already outfitted with a mobile transceiver unit approved by the NMFS Office of Law Enforcement (OLE) that complies with the requirements of the Monument. All vessels chartered by the cooperative research lobster tagging project will be outfitted with a mobile transceiver unit approved by the OLE that complies with the requirements of the Monument. The Monument will be presented with all of the appropriate documentation prior to any and all NWHI lobster research cruises.

*j. There are no other factors that would make the issuance of a permit for the activity inappropriate.*

There are no other factors that would make the issuance of a permit for the activity inappropriate. Nothing demonstrates this more then the conduct and activity of the previous 20 plus lobster community survey cruises and the 10 tagging cruises in the NWHI. This research, the captains and crewmembers of the chartered vessels, and the scientists have successfully completed their objectives with absolute ethical and scientific integrity.

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# 3 Bottomfish Research and Studies

For bottomfish research, this chapter incorporates:

- Description of the No Action alternative,
- Description of the action alternatives,
- Descriptions of the alternatives not considered in detail with rationale,
- Description of the affected environment,
- Impact analyses,
- Analyses considering the factors for permitting the actions within the Monument, and
- Literature cited.

## *3.1 Description of Alternatives*

### 3.1.1 Alternative 1: Continuation of the Current Research Program in the NWHI (No Action and Preferred Alternative)

The PIFSC bottomfish life history estimation sampling program currently collects samples from many Bottomfish Management Unit Species (BMUS) caught in the NWHI during routine commercial fishing operations. When necessary, additional samples are supplemented with bottomfish caught on federal research vessels.

Project objectives are:

- Collect geo-referenced genetic, gonadal, and hard part (otoliths and spine) samples from NWHI bottomfish.
- Collect tissue samples for genetic analysis.
- Determine basic life history parameters including reproductive seasonality, maturity, age and growth, and natural mortality.
- Incorporate resulting life history parameters in improved stock assessment models.

**Methods**

Regardless of the source of collected bottomfish, specimens will be weighed, sexed, and measured then gonads, otoliths and dorsal spines, and a tissue sample (fin clip) will be removed and preserved. Gonads will be weighed and histologically examined to establish reproductive status. Otoliths and spines will be sectioned and examined microscopically. Micro-increments on these hard parts will be enumerated and used to establish age and growth of individual fishes. Tissue samples will be preserved for genetic analysis. All samples will be geo-referenced allowing for determination of appropriate geographical scale for effective resource assessment and management.

BMUS of a range of sizes will be purchased from permitted commercial fishermen operating routinely independently of the NMFS research. The commercial fishermen agree to sell their

catch directly to NMFS researchers rather than selling it on the open market. If NMFS researchers did not purchase the catch, it would be sold on the open market.

When time and weather permits during the lobster resource monitoring surveys in the NWHI, bottomfishing will be conducted by NOAA ship and charter to collect biological and morphometric data including tissue samples such as otoliths, spines, and gonads for NWHI bottomfish stock assessment purposes. These lobster research cruises have been conducted annually since 1986, with the exception of 1989. Bottomfish sampling has been conducted sporadically over this period with a greater priority attached to this work in the last few years as a result of recommendations reported by an independent bottomfish assessment review panel (Ralston et al. 2004).

Bottomfishing on the research cruises will be hook and line operations. Gear will include a braided Dacron main line spooled on a hydraulic reel. Terminal gear will consist of a 5-10 pound drop weight and 4-6 baited hooks branching off of a monofilament line approximately 15-30 feet in length. A total of three bottomfishing rigs will be operated off the NOAA vessel simultaneously. The vessel will locate suitable fishing grounds, generally hard bottom slopes at depths of 100 to 400 m. Lines will be fished just off the bottom while the vessel conducts a controlled drift. Cut fish and squid will be used as bait. All fish captured will be identified to species, measured, and recorded along with appropriate data of time, depth of capture, and location. Fin clips will be taken for genetic analysis from all fish caught. Fish from which otoliths, spines, and gonads are to be collected will be measured and put on ice for future processing. Some of the captured species, including BMUS of the jack family, can be measured and released if not required for reproductive or age and growth study sampling. Many of the fish species captured at these depths, including BMUS snappers and groupers, suffer severe barotrauma when brought to the surface and are unlikely to survive release. If not needed for reproductive or age and growth studies, some of these fish will have their air bladders punctured and stomachs reverted prior to release giving them a chance at survival.

It is desirable to collect hard part samples, including otoliths and spines, from 100 individuals of each species per sampling location (Necker Island and Maro Reef currently and other banks if lobster sampling locations are expanded). These samples do not have to be captured on the same cruise to be valuable; however, value increases with a decrease in the sampling period (e.g. 2 to 3 years versus 8 to 10 years). Past experience indicates that a collection of 100 individuals of all species combined for each location is more than is likely to occur on any one trip.

### 3.1.2 Alternative 2: Expand the Current Life History Studies to the MHI

This alternative would include the current program as described in Alternative 1 expanded to the MHI, using purchased fish with the same research objectives. One major difference is that the recent Hawaiian Archipelago bottomfish stock assessment determined that overfishing was occurring in the archipelago and that excessive fishing in the MHI was the main cause for the overfishing determination (Moffitt et al. 2006). For this reason collection of required specimens in the MHI would be solely through expansion of the fish purchasing program to include licensed fishermen in the MHI. No additional fishing activities (e.g. research cruises or charters) beyond those currently conducted by the existing commercial fleet would be conducted in the MHI.

