PROPOSED ACTION: Issuance of an Incidental Harassment Authorization to the University of Hawaii to Take Marine Mammals by Harassment Incidental to a Marine Geophysical Survey in the Central Pacific Ocean, Fall 2017

TYPE OF STATEMENT: Environmental Assessment

LEAD AGENCY: U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

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LOCATION: Central Pacific Ocean

ABSTRACT: This Environmental Assessment analyzes the environmental impacts of the National Marine Fisheries Service, Office of Protected Resources proposal to issue an Incidental Harassment Authorization to the University of Hawaii, for takes of small numbers of marine mammals by Level A and Level B harassment incidental to a marine geophysical survey in the Central Pacific Ocean in Fall 2017

DATE: September 2017

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LIST OF ACRONYMS AND ABBREVIATIONS

μPa	microPascal
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
dB	decibel
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
FONSI	Finding of No Significant Impact
FR	Federal Register
IHA	Incidental Harassment Authorization
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
Km	kilometer
m	meter
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation Management Act
NAO	NOAA Administrative Order
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OPR	Office of Protected Resources
OMB	Office of Management and Budget
PAM	Passive Acoustic Monitoring
PSAO	Protected Species Acoustic Observer
PSO	Protected Species Observer
rms	root-mean-square
ACOE	US Army Corp of Engineers
UH	University of Hawaii
USFWS	US Fish and Wildlife Service

Chapter 1 Introduction and Purpose and Need

1.1. Background

The Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1631 et seq.) prohibits the incidental taking of marine mammals. The incidental take of a marine mammal falls under three categories: mortality, serious injury or harassment (i.e., injury and behavioral effects). Harassment[1] is any act of pursuit, torment or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns (Level B harassment). Disruption of behavioral patterns includes, but is not limited to, migration, breathing, nursing, breeding, feeding or sheltering. However, there are exceptions to the prohibition on take in Sections 101(a)(5)(A) and (D) of the MMPA that gives the National Marine Fisheries Service (NMFS) the authority to authorize the incidental but not intentional take of small numbers of marine mammals by harassment, provided certain determinations are made and statutory and regulatory procedures are met. Refer to Chapter 2 for details regarding this exception and NMFS incidental harassment authorization (IHA) criteria.

NMFS also promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals, 50 Code of Federal Regulations (CFR) Part 216 and produced Office of Management and Budget (OMB)-approved application instructions (OMB Number 0648-0151) that prescribe the procedures necessary to apply for permits. All applicants must comply with these regulations and application instructions in addition to the provisions of the MMPA.

1.1.1. Applicant's Incidental Take Authorization Request

The University of Hawaii (UH) requested an Incidental Take Authorization (ITA) for take of marine mammals, by harassment, incidental to conducting a marine seismic survey north of the Hawaiian Islands in the central Pacific Ocean during fall 2017. This survey will take place partly within the Exclusive Economic Zone (EEZ) of the United States and partly in adjacent International Waters in the approximate area 22.6–25.0°N and 153.5–157.4°W in water depths ranging from 4000 to 5000 m. Therefore, UH's proposed survey will be conducted in collaboration with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), who is also a sponsor of the survey.

In accordance with the Law of the Sea Convention, coastal States, including the United States, have the right to regulate and authorize marine scientific research in maritime areas. In all instances, consent of the coastal State is required. While the Law of the Sea Convention does not define marine scientific research, the term generally refers to those activities undertaken in the ocean to expand knowledge of the marine environment and its processes. If the research will occur within the United States exclusive economic zone (EEZ) and is expected to result in the incidental take of marine mammals, then the applicant must obtain an ITA from NMFS, which can only be issued to citizens of the United States. Thus, in this instance, an ITA will be issued to a UH representative who is a United States citizen.

UH proposes to use conventional seismic methodology to image a typical/stable oceanic crust, mantle, and the boundary between the Earth's crust and the mantle. The data obtained from the survey would be used to inform and refine planning efforts for a proposed project under

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[1] As defined in the MMPA for non-military readiness activities (Section 3 (18)(A))

consideration by the International Ocean Discovery Program. UH's IHA application, available online at http://www.nmfs.noaa.gov/pr/permits/incidental/research, presents more detailed information on the proposed project.

The airgun array that would be deployed on the R/V *Kairei* consists of 32 airguns with a total volume of ~7800 in^3. The receiving system would consist of one 6-km long hydrophone streamer and ocean bottom seismometers (OBSs). As the airgun array is towed along the survey lines, the hydrophone streamer would receive the returning acoustic signals and transfer the data to the onboard processing system. The OBSs would record the returning acoustic signals internally for later analysis. Upon arrival at the survey area, two OBSs would be deployed. The streamer and airgun array would then be deployed, and seismic operations would commence.

The total survey effort would consist of ~1083 km of transect lines (Figure 1). There would be additional seismic operations in the survey area associated with turns, airgun testing, and repeat coverage of any areas where initial data quality is sub-standard.

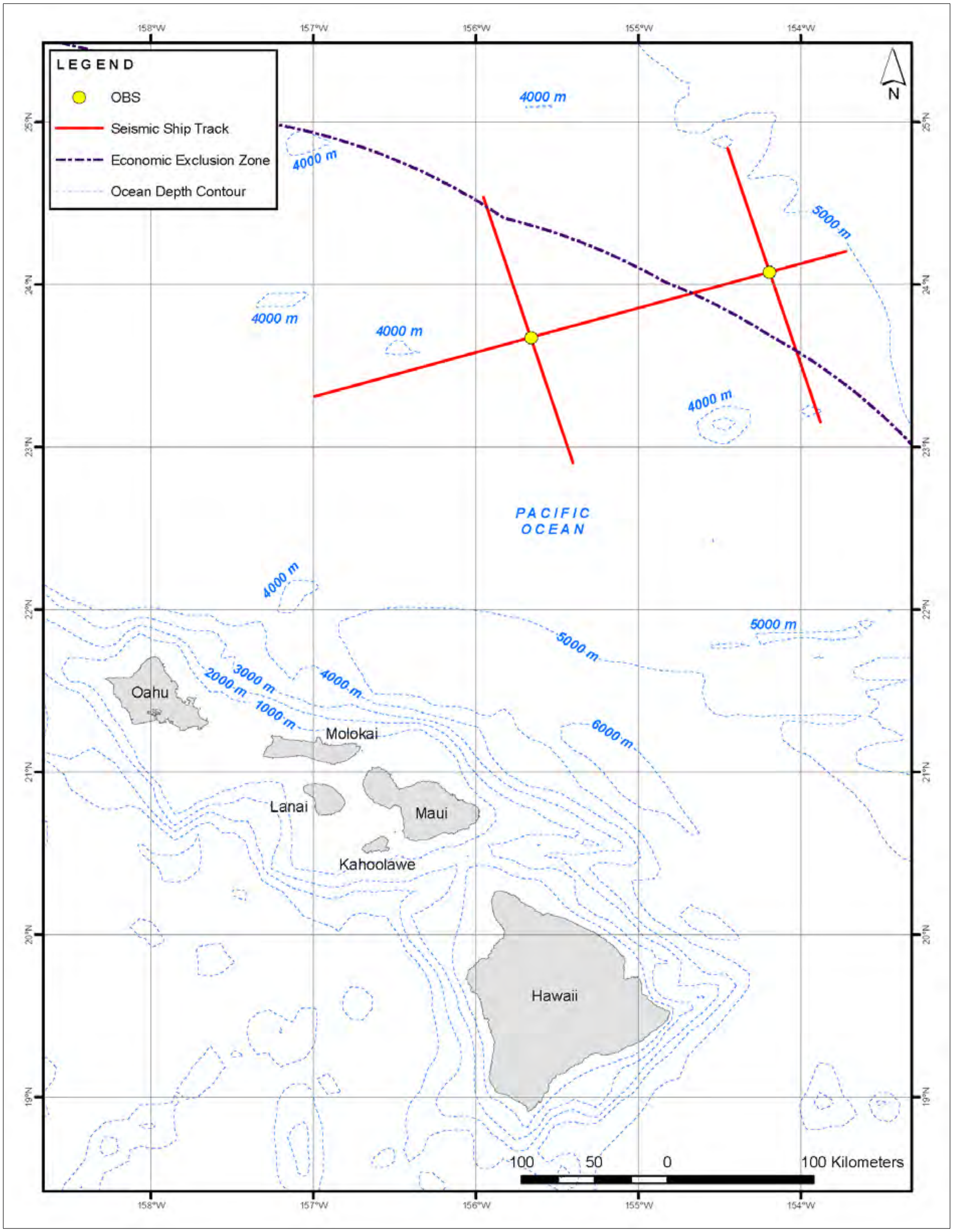

Figure 1: Planned track lines for seismic survey proposed by University of Hawaii conducted aboard the R/V *Kairei.*