### 3.1.3 Alternative 3: Expand Bottomfish Life History Studies to American Samoa, Guam, and CNMI

Bottomfish research in the western Pacific island areas of American Samoa, Guam, and the CNMI has been very limited. The last major project conducted was the Resource Assessment Investigation of the Mariana Archipelago (RAIOMA) program conducted by NMFS in the early 1980s (Polovina et al. 1985). There is a great need to update and improve life history and abundance information from these areas. As with Hawaii, current stock assessments are based solely on fishery-dependent records of landings and effort. Collection of fishery-independent data is necessary to update and improve stock assessments methodology used in Magnuson-Stevens Act-compliant management decisions (Ralston et al. 2004). This project would include purchase of geo-referenced fish from commercial fishermen after normal fishing operations, catching bottomfish during charter cruises, and, possibly, ancillary bottomfishing operations conducted on NMFS research cruises.

Project objectives are:

1. Collect geo-referenced genetic, gonadal, and hard part (otoliths and spine) samples from NWHI bottomfish.
2. Collect tissue samples for genetic analysis.
3. Determine basic life history parameters including reproductive seasonality, maturity, age and growth, and natural mortality.
4. Incorporate resulting life history parameters in improved stock assessment models.

Fishing and sampling methods are similar to those described in Alternative 1.

### 3.1.4 Alternative 4: Cease All Bottomfish Research

Under this alternative, none of the activities described in any of the above alternatives would occur, i.e., the program would cease. None of the data or analyses obtained via the current program would be obtained through other programs or efforts.

### 3.1.5 Alternatives Not Considered in Detail

#### 3.1.5.1 Using Non-Calibrated Measurement Instruments and Gear

No non-calibrated measurement instruments or gear will be used unless for the purpose of calibration.

#### 3.1.5.2 Use Poisons, Bottom Gill Nets, Bottom Trawl Gear, Explosives or Other Gear Not Included in the Alternatives

Due to lack of effectiveness in catching any of the three types of animals considered in this PEA and high potential for unacceptable impacts, these types of gear and methods of capture will not be used at any time.

#### 3.1.5.3 Evaluate Effectiveness of MHI Marine Protection Areas (MPAs)

Both the State of Hawaii and WPRFMC are instituting area closures in 2007 in the MHI as a means of curtailing overfishing in the archipelago. It should be noted that the State of Hawaii

implemented a closed area program in 1998 to increase bottomfish spawning stock biomass in the MHI, but did not follow up with monitoring to measure the benefits of the closures. Further, some of the areas that were closed in 1998 are either reopened or have their boundaries redefined in 2007 based on better habitat data. Prior to the establishment of closed and reopened areas in 2007, baseline data on bottomfish densities, population structure, and distribution in the closed and reopened areas are necessary if future benefits are to be determined. To collect necessary sampling data, 700 fishing days would be required, which would be approximately 50% over the existing commercial catch in the MHI on an already stressed population. Therefore, PIFSC will not conduct such studies, although the State or other entities can choose to do so.

#### 3.1.5.4 Reduce the Scope of the Current Bottomfish Research Program

This PEA does not consider a reduction of research effort in the existing bottomfish research program because the data collected are the minimum required for setting allowable catch levels pursuant to the Magnuson-Stevens Act. The current fisheries statistics data are based solely on commercial fisheries-dependent data sources (catch logs for evaluating CPUE). PIFSC requires data on life history parameters such as age and growth, population connectivity, and natural mortality that are not available from commercial fisheries-dependent sources for improving stock assessments. Therefore, collecting less data would result in unacceptable uncertainty in setting allowable catch levels per the Magnuson-Stevens Act.

## *3.2 Affected Environment*

This summary is taken primarily from the 2005 Annual Report for the Bottomfish and Seamount Groundfish Fisheries of the Western Pacific Region (June 2006) prepared by the WPRFMC unless cited otherwise. More information about the affected environment can be obtained by reviewing this document, available from the WPRFMC.

The Bottomfish and Seamount Groundfish of the Western Pacific Region FMP was implemented by NMFS on August 27, 1986, and included 19 species of bottomfish in the EEZs around Hawaii, American Samoa, Guam, and the CNMI. Bottomfish species are non-migratory and thrive in cool, dark waters from 90 feet to deeper than 600 feet, depending on the species, over expansive hard-bottom ocean floor on high relief areas such as rocky ledges, undersea cliffs, topographical dropoffs, pinnacles, and holes. While bottomfish species are generally found throughout the western Pacific Ocean, the deepslope fishery of Hawaii, including the NWHI and MHI, is the largest and most important Pacific resource for bottomfish in the US.

Throughout the range under US jurisdiction, bottomfish are caught using vertical hook-and-line gear, which are highly selective to bottomfish. Virtually 100% of the marketable commercial catch is retained and sold. The minimal bycatch of other species is released alive. Commercial trips may vary from one day trips occurring close to shore to trips lasting several weeks if fishing the NWHI.

Opakapaka (pink or crimson snapper, *Pristipomoides filamentosus*) is the most abundant bottomfish caught in Hawaii. Onaga (long tail red snapper, *Etelis coruscans*) is second in commercial importance and is most popular in Hawaii. Ehu (short tail red snapper, *Etilis carbunculus*) is found throughout the Western Pacific and is also valued in Hawaii. Uku (grey snapper, *Aprion virescens*) is a plentiful shallow water snapper of major commercial value by volume, rather than price per pound. Hapuupuu (sea bass, *Epinephelus fasciatus*) is endemic to the Hawaiian Islands and Johnston Atoll and is valued for its sweet firm meat. An additional

fourteen species of bottomfish, including snappers, trevallys, emperors, and groupers, are also included in this analysis (*Aphareus rutilans*, *Caranx ignobilis*, *C. lugubris*, *Epinephilus quernus*, *Lethrinus amboinensis*, *L. rubrioperculatus*, *Lutjanus kasmira*, *Pristipomoides auricilla*, *P. flavipinnis, P. seiboldi, P. zonatus, Pseudocaranx dentex, Seriola dumerili,* and *Variola louti*).

Bottomfishing was part of the economy and culture of the indigenous peoples of Hawaii, harvesting the same deep-sea species as the modern fishery and using similar types of gear and techniques. The fishery in the MHI is mostly in state waters within 3 nm of shore. The remaining 20% of the MHI fishery occurs in federal waters in Middle Bank, most of Penguin Bank, and approximately 45 nm of 100-fathom bottomfish habitat in the Maui Nui complex. In the MHI, the mostly recreational fishermen may buy an inexpensive commercial fishing license and sell some of their catch to pay for their trip. The fishery in the NWHI has been divided into the Mau Zone in the eastern portion of the archipelago and the Hoomalu Zone west of 165$^{o}$ W to improve the economic health and stability of the NWHI bottomfishery. Bottomfishing in the NWHI is solely commercial by permit only. Only a limited number of permits are issued by NMFS per year. Through 2011, bottomfishing is allowed within the Monument, whereafter it is prohibited completely by Presidential Proclamation. Throughout the archipelago, the use of bottom trawls, bottom gillnets, explosives, and poisons are prohibited.

In 2004 and 2005, data indicated that the Hawaii archipelago multispecies bottomfish complex was subject to overfishing, with the MHI being the area where the overfishing primarily occurred (70 CFR 34452, June 14, 2005, Moffitt et al. 2006). Noncommercial landings in the MHI in 1990-1991 may have been twice the commercial landings, but cannot be proven because of lack of required reporting (Moffitt et al. 2006). The WPRFMC was mandated by the Secretary of Commerce to address the overfishing conditions. The WPRFMC is working cooperatively with the State of Hawaii to identify appropriate actions in both federal and state waters to eliminate overfishing in the Hawaiian archipelago. In 2005, NMFS recommended that the WPRFMC form an interagency working group to address the relevant evaluation, monitoring, and assessment issues associated with overfishing in the MHI, including using both fishery-dependent and -independent methodologies. Using modeling, a reduction of at least 24% or more is needed for the MHI to sufficiently reduce fishing mortality and to support a risk-averse management policy (Moffitt et al. 2006).

In American Samoa, indigenous peoples had specialized techniques for catching bottomfish from canoes. By the 1950s, bottomfishing was still primarily for subsistence use; by the 1970s, the bottomfish fishery developed into a commercial venture, decreasing by the late 1970s. By the 1980s, bottomfish landings increased due to the availability of more seaworthy fishing vessels, with bottomfish making up as much as half of the total catch of the local commercial fishery. However, since 1988, the commercial fishery has shifted more to trolling and longlining for pelagic fish species. Total CPUE varied without trend during 1982-2005 with peaks in 1988 and 1996, with some recent increases (Moffitt and Brodziak *in preparation*).

Bottomfishing on Guam is a combination of recreational, subsistence, and small-scale commercial fishing in both shallow waters (mostly recreational and subsistence) and deep waters (mostly commercial) for various species of bottomfish. The fishery is seasonal, based on weather and sea state conditions. Overall, total bottomfishing effort was relatively high in the mid- to late-1990s while associated CPUE was relatively low (Moffitt and Brodziak *in preparation*).

Bottom fishing in the CNMI is divided into deep- and shallow-water complex components. The deep complex supports a commercial fishery focusing on several species on Eteline snappers and groupers inhabiting the deep slope at depths of approximately 150 to 300 m. The shallow complex supports commercial, recreational and subsistence fisheries focusing on Lutjanid snappers, Emperors, and jacks inhabiting the deep reef from depths of 50 to 150 m. The fishery occurs primarily around the islands and banks from Rota Island to Zealandia Bank north of Sariguan. Although some large-vessel commercial ventures existed prior to 1994, it has been inconsistent, with a high turnover of participants in the commercial fisheries and an increased number of local fishermen focusing on reef fishes in preference to bottomfish. To stabilize the commercial fishery, training is needed for using appropriate technology, techniques, marketing, and financial planning. CPUE has fluctuated since 1983 with peaks in 1988 and 1999 (Moffitt and Brodziak *in preparation*).

Overall, a primary concern with calculating allowable catch levels in managing these bottomfish stocks in Guam, American Samoa and the CNMI is that the estimates of total fishery removals may be incomplete or inconsistent due to the voluntary nature of fishery catch reporting, changes in data collection protocols, and/or misidentification of species. Another potential problem is that fishery CPUE may not be proportional to changes in the relative abundance of bottomfish due to changes in fishing practices, fleet composition, or other factors that could alter standard measures of effective fishing effort on bottomfish (Moffitt and Brodziak *in preparation*).

## *3.3 Evaluation of Environmental Consequences*

The following impacts apply to the alternatives that involve conducting active research on bottomfish. Not conducting research would have no potential negative impacts on individual bottomfish or bottomfish populations, with no stock assessment information potentially resulting in population declines from overfishing. However, this cannot be known without the collection of data necessary for stock assessment.

### 3.3.1 Impact of Bottomfish Take on Status and Sustainability of Populations

Removal from the population of the amount of bottomfish desired for these studies is unlikely to have a lasting impact on the resource.

For the NWHI, the MSY is estimated to be approximately 435,000 pounds per year. The commercial fishery conducted in the area reported bottomfish landings from 2000 to 2004 of between 239,000 and 281,000 pounds per year (Moffitt et al. 2006). There are a total of 14 BMUS typically caught in the NWHI. Assuming an average weight of 5 pounds per fish, a research collection of even 200 individuals per species would amount to only 14,000 pounds which when combined with the estimated commercial catch still falls well below the estimated MSY for the area. Thus, this extra removal will have no lasting impact on the resource.