1.1.2. Marine Mammals in the Proposed Action Area

There are 24 marine mammal species with confirmed or potential occurrence in the area of the proposed seismic survey in the central Pacific Ocean, including four cetacean species that are listed under the U.S. Endangered Species Act (ESA) as endangered: fin, sei, blue, and sperm whales. These marine mammal species are listed below:

- Sperm whale (*Physeter macrocephalus*)
- Humpback whale (Hawaii DPS) (*Megaptera novaeangliae*)
- Minke whale (*Balaenoptera acutorostrata*)
- Bryde's whale (*Balaenoptera edeni/brydei*)
- Sei whale (*Balaenoptera borealis*)
- Fin whale (*Balaenoptera physalus*)
- Blue whale (*Balaenoptera musculus*)
- Pygmy whale (*Kogia breviceps*)
- Dwarf sperm whale (*Kogia sima*)
- Cuvier's beaked whale (*Ziphius cavirostris*)
- Indo-Pacific beaked whale (*Indopacetus pacificus*)
- Blainville's beaked whale (*Mesoplodon densirostris*)
- Rough-toothed dolphin (*Steno bredanensis*)
- Common bottlenose dolphin (*Tursiops truncatus*)
- Pantropical spotted dolphin (*Stenella attenuata*)
- Spinner dolphin (*Stenella longirostris*)
- Striped dolphin (*Stenella coeruleoalba*)
- Fraser's dolphin (*Lagenodelphis hosei*)
- Risso's dolphin (*Grampus griseus*)
- Melon-headed whale (*Peponocephala electra*)
- Pygmy killer whale (*Feresa attenuata*)
- False killer whale (*Pseudorca crassidens*)
- Killer whale (*Orcinus orca*)
- Short-finned pilot whale (*Globicephala macrorhynchus*)

1.2. Purpose and Need

1.2.1. Description of Proposed Action

NMFS proposes to issue an IHA to UH pursuant to Section 101(a)(5)(D) of the MMPA and 50 CFR Part 216. The IHA would be valid from September 14, 2017 through September 13, 2018 and would authorize takes of marine mammals, by Level A harassment and Level B harassment, incidental to the proposed seismic survey being conducted by UH from the R/V *Kairei*. NMFS's proposed action is a direct outcome of UH requesting an IHA to take marine mammals incidental to a marine seismic survey.

1.2.2. Purpose

The purpose of NMFS's proposed action is to authorize take of marine mammals incidental to UH's marine seismic survey. Acoustic stimuli from use of air guns during the marine seismic survey has the potential to result in marine mammals in and near the survey area to be injured and behaviorally disturbed and thus the activity warrants an IHA from NMFS.

The IHA would provide an exemption to UH from the take prohibitions contained in the MMPA. To authorize the incidental take of small numbers of marine mammals, NMFS evaluated the best available scientific information to determine whether the take would have a negligible impact on marine mammals or stocks and whether the activity would have an unmitigable impact on the availability of affected marine mammal species for subsistence use. NMFS cannot issue the IHA if it would result in more than a negligible impact on marine mammals or stocks or would result in an unmitigable impact on subsistence uses. In addition, NMFS must prescribe the permissible methods of taking and other means of effecting the least practicable impact on the species or stocks of marine mammals and their habitat, paying particular attention to rookeries, mating grounds, and other areas of similar significance. If appropriate, NMFS must prescribe means of effecting the least practicable impact on the availability of the species or stocks of marine mammals for subsistence uses. IHAs must also include requirements or conditions pertaining to monitoring and reporting, in large part to better understand the effects of such taking on the species.

1.2.3. Need

U.S. citizens seeking to obtain authorization for the incidental take of marine mammals under NMFS's jurisdiction must submit such a request (in the form of an application). On March 15, 2016, UH submitted an application demonstrating the need and potential eligibility for an IHA under the MMPA. Therefore, NMFS has a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities described in UH's application. NMFS's responsibilities under section 101(a)(5)(D) of the MMPA and its implementing regulations establish and frame the need for NMFS proposed action.

1.3. The Environmental Review Process

In accordance with the Council on Environmental Quality (CEQ) Regulations and agency policies for implementing the National Environmental Policy Act (NEPA), NMFS, to the fullest extent possible, integrates the requirements of NEPA with other regulatory processes required by law or by agency practice so that all procedures run concurrently, rather than consecutively. This includes coordination within National Oceanic Atmospheric Administration (NOAA), (e.g., the Office of the National Marine Sanctuaries) and with other regulatory agencies (*e.g.*, the U.S. Fish and Wildlife Service), as appropriate, during NEPA reviews prior to implementation of a proposed action to ensure that requirements are met. Regarding the issuance of IHAs, we rely substantially on the public process required by the MMPA for preparing proposed IHAs to develop and evaluate relevant environmental information and provide a meaningful opportunity for public participation when we prepare corresponding NEPA documents. We fully consider public comments received in response to the publication of proposed IHAs during the corresponding NEPA review process.

1.3.1. The National Environmental Policy Act

NEPA requires federal agencies to examine the environmental impacts of their proposed actions within the United States and its territories. A NEPA analysis is a public document that provides an assessment of the potential effects a major federal action may have on the human environment, which includes the natural and physical environment. Major federal actions include activities that federal agencies fully or partially fund, regulate, conduct or approve. NMFS issuance of IHAs allows for the taking of marine mammals albeit consistent with provisions under the MMPA and incidental to the applicant's activities and is considered a major federal action. Therefore, NMFS analyzes the environmental effects associated with authorizing incidental takes of protected species and prepares the appropriate NEPA documentation.

1.3.2. Scoping and Public Involvement

The NEPA process is intended to enable NMFS to make decisions based on an understanding of the environmental consequences and take actions to protect, restore, and enhance the environment. An integral part of the NEPA process is public involvement. Early public involvement facilitates the development of an environmental assessment (EA) and informs the scope of issues to be addressed in the EA. Although agency procedures do not require public involvement prior to finalizing an EA, NMFS determined the publication of the proposed IHA and EA was the appropriate step to involve the public to understand the public concerns for the proposed action, identify significant issues related to the proposed action and obtain the necessary information to complete an analysis. The notice of the proposed IHA and the corresponding public comment period are instrumental in providing the public with information on relevant environmental issues and offering the public a meaningful opportunity to provide comments for our consideration in both the MMPA and NEPA decision-making processes.

The public was given the opportunity to submit comments during a 30-day comment period that began the date that the notice of the proposed IHA was published in the *Federal Register* (82 FR 34352, July 24, 2017). The notice included a detailed description of the proposed action resulting from the MMPA incidental take authorization process; consideration of environmental issues and impacts of relevance related to the proposed issuance of the IHA; and potential mitigation and monitoring measures to avoid and minimize potential adverse impacts to marine mammals and their habitat. The *Federal Register* notice of the proposed IHA, the draft EA and the corresponding public comment period are instrumental in providing the public with information on relevant environmental issues and offering the public a meaningful opportunity to provide comments for our consideration in both the MMPA and NEPA decision-making processes.