Similarly, in Guam, American Samoa, and CNMI, bottomfish stocks are healthy and current landings are well below estimates of MSY (Moffitt and Brodziak *in preparation*). For Guam, American Samoa, CNMI, and NWHI, total cumulative catch, including commercial and research catch, will not exceed estimated MSY (Moffitt et al. 2006, Moffitt and Brodziak *in preparation*).

Data collection in the MHI will be solely constrained to purchasing fish from commercial fishermen conducting normal fishing operations. Therefore, no additional cumulative fish would

be taken from the MHI populations over that already routinely taken as part of the commercial fisheries.

### 3.3.2 Impacts of Bycatch Take on Status and Sustainability of Populations

Bycatch associated with bottomfishing is very low. Particular species of bottomfish can be targeted with great success by selection of certain habitats and depths and highly selective gear. Some of the bycatch species, such as jacks, do not suffer barotrauma and can be released alive at the surface with an excellent chance of survival. Others, such as snappers and groupers, generally suffer severe barotrauma and are highly unlikely to survive release without puncturing of their air bladder and repositioning of their stomach. However, survivability can be relatively high with this procedure (see Section 3.3.3).

The following data were obtained from WPRFMC 2005 Annual Report (2006).

No bycatch from the fishery in American Samoa was reported in 2004.

Bottomfish bycatch for Guam in 2005 consisted of 66 instances of grouper (*Epinephelus* spp.), and individuals of the families Mullidae, Balistidae, and genera *Melichthys*, *Odonus*, and *Rhinecanthus*, with all individuals released alive, although they might not have survived. From 2001 through 2005, a total of 1,355 nontarget individuals were caught and 100% were released alive.

In CNMI, a little over 7% of all the fishes caught in the bottomfish fishery from 2000 through 2005 were nontarget species, mostly snappers and groupers, and all were reported to be released alive, although they might not have survived release.

Bycatch in the NWHI commercial fisheries is low. Of 2,700 fish caught in 2004, 2,000 were released alive. Of those released, 1,800 were species that do not experience barotraumas and have excellent chance of survival. No data exist for bycatch in the commercial fishery for the MHI.

### 3.3.3 Impact on Individual Bottomfish of Capture and Taking Biological Samples

Many of the fish species captured during bottomfishing operations suffer severe barotrauma when brought to the surface and are unlikely to survive release. However, some of the species of jacks do not suffer from barotrauma and can be measured, fin clipped, and released without apparent harm. Air bladders of the unwanted, barotraumatized fish can be punctured and their stomach reverted prior to release to potentially increase survival. Release mortality is expected to be 10%-50% depending on species and size for those experiencing barotrauma (Moffitt and Parrish 1996, Okamoto 1993).

### 3.3.4 Essential Fish Habitat for Bottomfish

EFH for bottomfish species in the aggregate include the water column and bottom habitat out to a depth of 400 m for adults and juveniles (settled) and the water column down to 400 m for eggs and larvae. HAPC include all escarpments and slopes between 40 and 280 m, and three known areas of juvenile opakapaka habitat in the MHI.

Surveys of EFH habitat on four banks in the NWHI using submersibles, remotely operated vehicles (ROV), and multibeam sonar coverage indicated that the ocean floor had a relatively

homogeneous structure of a flat top with a moderately steep slope that generally flattened out before reaching a depth of 400 m. One area had several small pinnacles extending up from the floor approximately 40-60 m. The substrate was carbonate bedrock interspersed with sediment deposits made up mostly of carbonate sand and pebbles. Bedrock was predominant just below the break where the slope was the steepest while sediment was predominant above the break as well as near the lower slope where it flattened out. Bottomfish were associated with rock having more crevices in which to hide from predators (Kelley et al. 2006).

Bottomfishing would not adversely affect the hard bedrock bottom and slopes characteristic of adult bottomfish EFH habitat. Therefore, no impact to bottomfish EFH would occur. In addition, because impacts to the environment are negligible, no adverse impact to EFH of other species is anticipated.

### 3.3.5 Potential for Habitat Damage from Bottomfishing

There is limited potential for the weights and lines used in bottomfishing to damage living deepsea corals or other bottomfish habitat components as few coral exist on typical bottomfish habitat, which is made up primarily of exposed bedrock and intermittent sediment. Kelley and Ikehara (2006) conducted submersible surveys at known fishing sites in the NWHI and observed no evidence of damage and little potential for this to happen. Deepsea corals at bottomfishing depths were very sparsely distributed and no evidence of damaged colonies was observed.

## *3.4 Analyses for Monument Findings*

The Secretaries may not issue a permit unless the Secretaries find (a-j):

*a. The activity can be conducted with adequate safeguards for the resources and ecological integrity of the Monument.*

The objectives of bottomfish research have and will continue to be met utilizing minimal impact techniques. Impacts on the resources and ecological integrity of the Monument have been negligible in the past. Adequate safeguards for the resources and the ecological integrity of the Monument are incorporated into the scientific protocol. The bottomfish research project has addressed, altered, and in some cases gone beyond what is adequate to ensure their research does not comprise the Monument.

*b. The activity will be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects.*

The bottomfish research project is conducted in a manner compatible with the management direction of the Monument proclamation because it neither diminishes nor enhances Monument resources, qualities, and ecological integrity, nor has any indirect, secondary, or cumulative effects. It provides detailed population level and individual species-specific information in a manner that is not detrimental to the sustainability of bottomfish populations and does not negatively impact the NWHI ecosystem.

*c. There is no practicable alternative to conducting the activity within the Monument.*

There are several reasons why bottomfish research can not be conducted solely outside the Monument. First, bottomfish research is conducted in the NWHI because that is where the

commercial fishery operated. Second, because the NWHI extends approximately 1800 km over more than five degrees of latitude, bottomfish population dynamics is expected to vary naturally among groups of banks (MHI vs. NWHI). Also, environmental fluctuations may affect one area of the archipelago and not another.

*d. The end value of the activity outweighs its adverse impacts on Monument resources, qualities, and ecological integrity.*

High value end products will result because these research projects have negligible impacts on the Monument resources, qualities, and ecological integrity.

*e. The duration of the activity is no longer than necessary to achieve it stated purpose.*

This purpose of this research is to document spatial and temporal variability in bottomfish life history parameters and abundance. Temporal variability can occur at least on the same scale as large-scale environmental regimes; the research, therefore, must occur at the same time scale. Recent research has shown that there can be significant time lag (years) before the affects of large-scale regime shifts begins to manifest in specific trophic levels (Baker et al., in review). The NWHI will continue to experience large-scale regime shifts, such as those that occurred in the late 1980s and early 1990s (Polovina et al., 1994) and understand their effect on bottomfish life history parameters is essential. Bottomfish research is expected to continue, although not necessarily on an annual basis, into the future.

Thirty day cruises are the minimal amount needed for statistically meaningful analysis of all the data collected on bottomfish research cruises.

*f. The applicant is qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.*

The chief scientists aboard all PIFSC bottomfish research vessels are more than adequately qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct. All have acquired a minimum of a Bachelors of Science degree in a life science and many will have advanced degrees. PIFSC chief scientists also have vast at-sea experience, including experience on federal and commercially chartered vessels. The experience also typically includes other research activities beyond just shrimp research and has occurred in places other than the NWHI. In addition, mitigation has been built into each cruise's scientific protocol.

*g. The applicant has adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.*

The PIFSC bottomfish research projects have more than adequate financial resources available to conduct and complete the proposed activity's goals in relation to their impacts to Monument resources, qualities and ecological integrity. It continues with the financial support of PIFSC.

*h. The methods and procedures proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts on Monument resources, qualities, and ecological integrity.*

The goal of the bottomfish research is to document species specific life history parameters. The methods and procedures (hook-and-line) proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument resources,

qualities, and ecological integrity. The research results in high quality data that enable accurate descriptions of bottomfish populations that can be used in management decisions with confidence.

*i. The applicant's vessel has been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of this proclamation.*

Bottomfish research during the lobster community resource monitoring research project takes place on federal research vessels that are already outfitted with a mobile transceiver unit approved by the OLE that complies with the requirements of the Monument.

*j. There are no other factors that would make the issuance of a permit for the activity inappropriate.*

There are no other factors that would make the issuance of a permit for the activity inappropriate. Nothing demonstrates this more then the conduct and activity of the previous bottomfish research in the NWHI. This research, the captains and crewmembers of the chartered vessels, and the scientists have successfully completed their objectives with absolute ethical and scientific integrity.

## *3.5 References*


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# 4 Deepwater Shrimp (*Heterocarpus* spp.) Research and Studies

For deepwater shrimp research, this chapter incorporates:

- Description of the No Action alternative,
- Description of the action alternatives,
- Descriptions of the alternatives not considered in detail with rationale,
- Description of the affected environment,
- Impact analyses,
- Analyses considering the factors for permitting the actions within the Monument, and
- Literature cited.

## *4.1 Description of Alternatives*

### 4.1.1 Alternative 1: Do Not Conduct Research and Studies of *Heterocarpus* spp. for Stock Assessments (No Action Alternative)

Currently, other than the limited studies described in Section 4.2, Affected Environment, no stock assessment study has been or is being conducted. Amendment 13 to the Crustaceans FMP has not been approved and therefore stock assessment studies could not be conducted until this amendment formally incorporates deepwater shrimp into the FMP. No funding would be made available to PIFSC to conduct any such studies should the Amendment be approved.

### 4.1.2 Alternative 2: Initiation of Research in Hawaii and the Western Pacific Ocean under the Jurisdiction of the United States (Preferred Alternative)

Little information on *Heterocarpus* spp. life cycle and population dynamics exists for anywhere in the region, including data on growth rates, reproductive potential, and natural mortality rates at each life cycle stage. The purpose of this proposed research is to identify this basic information for determination of biological reference points and total allowable catch levels for deepwater shrimp fisheries in the waters off Hawaii and the Western Pacific Ocean under the jurisdiction of the US with goals including:

- Collect geo-referenced abundance and size-frequency data.
- Collect geo-referenced genetic data.
- Determine patio-genetic stock structure.
- Determine basic life history parameters including reproductive seasonality, maturity, age and growth, and natural mortality.
- Develop spatially specific stock assessment models.

**Methods**

*Heterocarpus* spp. shrimp in the Western Pacific will be caught using baited traps. PIFSC has used several trap designs in the past. The most recent and most efficient design used by PIFSC is a pyramid trap similar to that described in Tagami and Barrows (1988). These traps are comprised of a heavy rebar frame wrapped with 1x2 wire mesh. The sides of the pyramid are covered with fabric and the top is inverted forming a funneling entrance. The base dimensions of these traps generally range from 4-6 feet with a height of about 4 feet. These traps are generally baited with fish and dropped to the bottom at depths of 350 to 1200 m. They are attached to the surface via a buoyed main line. Deployment of single traps on a main line, as opposed to multiple traps on a ground line, would be employed as it reduces the likelihood of gear loss from snagging on the bottom.