During the 30-day public comment period following the publishing of the proposed IHA in the *Federal Register* (82 FR 34352, July 24, 2017) NMFS received a comment letter from the Marine Mammal Commission (Commission) as well as one comment from a member of the general public. The Commission expressed concerns regarding UH's method to estimate Level A and Level B harassment zones and numbers of incidental takes; rounding of estimated takes; mitigation measures including power downs of the airgun array; and the extent to which monitoring requirements result in accurate reporting of the types of taking and the numbers of animals taken by the proposed activity. The comment received from a private citizen expressed concern that the project would result in the deaths of marine mammals. NMFS has posted the comments online at: *http://www.nmfs.noaa.gov/pr/permits/incidental*. A more detailed summary of the comments, and NMFS' responses to those comments, will be included in the *Federal Register* notice for the issued IHA, if NMFS determines the IHA should be issued.

1.4. Other Environmental Laws or Consultations

NMFS must comply with all applicable federal environmental laws, regulations, and Executive Orders (EO) necessary to implement a proposed action. NMFS evaluation of and compliance with environmental laws, regulations and EOs is based on the nature and location of the applicants proposed activities and NMFS proposed action. Therefore, this section only summarizes environmental laws and consultations applicable to NMFS' issuance of an IHA to UH. There are no other environmental laws, regulations, EOs, consultations, federal permits or licenses applicable NMFS' issuance of an IHA to UH.

1.4.1. The Endangered Species Act

The ESA established protection over and conservation of threatened and endangered species (T&E) and the ecosystems upon which they depend. An endangered species is a species in danger of extinction throughout all or a significant portion of its range. A threatened species is one that is likely to become endangered within the near future throughout all or in a significant portion of its range. The USFWS and NMFS jointly administer the ESA and are responsible for the listing of species (designating a species as either threatened or endangered) and designating geographic areas as critical habitat for T&E species. The ESA generally prohibits the "take" of an ESA-listed species unless an exception or exemption applies. The term "take" as defined in section 3 of the ESA means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Section 7(a)(2) requires each federal agency to ensure that any action it authorizes, funds or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat of such species. When a federal agency's action may affect a listed species, that agency is required to consult with NMFS and/or the USFWS under procedures set out in 50 CFR Part 402. NMFS and USFWS can also be action agencies under section 7. Informal consultation is sufficient for species the action agency determines are not likely to be adversely affected if NMFS or USFWS concurs with the action agency's findings, including any additional measures mutually agreed upon as necessary and sufficient to avoid adverse impacts to listed species and/or designated critical habitat.

NMFS issuance of an IHA is a federal action that is also subject to the requirements of section 7 of the ESA. As a result, we are required to ensure that the issuance of an IHA to UH is not likely to jeopardize the continued existence of any T&E species or result in the destruction or adverse modification of designated critical habitat for these species. There are four marine mammal species under NMFS's jurisdiction listed as endangered under the ESA with confirmed or possible occurrence in the proposed project area including the sei, fin, blue and sperm whales. There is no designated critical habitat for any of the ESA-listed species within the action area; thus, our proposed Authorization would not affect any of these species' critical habitats. The NMFS OPR ESA Interagency Cooperation Division initiated formal consultation with the NMFS OPR Permits and Conservation Division and issued a Biological Opinion on September 14, 2017, which determined the action would not jeopardize the continued existence of any marine mammal species and would not destroy or adversely modify critical habitat.

1.4.2. Magnuson-Stevens Fishery Conservation and Management Act

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), Federal agencies are required to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency which may adversely affect essential fish habitat (EFH) identified under the MSFCMA.

There is no designated EFH within the action area for this proposed project. In accordance with the EFH requirements of the MSFCMA, we notified the NMFS Pacific Islands Regional Office about this activity, and EFH consultation was not considered necessary for issuance of this IHA. Authorizing the take of marine mammals through the issuance of this IHA is unlikely to affect the ability of the water column or substrate to provide necessary spawning, feeding, breeding or growth to maturity functions for managed fish. Likewise, authorizing the take of marine mammals is not likely to directly or indirectly reduce the quantity or quality of EFH by affecting the physical, biological or chemical parameters of EFH. Marine mammals have not been identified as a prey component of EFH for managed fish species, so authorizing the incidental take of marine mammals probably will not reduce the quantity and/or quality of EFH.

1.5. Document Scope

This EA was prepared in accordance with NEPA (42 USC 4321, et seq.) and CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508). The analysis in this EA addresses potential impacts to the human environment and natural resources, specifically marine mammals and their habitat, resulting from NMFS' proposed action to authorize incidental take associated with the proposed seismic survey by UH. We analyze direct, indirect, and cumulative impacts related to authorizing incidental take of marine mammals under the MMPA. The scope of our analysis is limited to the decision for which we are responsible (i.e. whether or not to issue the IHA). This EA is intended to provide focused information on the primary issues and impacts of environmental concern, which is our issuance of the IHA authorizing the take of marine mammals incidental to UH's seismic survey activities, and the mitigation and monitoring measures to minimize the effects of that take. For these reasons, this EA does not provide a detailed evaluation of the effects to the elements of the human environment listed in Table 1 below. In summary, the analysis herein supports our determination that the issuance of an IHA would not result in any significant direct, indirect or cumulative impacts. Based on our MMPA analysis, harassment from the seismic survey activities involving the use of airguns may have short-term, limited impacts on individual marine mammals, but impacts resulting from the activity are not expected to adversely affect the marine mammal species or stocks through effects on annual rates of recruitment or survival

1.5.1. Best Available Data and Information

In accordance with NEPA and the Administrative Procedure Act of 1946 (5 U.S.C. §§ 551–559), NMFS used the best available data and information accepted by the appropriate regulatory and scientific communities to compile and assess the environmental baseline and impacts evaluated in this document. Literature searches of journals, books, periodicals or technical reports and prior analyses were conducted to support the analysis of potential impacts to marine mammals associated with acoustic sources and for the identification and evaluation of mitigation measures. In addition, NMFS previously prepared EAs analyzing the environmental impacts associated withthe authorization of marine seismic surveys involving the use of airgun arrays which resulted in Findings of No Significant Impacts (FONSIs).Each of these EAs demonstrate the issuance of an IHA does not affect other aspects of the human environment because the action only affects the marine mammals that are the subject of the IHA. These EAs also demonstrate the issuance of IHAs for these types of activities (i.e., marine seismic surveys involving use of airgun arrays) do not individually or cumulatively have a significant effect on the human environment and resulted in negligible impacts to marine mammals under the MMPA (NMFS 2013a, NMFS 2013b, NMFS 2014a). While the activities evaluated in these EAs took place in various regions of the Atlantic Ocean, it is reasonable to expect that the findings would be similar for UH's proposed activity in the Pacific Ocean. NOTE: All sources identified in this EA,including those listed in Chapter 6, were evaluated for credibility of the source, quality of the information, and relevance of the content to ensure use of the best available information.