The sampling design would involve a random stratified sampling program similar to that conducted in Hawaii by Ralston and Tagami (1992). The geographic scope would include Hawaii (both the MHI and NWHI), American Samoa, Guam, and the CNMI. Baited traps would be soaked overnight at selected sites and hauled the next day. All animals collected in each trap, including bycatch such as crab, and fish, would be identified to species and counted. Shrimp would be measured and sexed with gross reproductive state recorded. Most of the organisms caught in these traps, including the targeted shrimp species, are moribund when brought to the surface and not likely to survive if released.

The vessel platforms for these surveys would include NOAA research vessels and chartered fishing vessels. Any vessel used in the Monument or within state or territorial waters will comply with all Monument and local government requirements including those relating to effluent discharge and vessel and hull inspections. No shrimp trapping operations in the NWHI would occur within waters under the jurisdiction of the State of Hawaii or the US Department of Interior US Fish and Wildlife Service. All trapping operations conducted within waters under local government jurisdictions will comply with CZMA and local regulations.

### 4.1.3 Alternatives Not Considered in Detail

#### 4.1.3.1 Use of Poisons, Bottom Gill Nets, Bottom Trawl Gear, Explosives or Other Gear Not Included in the Alternatives

Due to lack of effectiveness in catching any of the three types of animals considered in this PEA and high potential for unacceptable impacts, these types of gear and methods of capture will not be used at any time.

## *4.2 Affected Environment*

This information is taken from the Draft Amendment 13 to the FMP for the Crustacean Fisheries of the Western Pacific Region, March 5, 2007, prepared by the WPRFMC. If this amendment is ultimately approved and implemented, then research may be considered for this fishery. More information regarding the affected environment is available by contacting the WPRFMC for a copy of the publicly-available version of this draft document.

Throughout the Pacific, deepwater shrimp commercial fisheries (*Heterocarpus* spp.) have been sporadic, including in the areas under the jurisdiction of the US (Hawaii, American Samoa, CNMI and Guam). The primary causes of this lack of consistent profitability are:

- Loss of gear in deep water areas from strong currents and rough bottom topography;

- Short shelf life and inconsistent quality, leading to fluctuating market demand;
- The limited extent of known fishing areas and the propensity for reduced catch rates following initially high harvests.

The three species of deepwater shrimp with greatest potential commercial value (*Heterocarpus laevigatus*, the largest; *H. ensifer;* and *H. longirostris*) occur at varying depths, with *H. ensifer* the shallowest species and *H. longirostris* the deepest species. Of the three, *H. laevigatus* is by far the most desirable due to larger size, more attractive appearance, and high quality flesh. An additional five species of *Heterocarpus* spp. are reported from the Mariana archipelago (Moffitt and Polovina 1987) and are likely to occur with varying abundance in other US island areas.

A deepwater shrimp fishery was initiated in the Marianas in the mid-1990s, primarily catching *H. laevigatus*, with shrimp trapping occurring on flat areas near steep banks at depths greater than 350 m, localized on fishing grounds near Saipan and Tinian (Ostazeski 1997). The CNMI Division of Fish and Wildlife monitors the participating local fish purchasers in Saipan; it also conducted a data collection project between 1994 and 1995, including catch and effort data, depth range, and sex ratios and reproductive cycles. CNMI does not have permitting or reporting requirements.

A small-scale deepwater shrimp fishery was attempted in Guam in the 1970s, but no known operations have occurred since. Little information on *Heterocarpus* spp. is available for American Samoa and no known deepwater shrimp fishery is known to have occurred. Permitting and reporting are not required for either Guam or American Samoa.

In Hawaii, *H. laevigatus* and *H. ensifer* are found in both the MHI and the NWHI. An intermittent deepwater shrimp fishery began in 1967, increasing over time to approximately 275,000 pounds in 1984. Between 1982 and 2005 cumulative landings of 1.5 million pounds of *H. laevigatus* and 20,000 pounds of *H. ensifer* have been reported. The State of Hawaii requires a commercial marine license for commercial fishermen and maintains a commercial landings database. There is no additional federal permitting or reporting requirement and the State of Hawaii does not require permitting or reporting for non-commercial takes (e.g., recreational or subsistence).

## *4.3 Evaluation of Environmental Consequences*

The following impacts apply to the alternatives that involve conducting active research on *Heterocarpus spp*. in Hawaii, Guam, American Samoa and CNMI. Not conducting research would have no impact on deepwater shrimp populations, except that the continuation of the deepwater shrimp fisheries would occur without requisite information to establish sustainable harvest levels and develop effective management strategies.

### 4.3.1 Impact of *Heterocarpus* spp. Take on Status and Sustainability of Populations

The limited existing deepwater shrimp fishery in the waters of Hawaii and CNMI is not currently known to be depleting the populations, although little information is available. In CNMI, Moffitt and Polovina (1987) estimated that harvest levels of 0.2 tons/nm$^2$ may be sustainable for many Pacific island areas. However, these existing fisheries have been reported to reduce populations to the point where commercial fishing activities are typically suspended until populations regain

numbers. The lack of basic information on population characteristics, including growth and age, recruitment, and age at sexual maturity, results in the inability to actually estimate biological reference points, including total allowable catch levels. However, the existing limited fisheries are not known to adversely affect *Heterocarpus* species.

As exploited populations appear to rebound in a relatively short period of time (Moffitt and Parrish 1992), taking limited numbers of individuals necessary for obtaining a sufficient sample size for basic population evaluation for stock assessments would not potentially adversely impact any populations.

### 4.3.2 Impacts of Bycatch Take on Status and Sustainability of Populations

Between 1994 and 1996, bycatch from a 12,160 kg fishery in CNMI included a few deepwater eels (*Synaphobranchus* spp.), dogfish sharks, and some Geryonid crabs, which are marketable. Therefore, there are no impacts to bycatch species populations from the deepwater shrimp fisheries, as the traps are highly selective and do not catch sufficiently large number of nontarget species to adversely affect populations. While the potential for gear loss exists, anecdotal evidence from limited gear use in the past suggests that there are no impacts associated with "ghost fishing". In particular, once the bait used to lure the crustaceans has been eaten, the traps no longer attract the target species.