Table 1. Components of the human environment not affected by our issuance of an IHA

Biological	Physical	Socioeconomic / Cultural
Amphibians	Air Quality	Commercial Fishing
Humans	Geography	Military Activities
Non-Indigenous Species	Land Use	Oil and Gas Activities
Seabirds	Oceanography	Recreational Fishing
	State Marine Protected Areas	Shipping and Boating
	Federal Marine Protected Areas	National Historic Preservation Sites
	National Estuarine	National Trails and

	Research Reserves	Nationwide Inventory of Rivers
	National Marine Sanctuaries	Low Income Populations
	Park Land	Minority Populations
	Prime Farmlands	Indigenous Cultural Resources
	Wetlands	Public Health and Safety
	Wild and Scenic Rivers	Historic and Cultural Resources
	Ecologically Critical Areas	

Chapter 2 Alternatives

2.1. Introduction

As described in Chapter 1, the National Marine Fisheries Service (NMFS) Proposed Action is to issue an IHA to authorize the take of small numbers of marine mammals incidental to the University of Hawaii's (UHs) proposed seismic survey activity. NMFS Proposed Action is triggered by UHs request for an IHA per the Marine Mammal Protection Act of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq.*). In accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) Regulations, NMFS is required to consider alternatives to a Proposed Action. This includes the no action and other reasonable course of action associated with authorizing incidental take of protected species. This evaluation of alternatives under NEPA assists NMFS with ensuring that any unnecessary impacts are avoided through an assessment of alternative ways to achieve the purpose and need for our Proposed Action that may result in less environmental harm. To warrant detailed evaluation under NEPA, an alternative must be reasonable along with meeting the stated purpose and need for the proposed action. For the purposes of this EA, an alternative will only meet the purpose and need if it satisfies the requirements under section 101(a)(5)(D) the MMPA. Therefore, NMFS applied the following screening criteria to the alternatives to identify which alternatives to carry forward for analysis. Accordingly, an alternative must meet the criteria described below to be considered "reasonable".

The MMPA requires NMFS to prescribe the means of effecting the least practicable impact on the species or stocks of marine mammals and their habitat. In order to do so, NMFS must consider UHs proposed mitigation measures, as well as other potential measures, and assess how such measures could minimize impacts on the affected species or stocks and their habitat. Our evaluation of potential measures includes consideration of the following factors in relation to one another: (1) the manner in which, and the degree to which, we expect the successful implementation of the measure to minimize adverse impacts to marine mammals; (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation. Any additional mitigation measure proposed by us beyond what the applicant proposes should be able to or have a reasonable likelihood of accomplishing or contributing to the accomplishment of one or more of the following goals:

- Avoidance or minimization of marine mammal injury, serious injury, or death, wherever possible;
- A reduction in the numbers of marine mammals taken (total number or number at biologically important time or location);
- A reduction in the number of times the activity takes individual marine mammals (total number or number at biologically important time or location);
- A reduction in the intensity of the anticipated takes (either total number or number at biologically important time or location);
- Avoidance or minimization of adverse effects to marine mammal habitat, paying special attention to the food base; activities that block or limit passage to or from biologically important areas; permanent destruction of habitat; or temporary destruction/disturbance of habitat during a biologically important time; and

- For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Alternative 1 includes a suite of mitigation measures intended to minimize potentially adverse interactions with marine mammals.

2.2. Description of Applicants Proposed Activities

UH, in collaboration with JAMSTEC, plans to use conventional seismic methodology to image a typical/stable oceanic crust, mantle, and Moho. The data obtained from the survey would be used to help better inform and further refine planning efforts for a proposed “Project Mohole” under consideration for scheduling by the International Ocean Discovery Program. The survey would involve one source vessel, the R/V *Kairei*. The *Kairei* would deploy a 32-airgun array as an energy source. The receiving system would consist of one 6-km long hydrophone streamer and OBSs. As the airgun array is towed along the survey lines, the hydrophone streamer would receive the returning acoustic signals and transfer the data to the on-board processing system. The OBSs would record the returning acoustic signals internally for later analysis. Upon arrival at the survey area, two OBSs would be deployed. The streamer and airgun array would then be deployed, and seismic operations would commence.

During the survey, the airgun array would consist of 32 Bolt Annular Port airguns, with a total volume of ~7800 in^3. The airguns would be configured as four identical linear arrays or “strings” (Figure 2). Each string would have eight airguns; the first and last airguns in the strings would be spaced 10 m apart. All eight airguns in each string would be fired simultaneously. The four airgun strings would be towed behind the *Kairei* and would be distributed across an area ~40 m × 10 m. The shot interval would be ~20–30 s or ~50–60 m. The firing pressure of the array would be ~2000 psi. During firing, a brief (~0.1 s) pulse of sound is emitted. The airguns would be silent during the intervening periods. Airgun array specifications are shown in Table 2.

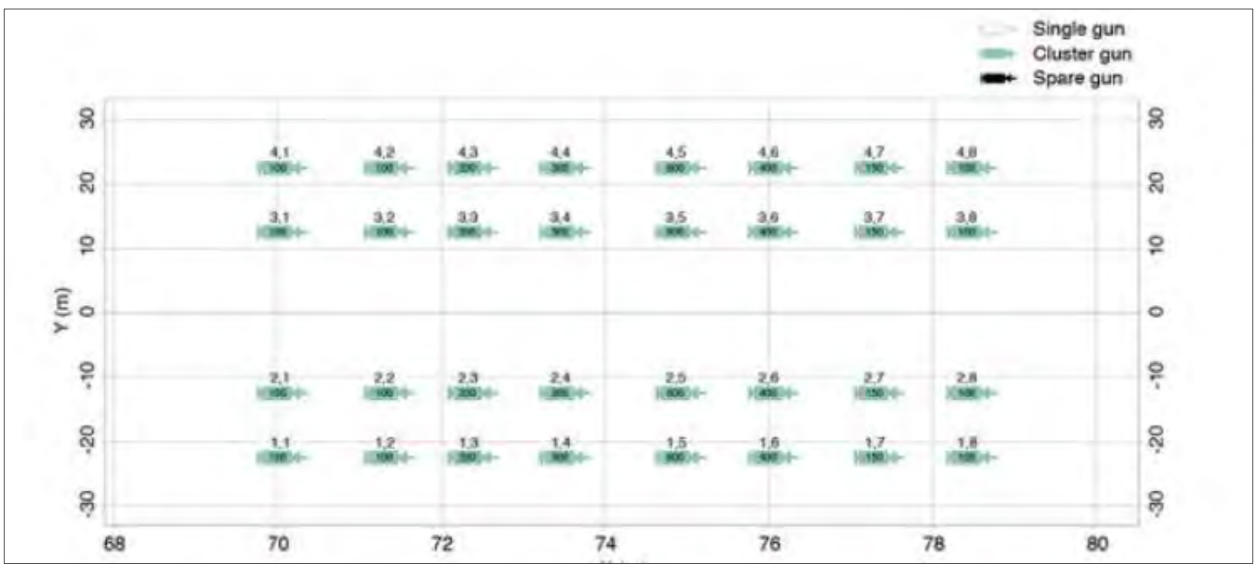

Figure 2: Configuration of the airgun array consisting of 32 Bolt airguns totaling 7800 in^3

The tow depth of the array would be 10 m during the survey. Because the actual source is a distributed sound source (32 airguns) rather than a single point source, the highest sound levels measurable at any location in the water would be less than the nominal source level. In addition, the effective source level for sound propagating in near-horizontal directions would be substantially lower than the nominal source level applicable to downward propagation because of the directional nature of the sound from the airgun array.

Table 2: Specifications of the R/V Kairei Airgun Array

Number of airguns	32
Tow depth of energy source	10 meters (m)
Dominant frequency components	2–120 Hz
Total volume	~7800 in^3
Pulse duration	~0.1 second
Shot interval	~20–30 s or ~50–60 m

The total survey effort would consist of ~1083 km of transect lines (Figure 1). There would be additional seismic operations in the survey area associated with turns, airgun testing, and repeat coverage of any areas where initial data quality is sub-standard. To account for these additional seismic operations in the estimate of marine mammal takes that would occur as a result of the seismic survey, UH added 25% in the form of operational days, which is equivalent to adding 25% to the proposed line km to be surveyed, in their calculation of marine mammal exposures to sounds exceeding the Level A and Level B harassment thresholds.

The R/V *Kairei* has a length of 106.0 m, a beam of 16.0 m, and a maximum draft of 4.7 m. Its propulsion system consists of two diesel engines, each producing 2206 kW, which drive the two propellers at 600 revolutions per minute. The operation speed during seismic acquisition would be ~8.3 km/h. The *Kairei* will depart from and return to port of Honolulu, HI. When not towing seismic survey gear, the *Kairei* typically cruises at 30 km/h and has a range of ~18,000 km. The *Kairei* would also serve as the platform from which vessel-based protected species observers (PSOs) would watch for marine mammals before and during airgun operations (as described in § XIII of the IHA application).

2.2.1. Specified Time and Specified Area

Seismic operations would be carried out for ~5.5 days, including 3.5 days within the United States EEZ and 2 days in international waters, starting on approximately September 15, 2017. The exact dates of the activities are unknown as they depend on logistics and weather conditions.

The survey would encompass the approximate area 22.6–25.0°N and 153.5–157.4°W in the central Pacific Ocean north of Hawaiian Islands, partly within the U.S. EEZ and partly in international waters. Representative survey tracklines are shown in Figure 1 on page; however, some deviation in actual track lines could be necessary for reasons such as science drivers, poor data quality, inclement weather, or mechanical issues with the research vessel and/or equipment. Water depth in the survey area ranges from ~4,000 to 5,000 m.

2.3. Alternative 1 – Issuance of an Authorization with Mitigation Measures

The Proposed Action constitutes Alternative 1 and is the Preferred Alternative. Under this alternative, NMFS would issue an IHA to UH allowing the incidental take, by Level A harassment and Level B harassment, of 24 species of marine mammals subject to the mandatory mitigation and monitoring measures and reporting requirements set forth in the proposed IHA. This Alternative includes mandatory requirements for UH to achieve the MMPA standard of effecting the least practicable impact on each species or stock of marine mammal and their habitat, paying particular attention to rookeries, mating grounds, and other areas of similar significance.

2.3.1. **Proposed Mitigation and Monitoring Measures**

As described in Section 1.2.2, NMFS must prescribe the means of effecting the least practicable impact on the species or stocks of marine mammals and their habitat. In order to do so, we must consider UH's proposed mitigation measures, as well as other potential measures, and assess how such measures could benefit the affected species or stocks and their habitat. Our evaluation of potential measures includes consideration of the following factors in relation to one another: (1) the manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks, and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned) the likelihood of effective implementation (probability implemented as planned). And (2) the practicability of the measure(s) for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

To reduce the potential for disturbance associated with the activities, UH has proposed to implement several mitigation and monitoring measures. UH would employ the following mitigation measures:

1. Establishment of an Exclusion Zone (EZ). An exclusion zone is a defined area within which occurrence of a marine mammal triggers mitigation action intended to reduce the potential for certain outcomes, *e.g.*, auditory injury, disruption of critical behaviors. PSOs would establish a default EZ with a 500 m radius. The 500 m EZ would be based on radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). With certain exceptions (described below), if a marine mammal appears within, enters, or appears on a course to enter this zone, the acoustic source would be powered down.
2. Use of power down procedures. A power down involves decreasing the number of airguns in use such that the radius of the mitigation zone is decreased to the extent that marine mammals are no longer in, or about to enter, the 500 m EZ. During a power down, one 100-in^3 airgun would be operated. The continued operation of one 100-in^3 airgun is intended to alert marine mammals to the presence of the seismic vessel in the area, and to allow them to leave the area of the seismic vessel if they choose. If a marine mammal is detected outside the EZ but appears likely to enter the EZ, the airguns would be powered down before the animal is within the EZ. Likewise, if a mammal is already within the EZ when first detected, the airguns would be powered down immediately.

   Following a power down, airgun activity would not resume until all marine mammals have cleared the 500 m EZ. The animal would be considered to have cleared the EZ if (1) it is visually observed to have left the EZ, or (2) it has not been seen within the EZ for 15 min in the case of small odontocetes, or (3) it has not been seen within the EZ for 30 min in the case of mysticetes and large odontocetes, including sperm, pygmy sperm, dwarf sperm, and beaked whales.

   This power down requirement would be in place for all marine mammals, with the exception of small delphinoids under certain circumstances. The small delphinoid group is intended to encompass those members of the Family Delphinidae most likely to voluntarily approach the source vessel for purposes of interacting with the vessel and/or airgun array (*e.g.*, bow riding). This exception to the power down requirement would apply solely to specific genera of small dolphins — *Steno*, *Tursiops*, *Stenella* and *Lagenodelphis* — and would only apply if the animals were traveling, including approaching the vessel. If an animal or group of animals were stationary (*e.g.*, feeding) and the source vessel approached the animals, the shutdown requirement applies.

In the event of a power down, a 100 m EZ would be stablished around the single 100-in^3 airgun. If a marine mammal is detected within or near the 100 m EZ for the single 100-in^3 airgun, the single airgun would be shut down.

3. Use of shutdown procedures. The operating airgun(s) would be completely shut down if a marine mammal is seen within or approaching the 100 m EZ for the single 100-in^3 airgun. Shutdown would be implemented (1) if an animal enters the EZ of the single 100-in^3 airgun after a power down has been initiated, or (2) if an animal is initially seen within the 100 m EZ of the single airgun when more than one airgun (typically the full array) is operating. Airgun activity would not resume until all marine mammals have cleared the 500 m EZ. Criteria for judging that the animal has cleared the 500 m EZ would be as described above. The shutdown requirement, like the power down requirement, would be waived for dolphins of the following genera: *Steno*, *Tursiops*, *Stenella*, and *Lagenodelphis*. The shutdown waiver for dolphins would not apply if the animals were stationary and the source vessel approached the animals.
4. Use of ramp-up procedures. Ramp-up of an acoustic source is intended to provide a gradual increase in sound levels following a power down or shutdown, enabling animals to move away from the source if the signal is sufficiently aversive prior to its reaching full intensity. Ramp-up procedures would occur any time the array is started up, including after power down or shutdown for any reason. The ramp-up procedure involves a step-wise increase in the number of airguns firing and total array volume until all operational airguns are activated and the full volume is achieved.
5. Visual and Acoustic Monitoring. Monitoring would be conducted by a minimum of five dedicated, trained, NMFS-approved PSOs. The PSOs would have no tasks other than to conduct observational effort, record observational data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements. PSO observations would take place during daytime airgun operations and nighttime start ups (if applicable) of the airguns. Airgun operations would be suspended when marine mammals are observed within, or about to enter, the EZ. PSOs would also watch for marine mammals near the seismic vessel for at least 30 minutes prior to the planned start of airgun operations. Observations would also be made during daytime periods when the *Kairei* is underway without seismic operations, such as during transits.

   During the majority of seismic operations, at least two PSOs would monitor for marine mammals around the seismic vessel (with the exception of meal times, during which one PSO may be on duty). Use of two simultaneous observers would increase the effectiveness of detecting animals around the source vessel. PSOs would be on duty in shifts of duration no longer than four hours.

   In addition to visual monitoring, passive acoustic monitoring (PAM) would complement the visual monitoring program. Acoustic monitoring can be used in addition to visual observations to improve detection, identification, and localization of cetaceans. PAM would serve to alert visual observers when vocalizing cetaceans are detected. One acoustic PSO would be on board in addition to the four visual PSOs. When a vocalization is detected while visual observations are in progress, the acoustic PSO would contact the visual PSO(s) immediately, to alert the visual PSO(s) to the presence of cetaceans (if they have not already been seen), and to allow a power down or shutdown to be initiated, if required.

2.3.2. Proposed Reporting Measures

UH is required to submit a draft monitoring report to the NMFS Office of Protected Resources within 90 days after the conclusion of the activities. A final report shall be prepared and submitted within 30 days following resolution of any comments on the draft report from NMFS. The final report will include:

The following information would be recorded for each sighting and would be documented in the monitoring report submitted to NMFS:

- Species, group size, age/size/sex categories (if determinable);
- Behavior when first sighted and after initial sighting;
- Heading (if consistent), bearing and distance from seismic vessel;
- Sighting cue, apparent reaction to the airguns or vessel (e.g., none, avoidance, approach, paralleling, etc.);
- Behavioral pace;
- Time, location, heading, speed, activity of the vessel;
- Sea state;
- Visibility; and
- Sun glare.