### 4.3.3 Essential Fish Habitat for *Heterocarpus* spp.

With the potential incorporation of *Heterocarpus* spp. into the Crustaceans FMP, proposed EFH has been identified for the complete assemblage (all species of the genus *Heterocarpus*) as the water column and associated outer reef slopes between 350 and 700 meters around every island and submerged banks in the Western Pacific Region. It should be noted that this depth range for EFH is a draft suggestion and may be expanded to cover more of the range of occurrence and to include deeper habitat. HAPC have not yet been recommended for these species based on lack of information.

Limited trapping would not adversely impact proposed EFH for *Heterocarpus* spp. In addition, because impacts to the environment are negligible, no adverse impact to EFH of other species is anticipated.

### 4.3.4 Potential for Habitat Damage from Trapping

There is no potential for the traps used in catching deepwater shrimp to damage living deepsea corals or other habitat components as few coral exist on typical bottomfish habitat, which is made up primarily of exposed bedrock and intermittent sediment. Kelley and Ikehara (2006) conducted submersible surveys at known fishing sites in the NWHI and observed no evidence of damage and little potential for this to happen. Deepsea corals at bottomfishing depths were very sparsely distributed and no evidence of damaged colonies was observed.

## *4.4 Analyses for Monument Findings*

The Secretaries may not issue a permit unless the Secretaries find (a-j):

*a. The activity can be conducted with adequate safeguards for the resources and ecological integrity of the Monument.*

The objectives of shrimp research will be met utilizing minimal impact techniques. Adequate safeguards for the resources and the ecological integrity of the Monument will be incorporated into the scientific protocol. The shrimp research project will address, alter, and when possible, go beyond what is adequate to ensure their research does not comprise the Monument.

*b. The activity will be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects.*

The shrimp research project will be conducted in a manner compatible with the management direction of the Monument proclamation because it will neither diminish nor enhance Monument resources, qualities, and ecological integrity, nor have any indirect, secondary, or cumulative effects. It will provide detailed population level and individual species-specific information in a manner that is not detrimental to the sustainability of shrimp populations and does not negatively impact the NWHI ecosystem.

*c. There is no practicable alternative to conducting the activity within the Monument.*

There are several reasons why shrimp research can not be conducted solely outside the Monument. First, shrimp research is conducted in the NWHI because that is where the commercial fishery operated. Second, because the NWHI extends approximately 1800 km over more than five degrees of latitude, shrimp population dynamics is expected to vary naturally among groups of banks (MHI vs. NWHI). Also, environmental fluctuations may affect one area of the archipelago and not another.

*d. The end value of the activity outweighs its adverse impacts on Monument resources, qualities, and ecological integrity.*

High value end products will result because these research projects have negligible impacts on the Monument resources, qualities, and ecological integrity.

*e. The duration of the activity is no longer than necessary to achieve it stated purpose.*

This purpose of this research is to document spatial and temporal variability in shrimp life history parameters and abundance. Temporal variability can occur at least on the same scale as large-scale environmental regimes, the research, therefore, must occur at the same time scale. Recent research has shown that there can be significant time lag (years) before the effects of large-scale regime shifts begin to manifest in specific trophic levels (Baker et al., in review). The NWHI will continue to experience large-scale regime shifts, such as those that occurred in the late 1980s and early 1990s (Polovina et al., 1994) and understand their effect on shrimp life history parameters is essential. Shrimp research is expected to be ongoing, although not necessarily on an annual basis.

Thirty-day cruises are the minimal amount needed for statistically meaningful analysis of all the data collected on shrimp research cruises.

*f. The applicant is qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.*

The chief scientists aboard all PIFSC research vessels are more than adequately qualified to conduct and complete the activity and mitigate any potential impacts resulting from its

conduct. All have acquired a minimum of a Bachelors of Science degree in a life science and many will have advanced degrees. PIFSC chief scientists also have vast at-sea experience, including experience on federal and commercially chartered vessels. In addition, mitigation has been built into each cruise's scientific protocol.

*g. The applicant has adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.*

If Amendment 13 to the Crustaceans FMP is enacted, the PIFSC shrimp research project would have adequate financial resources available to conduct and complete the proposed activity's goals in relation to its impacts to Monument resources, qualities and ecological integrity.

*h. The methods and procedures proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts on Monument resources, qualities, and ecological integrity.*

The goal of the shrimp research is to document species specific life history parameters. The methods and procedures proposed by the applicant are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument resources, qualities, and ecological integrity. The research results in high quality data that enable accurate descriptions of shrimp populations that can be used in management decisions with confidence.

*i. The applicant's vessel has been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of this proclamation.*

Shrimp research will take place on federal research vessels that are already outfitted with a mobile transceiver unit approved by the OLE that complies with the requirements of this proclamation. All vessels chartered for shrimp research will be outfitted with a mobile transceiver unit approved by the OLE that complies with the requirements of this proclamation. The Monument will be presented with all of the appropriate documentation prior to any and all NWHI shrimp research cruises.

*j. There are no other factors that would make the issuance of a permit for the activity inappropriate.*

There are no other factors that would make the issuance of a permit for the activity inappropriate.