All observations and power downs or shut downs would be recorded in a standardized format. Data would be entered into an electronic database. The accuracy of the data entry would be verified by computerized data validity checks as the data are entered and by subsequent manual checking of the database. These procedures would allow initial summaries of data to be prepared during and shortly after the field program, and would facilitate transfer of the data to statistical, graphical, and other programs for further processing and archiving.

Results from the vessel-based observations would provide

1. The basis for real-time mitigation (airgun power down or shut down).
2. Information needed to estimate the number of marine mammals potentially taken by harassment.
3. Data on the occurrence, distribution, and activities of marine mammals in the area where the seismic study is conducted.
4. Information to compare the distance and distribution of marine mammals relative to the source vessel at times with and without seismic activity.
5. Data on the behavior and movement patterns of marine mammals seen at times with and without seismic activity.

2.4. Alternative 2 – No Action

For NMFS, denial of MMPA authorizations constitutes the NMFS No Action Alternative, which is consistent with our statutory obligation under the MMPA to grant or deny permit applications and to prescribe mitigation, monitoring and reporting with any authorizations. Under the No Action Alternative, there are two potential outcome scenarios. One is that the planned marine seismic survey, including deployment of the airgun array, would occur in the absence of an MMPA authorization.In this case, (1) UH would be in violation of the MMPA if takes occur, (2) mitigation, monitoring and reporting measures would not be prescribed by NMFS, and 3) mitigation measures might not be performed voluntarily by the applicant.. Another potential outcome scenario is UH could choose not to proceed with their marine seismic survey.

By prescribing measures to protect minimize impacts on marine mammals species or stocks from incidental take through the authorization program, we can potentially lessen the impacts of these activities on the marine environment. While NMFS does not authorize the anchor retrieval operations, NMFS does authorize the unintentional, incidental unintentional take of marine mammals (under its jurisdiction) in connection with these activities and prescribes, where applicable, the methods of taking and other means of effecting the least practicable impact on the species and stocks and their habitats. Although the No Action Alternative would not meet the purpose and need to allow incidental takes of marine mammals under certain conditions, the CEQ's regulations require consideration and analysis of a No Action Alternative for the purposes of presenting a comparative analysis to the action alternatives.

2.5. Alternatives Considered but Eliminated from Further Consideration

NMFS considered whether other alternatives could meet the purpose and need and support UH's proposed project. An alternative that would allow for the issuance of an IHA with no required mitigation or monitoring measures was considered but eliminated from consideration, as it would not be in compliance with the MMPA and, therefore, would not meet the purpose and need. For that reason, this alternative is not analyzed further in this document.

Chapter 3 Affected Environment

NMFS reviewed all possible environmental, cultural, historical, social, and economic resources based on the geographic location associated with NMFS's proposed action, alternatives, and UH's request for an IHA. Based on this review, this section describes the affected environment and existing (baseline) conditions for select resource categories. As explained in Chapter 1, certain resource categories not affected by NMFS's proposed action and alternatives were not carried forward for further consideration or evaluation in this EA (See Table 1 in Section 1.5.1). Chapter 4 provides an analysis and description of environmental impacts associated with the affected environment.

3.1. Physical Environment

The Pacific Ocean covers approximately 165.2 million square kilometers (63.8 million square mi) and extends approximately 15,500 km (9,600 mi) from the Bering Sea in the Arctic to the northern extent of the circumpolar Southern Ocean at 60 S. The survey study area would occur in the approximate area 22.6–25.0 N and 153.5–157.4 W in the central Pacific Ocean north of Hawaii, partly within the Hawaiian Islands EEZ and partly in International Waters (LGL, 2017). The proposed survey activity will not take place within or near a national marine sanctuary or marine monuments, wildlife refuge, National Park or other conservation area.

3.1.1. Ambient Sound

The need to understand the marine acoustic environment is critical when assessing the effects of anthropogenic noise on marine wildlife. Sounds generated by seismic surveys within the marine environment can affect its inhabitants' behavior (e.g., deflection from loud sounds) or ability to effectively live in the marine environment (e.g., masking of sounds that could otherwise be heard).

Ambient sound levels are the result of numerous natural and anthropogenic sounds that can propagate over large distances and vary greatly on a seasonal and spatial scale. These ambient sounds occupy all frequencies and contributions in ocean soundscape from a few hundred Hz to 200 kHz (NRC, 2003). The main sources of underwater ambient sound are typically associated with:

- Wind and wave action
- Precipitation
- Vessel activities
- Biological sounds (e.g. fish, snapping shrimp)

The contribution of these sources to background sound levels differs with their spectral components and local propagation characteristics (e.g., water depth, temperature, salinity, and ocean bottom conditions). In deep water, low-frequency ambient sound from 1-10 Hz mainly comprises turbulent pressure fluctuations from surface waves and the motion of water at the air-water interfaces. At these infrasonic frequencies, sound levels depend only slightly on wind speed. Between 20-300 Hz, distant anthropogenic sound (ship transiting, etc.) dominates wind-related sounds. Above 300 Hz, the ambient sound level depends on weather conditions, with wind- and wave-related effects mostly dominating sounds. Biological sounds arise from a variety of sources (e.g., marine mammals, fish, and shellfish) and range from approximately 12 Hz to over 100 kHz. The relative strength of biological sounds varies greatly; depending on the situation, biological sound can be nearly absent to dominant over narrow or even broad frequency ranges (Richardson et al. 1995).

3.2. Biological Environment

The primary component of the biological environment that would be impacted by the proposed issuance of an IHA would be marine mammals, which would be directly impacted by the authorization of incidental take.

3.2.1. Marine Mammal Habitat

We present information on marine mammal habitat and the potential impacts to marine mammal habitat in our *Federal Register* notice of the proposed IHA (82 FR 34352, July 24, 2017). Also, UH presented more detailed information on the physical and oceanographic aspects of the central Pacific Ocean environment in the IHA application (LGL, 2017). In summary, there are no rookeries or major haulout sites nearby or ocean bottom structure of significant biological importance to marine mammals that may be present in the marine waters in the vicinity of the project area. No ESA-listed designated critical habitat exists in the area of the proposed activities. Marine mammals in the survey area use pelagic, open ocean waters, but may have differing habitat preferences based on their life history functions (LGL, 2017).

3.2.2. Marine Mammals

Of the 24 cetacean species that may occur within or near the survey area in the central Pacific Ocean, four are listed under the ESA as endangered: fin, sei, blue, and sperm whales. The rest of this section deals with species distribution in the proposed survey area north of Hawaii. Information on the occurrence near the proposed survey area, habitat, population size, and conservation status for each of the cetacean species is presented in Table 3.

The Hawaiian monk seal (*Neomonachus schauisnlandi*), which is ESA-listed as endangered, mainly occurs within the 500-m isobath around the Northwestern Hawaiian Islands, but lower numbers are also found in the Main Hawaiian Islands (NMFS 2014); it is not expected to occur in the offshore proposed survey area. Except for Bryde's whales, baleen whales are expected to be rare in the study area during the proposed survey; most individuals would be at northern-latitude feeding areas during the proposed survey.