## *4.5 References*

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# 5 Cumulative Effects

Research on lobsters and bottomfish by PIFSC has had a direct positive effect on these populations by contributing to setting sustainable fishing levels, and advancing our understanding of their population dynamics, spatial structure, and ecological relationships. Any studies conducted on *Heterocarpus spp*. would provide similar positive contributions. While the benefits stemming from continued research on lobster, bottomfish, and shrimp populations (single species or complex) are thoroughly described in previous sections of this document, ecological impacts due to continuing, or even increasing, research activities needs to be assessed. In this section cumulative impacts to the ecosystem from historical research activities are assessed, as well as the potential for future impacts due to both proposed research activities and foreseeable non-research activities (e.g., ecotourism). It should be noted that identifying future non-research activities is speculative at best, and dependent on economic and political factors.

Assessing measurable impacts at the species level requires the collection of vast amounts of data throughout the animals range. Extending this assessment to address measurable cumulative impacts, requires the collection of data through time as well, and an analysis of temporal changes or trends in the data. Increasing the scope of the analysis to assess measurable cumulative impacts of activities at the ecosystem level requires data from either a large number of components of the ecosystem (individual species) or indicator species, over appropriate spatiotemporal scales. Much of the available data to assess cumulative impacts of PIFSC research and non-research activities is from shallow coral reef surveys conducted in the NWHI, American Samoa, Guam, and CNMI. These are synoptic ecosystem surveys used to assess spatiotemporal changes in resource components. While these surveys have only recently been implemented, provisional analyses of the data show wide variation in abundance over time, with no measurable declining trends. Catch rates of non-target species (e.g., bycatch) in the NWHI lobster resource survey, conducted by PIFSC since the mid 1980s, are also available and can be used to assess cumulative impacts. Assuming that temporal changes in bycatch composition and abundance are indicative of changes to the ecosystem, an analysis of these data showed no declining trends that can be linked to past research activities. In fact, the NWHI ecosystem is reported to be in near pristine condition, despite approximately 30 years of lobster and bottomfish research and over 50 years of commercial fishing. Therefore, past research activities have had no measurable impact on local ecosystems. Because the magnitude and scope of historical research activities were significantly higher compared to current activity levels, and assuming that the past activity levels represent an upper limit of allowable activities in the future, increasing current levels will have no measurable ecological impact.

Future cumulative impacts from non-research activities are generally difficult to quantify since the likelihood of a specific activity is unknown. However, in some of the areas covered by this PEA, regulations and oversight are currently in place that significantly limit accessibility and ensure a low probability of cumulative impacts. Below is a discussion of potential cumulative impacts in the areas affected by the actions proposed in this EA:

Lobster, bottomfish, and deepwater shrimp research in the NWHI. All research associated with these species as identified in this PEA would take place within the boundaries of Monument. The Monument has in place an extensive permitting program designed to evaluate environmental effects associated with all proposed activities within Monument boundaries, both individually and cumulatively. No access to areas within the Monument is allowed without a permit. As a

result, the addition of the proposed research activities, to the extent allowed by Monument implementation, would not create a significant cumulative impact in the Monument.

Bottomfish and deepwater shrimp research in the MHI. Research activities associated bottomfish and deepwater shrimp would take place well offshore, and therefore are in areas relatively unaffected by onshore and nearshore activities (e.g., turbidity and contamination associated with runoff, placement of piers and breakwaters). Potential activities in areas associated with the proposed research include commercial and recreational fishing, both for bottomfish and deepwater shrimp as well as for other species. Active commercial fisheries, including the bottomfish fishery, are subject to state and federal regulation that considers overall environmental impact. Because the environmental impact of research activities associated with these fisheries is negligible relative to the impact of fishing activities, total cumulative environmental impacts in these areas associated with fishing activities are not expected to be significant. In addition, military activity that involves habitat destruction, natural resource extraction (e.g., oil drilling), and similar large-scale activities are unlikely.

Bottomfish and deepwater shrimp research in American Samoa, Guam, and CNMI. Similar to the MHI, activities associated bottomfish and deepwater shrimp would take place well offshore, and therefore are in areas relatively unaffected by onshore and nearshore activities (e.g., turbidity and contamination associated with runoff, placement of piers and breakwaters). Potential activities in areas associated with the proposed research include commercial and recreational fishing, both for bottomfish and deepwater shrimp as well as for other species. As noted in earlier sections of this analysis, bottomfish and deepwater shrimp fisheries in these areas exhibit significant fluctuations in effort, with fishermen in recent years moving to reef fisheries. Overall, the impact on these areas of the research effort is negligible relative to the impact of fishing activity in these areas. Some military activity does take place in Guam and CNMI; however, effects to the marine environment typically occur in areas shallower than those associated with the proposed research. Other activities that involve habitat destruction, such as natural resource extraction (e.g., oil drilling), and similar large-scale activities, are unlikely. Finally, while ecotourism operations exist in the area, such operations are not anticipated to be on a scale that would cause extensive impacts (i.e., only a few operations taking a few divers per trip). As a result, the cumulative environmental impacts in these areas are not expected to be significant.

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# 7 List of Preparers

Gerard DiNardo
Program Leader, Stock Assessment Program
NOAA Fisheries, Pacific Island Fisheries Science Center, Honolulu, HI.
Ph.D. Marine, Estuarine and Environmental Sciences.

Robert B. Moffitt
Fishery Biologist, Stock Assessment Program
NOAA Fisheries, Pacific Island Fisheries Science Center, Honolulu, HI.
M.S. Zoology.

Joseph M. O'Malley
Research Associate
Joint Institute for Marine and Atmospheric Research, University of Hawaii
NOAA Fisheries, Pacific Island Fisheries Science Center, Honolulu, HI
M.S. Fisheries Science

Judith Lee
President and Senior Environmental Analyst
Environmental Planning Strategies, Inc.
Pleasant Valley, IA
M.S. Wildlife Management and Biology