Table 3. Marine mammals that could occur in or near the proposed survey area in the central Pacific Ocean

Species	Stock	ESA/MMPAstatus (Y/N)[1]	Stock Abundance[2]	Occurrence in Project Area
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)				
Family: Balaenopteridae				
Humpback whale (*Megaptera novaeangliae*)	Central North Pacific	-/-; N	10,103[3]	Seasonal; throughout known breeding grounds during winter and spring (most common November through April)
Blue Whale (*Balaenoptera musculus)*	Central North Pacific	E/D; Y	81	Seasonal; infrequent winter migrant; few sightings, mainly fall and winter; considered rare

Species	Stock	ESA/MMPAstatus (Y/N)[1]	Stock Abundance[2]	Occurrence in Project Area
Fin whale (*Balaenoptera physalus*	Hawaii	E/D; Y	58	Seasonal, mainly fall and winter; considered rare
Sei whale (*Balaenoptera borealis)*	Hawaii	E/D; Y	178	Rare; limited sightings of seasonal migrants that feed at higher latitudes
Bryde's whale (*Balaenoptera brydei/edeni)*	Hawaii	-/-; N	798	Uncommon; distributed throughout the Hawaiian Exclusive Economic Zone
Minke whale (*Balaenoptera acutorostrata)*	Hawaii	-/-; N	n/a	Seasonal, mainly fall and winter; considered rare
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family: Physeteridae				
Sperm whale (*Physeter macrocephalus*)	Hawaii	E/D; Y	3,354	Widely distributed year round
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family: Kogiidae				
Pygmy sperm whale[6] (*Kogia breviceps*)	Hawaii	-/-; N	7,139	Widely distributed year round
Dwarf sperm whale[6] (*Kogia sima*)	Hawaii	-/-; N	17,519	Widely distributed year round
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family delphinidae				
Killer whale (*Orcinus orca*)	Hawaii	-/-; N	101	Uncommon; infrequent sightings
False killer whale (*Pseudorca crassidens*)	Hawaii Pelagic	-/-; N	1,540	Regular
Pygmy killer whale (*Feresa attenuata*)	Hawaii	-/-; N	3,433	Year-round resident
Short-finned pilot whale	Hawaii	-/-; N	12,422	Commonly observed around Main Hawaiian Islands and

Species	Stock	ESA/MMPAstatus (Y/N)[1]	Stock Abundance[2]	Occurrence in Project Area
(*Globicephala macrorhynchus*)				Northwestern Hawaiian Islands
Melon headed whale (*Peponocephala electra)*	Hawaiian Islands	-/-; N	5,794	Regular
Bottlenose dolphin (*Tursiops truncatus*)	Hawaii pelagic	-/-; N	5,950	Common in deep offshore waters
Pantropical spotted dolphin (*Stenella attenuata*)	Hawaii pelagic	-/-; N	15,917	Common; primary occurrence between 100 and 4,000 m depth
Striped dolphin (*Stenella coeruleoala*)	Hawaii	-/-; N	20,650	Occurs regularly year round but infrequent sighting during survey
Spinner dolphin (*Stenella longirostris*)	Hawaii pelagic	-/-; N	3,351[4]	Common year-round in offshore waters
Rough-toothed dolphin (*Steno bredanensis*)	Hawaii	-/-; N	6,288	Common throughout the Main Hawaiian Islands and Hawaiian Islands EEZ
Fraser's dolphin (*Lagenodelphis hosei*)	Hawaii	-/-; N	16,992	Tropical species only recently documented within Hawaiian Islands EEZ (2002 survey)
Risso's dolphin (*Grampus griseus*)	Hawaii	-/-; N	7,256	Previously considered rare but multiple sightings in Hawaiian Islands EEZ during various surveys conducted from 2002-2012
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)				
Family:Ziphiidae				
Cuvier's beaked whale (*Ziphius cavirostris*)	Hawaii	-/-; N	1,941	Year-round occurrence but difficult to detect due to diving behavior
Blainville's beaked whale	Hawaii	-/-; N	2,338	Year-round occurrence but

Species	Stock	ESA/MMPAstatus (Y/N)[1]	Stock Abundance[2]	Occurrence in Project Area
(*Mesoplodon densirostris*)				difficult to detect due to diving behavior
Longman's beaked whale (*Indopacetus pacificus*)	Hawaii	-/-; N	4,571	Considered rare; however, multiple sightings during 2010 survey

[1]Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.
[2]Abundance estimates from Caretta et al. (2016) unless otherwise noted.
[3]Values for humpback whale from 2015 Alaska SAR (Muto *et al.* 2015).
[4]Values for spinner dolphin, dwarf and pygmy sperm whale from Barlow *et al.* (2006).

3.2.2.1 ESA-Listed Species

Sei Whale

The sei whale occurs in all ocean basins (Horwood 2009), but appears to prefer mid-latitude temperate waters (Jefferson et al. 2008). It undertakes seasonal migrations to feed in subpolar latitudes during summer and returns to lower latitudes during winter to calve (Horwood 2009). The sei whale is pelagic and generally not found in coastal waters (Harwood and Wilson 2001). It occurs in deeper waters characteristic of the continental shelf edge region (Hain et al. 1985) and in other regions of steep bathymetric relief such as seamounts and canyons (Kenney and Winn 1987; Gregr and Trites 2001).

During summer in the North Pacific, the sei whale can be found from the Bering Sea to the Gulf of Alaska and down to southern California, as well as in the western Pacific from Japan to Korea. In Hawaii, the occurrence of sei whales is considered rare (DoN 2005). However, 6 sightings were made during surveys in the Hawaiian Islands EEZ in July–December 2002 (Barlow 2006), and 1 sighting was made just outside of the EEZ, east of the proposed survey area at ~24.5°N, 150°W (Barlow et al. 2004). All sightings occurred in November; none of the sightings within the EEZ was made near the proposed survey area (Barlow et al. 2004). Bradford et al. (2013) reported 2 sightings in the northwestern portion of the Hawaiian Islands EEZ during summer–fall surveys in 2010. Hopkins et al. (2009) sighted 1 group of 3 subadult sei whales northeast of Oahu in November 2007; breeding and calving areas for this species in the Pacific are unknown, but those sightings suggest that Hawaii may be an important reproductive area (Hopkins et al. 2009). There is one record for the Hawaiian EEZ in the OBIS database south of the Hawaiian Islands (OBIS 2016).

Fin Whale

The fin whale is widely distributed in all the world's oceans (Gambell 1985), although it is most abundant in temperate and cold waters (Aguilar 2009). Nonetheless, its overall range and distribution are not well known (Jefferson et al. 2008). The fin whale most commonly occurs offshore, but can also be found in coastal areas (Aguilar 2009). Most populations migrate seasonally between temperate waters where mating and calving occur in winter, and polar waters where feeding occurs in summer (Aguilar 2009). However, recent evidence suggests that some animals may remain at high latitudes in winter or low latitudes in summer (Edwards et al. 2015).

The fin whale is known to use the shelf edge as a migration route (Evans 1987). Sergeant (1977) suggested that fin whales tend to follow steep slope contours, either because they detect them readily, or because the contours are areas of high biological productivity. However, fin whale movements have been reported to be complex, and not all populations follow this simple pattern (Jefferson et al. 2008). Stafford et al. (2009) noted that sea-surface temperature is a good predictor variable for fin whale call detections in the North Pacific.

North Pacific fin whales summer from the Chukchi Sea to California and winters from California southwards (Gambell 1985). In the U.S., three stocks are recognized in the North Pacific: California/Oregon/Washington, Hawaii, and Northeast Pacific (Carretta et al. 2015). Information about the seasonal distribution of fin whales in the North Pacific has been obtained from the detection of fin whale calls by bottom-mounted, offshore hydrophone arrays along the U.S. Pacific coast, in the central North Pacific, and in the western Aleutian Islands (Moore et al. 1998, 2006; Watkins et al. 2000a,b; Stafford et al. 2007, 2009). Fin whale calls are recorded in the North Pacific year-round (e.g., Moore et al. 2006; Stafford et al. 2007, 2009). In the central North Pacific, call rates peak during fall and winter (Moore et al. 1998, 2006; Watkins et al. 2000a,b).

Thompson and Friedl (1982) suggested that fin whales occur in Hawaiian waters during fall and winter; they are generally considered uncommon at that time (DoN 2005). During spring and summer, their occurrence in Hawaii is considered rare (DoN 2005). There were 5 sightings of fin whales during summer–fall surveys in 2002, most to the northwest of the Main Hawaiian Islands (Barlow et al. 2004) and 2 sightings in the Hawaiian Islands EEZ during summer–fall 2010 (Bradford et al. 2013); there were no sightings in or near the proposed survey area (Carretta et al. 2015). Two additional sightings in the EEZ were made by observers on Hawaii-based longline fishing vessels, including one near the proposed survey area (Carretta et al. 2015).vThere is one record for the Hawaiian EEZ in the OBIS database south of the Hawaiian Islands (OBIS 2016).

Blue Whale

The blue whale has a cosmopolitan distribution and tends to be pelagic, only coming nearshore to feed and possibly to breed (Jefferson et al. 2008). Blue whale migration is less well defined than for some other rorquals, and their movements tend to be more closely linked to areas of high primary productivity, and hence prey, to meet their high energetic demands (Branch et al. 2007). Generally, blue whales are seasonal migrants between high latitudes in the summer, where they feed, and low latitudes in the winter, where they mate and give birth (Lockyer and Brown 1981). Some individuals may stay in low or high latitudes throughout the year (Reilly and Thayer 1990; Watkins et al. 2000b).

In the North Pacific, blue whale calls are received year-round (Moore et al. 2002, 2006). Stafford et al. (2009) reported that sea-surface temperature is a good predictor variable for blue whale call detections in the North Pacific. Although it has been suggested that there are at least five subpopulations in the North Pacific (Reeves et al. 1998), analysis of calls monitored from the U.S. Navy Sound Surveillance System (SOSUS) and other offshore hydrophones (e.g., Stafford et al. 1999, 2001, 2007; Watkins et al. 2000a; Stafford 2003) suggest that there are two separate populations: one in the eastern and one in the central North Pacific (Carretta et al. 2015). The Eastern North Pacific Stock includes whales that that feed primarily off California from June to November and winter off Central America (Calambokidis et al. 1990; Mate et al. 1999); the Central North Pacific Stock feeds off Kamchatka, south of the Aleutians, and in the Gulf of Alaska during summer (Stafford 2003; Watkins et al. 2000b) and migrates to the western and central Pacific (including Hawaii) to breed in winter (Stafford et al. 2001; Carretta et al. 2015). Call types from both stocks have been recorded near Hawaii during August–April, although eastern calls were more prevalent (Stafford et al. 2001). Western calls were mainly detected during December–March, whereas eastern calls peaked during August and September and were rarely heard during October–March (Stafford et al. 2001).

Blue whales are considered rare in Hawaii (DoN 2005; Carretta et al. 2015). No sightings were made in the Hawaiian Islands EEZ during surveys in July–December 2002 (Barlow et al. 2004; Barlow 2006). One sighting was made in the Northwestern Hawaiian Islands during August–October 2010 (Bradford et al. 2013). Three additional sightings in the EEZ were made by observers on Hawaii-based longline fishing vessels during 1994–2009, including one in the proposed survey area (Carretta et al. 2015). There are no records for the Hawaiian EEZ in the OBIS database or near the proposed survey area (OBIS 2016).

Sperm Whale

The sperm whale is the largest of the toothed whales, with an extensive worldwide distribution from the edge of the polar pack ice to the Equator (Whitehead 2009). Sperm whale distribution is linked to its social structure: mixed groups of adult females and juveniles of both sexes generally occur in tropical and subtropical waters at latitudes less than ~40° (Whitehead 2009). After leaving their female relatives, males gradually move to higher latitudes with the largest males occurring at the highest latitudes and only returning to tropical and subtropical regions to breed. Sperm whales generally are distributed over large areas that have high secondary productivity and steep underwater topography, in waters at least 1000 m deep (Jaquet and Whitehead 1996). They are often found far from shore, but can be found closer to oceanic islands that rise steeply from deep ocean waters (Whitehead 2009).

Sperm whales are widely distributed in Hawaiian waters throughout the year (Mobley et al. 2000). During summer–fall surveys of the Hawaiian Islands EEZ, 43 sightings were made in 2002 (Barlow 2006) and 41 were made in 2010 (Bradford et al. 2013). Sightings were widely distributed across the EEZ during both surveys; numerous sightings occurred in and adjacent to the proposed survey area (Barlow et al. 2004; Barlow 2006; Bradford et al. 2013). There are ~110 records for the Hawaiian Islands EEZ in the OBIS database, including ~60 historical whaling records; 10 of the whaling records are in the proposed survey area (OBIS 2016).

3.2.2.2 Non-ESA Listed Species

Humpback Whale (Hawaii DPS)

The humpback whale is found throughout all oceans of the World (Clapham 2009). Although considered mainly a coastal species, the humpback whale often traverses deep pelagic areas while migrating (e.g., Mate et al. 1999; Garrigue et al. 2015). In October, 2016, NMFS issued a final determination that revised the listing status of the humpback whale under the ESA. The species was divided into 14 distinct population segments (DPS), with four DPSs listed as endangered and one DPS listed as threatened. Based on their current statuses, the remaining nine DPSs, including the Hawaii DPS, did not warrant listing (81 FR 62259).

In U.S. Pacific waters, four stocks are currently recognized: (1) California/Oregon/Washington, (2) Central North Pacific, (3), Western North Pacific, and (4) American Samoa (Carretta et al. 2015). Calambokidis et al. (2008) estimated that >50% of the population in the entire North Pacific winters in Hawaiian waters. Hawaii is the primary wintering area for whales from summer feeding areas in the Gulf of Alaska, southeast Alaska, and northern British Columbia, Canada; some individuals from the Bering Sea feeding area also winter in Hawaii (Calambokidis et al. 2008). Even though photo-identification studies showed that Hawaii is connected to various feeding grounds in Alaska (Calambokidis et al. 2008), genetic data indicated that it was significantly different from most feeding areas, except the Northern Gulf of Alaska and eastern Aleutians, and all other breeding areas (Baker et al. 2013).

North Pacific humpback whales migrate between summer feeding grounds along the Pacific Rim and the Bering and Okhotsk seas, and winter calving and breeding areas in subtropical and tropical waters (Pike and MacAskie 1969; Rice 1978; Winn and Reichley 1985; Calambokidis et al. 2000, 2001, 2008). They are known to assemble in three main winter breeding areas: (1) the eastern North Pacific along the coast of Mexico and Central America; (2) around the main Hawaiian Islands; and (3) in the western Pacific, particularly around the Ogasawara and Ryukyu islands in southern Japan and the northern Philippines (Calambokidis et al. 2008; Fleming and Jackson 2011). Bettridge et al. (2015) identified five distinct population segments of humpbacks in the North Pacific based on their breeding grounds: (1) Hawaii, (2) Central America, (3) Mexico, (4) Okinawa/Philippines, and (5) Second West Pacific (inferred, specific location unknown). There is a low level of interchange of whales among the wintering areas and among northern feeding areas (e.g., Darling and Cerchio 1993; Salden et al. 1999; Calambokidis et al. 2001, 2008; Baker et al. 2013).

Humpbacks use Hawaiian waters for breeding from December to April; peak abundance occurs from late February to early April (Mobley et al. 2001). Most humpbacks have been sighted there in water depths <180 m (Fleming and Jackson 2011), but Frankel et al. (1995) detected singers up to 13 km from shore at depths up to 550 m.

During vessel-based line-transect surveys in the Hawaiian Islands EEZ in July–December 2002, one humpback whale was sighted on 21 November at ~20.3°N, 154.9°W (Barlow et al. 2004), and one was sighted during surveys in 13 August–1 December 2010; the date and location of that sighting were not reported (Bradford et al. 2013). In the OBIS database, there are 577 records for the Hawaiian Islands EEZ (OBIS 2016); except for one sighting ~110 km northeast of Kauai, most records have been reported within 100 km from land. The closest sighting to the proposed survey area was made at 22.3°N, 158.1°W, ~160 km from the western-most survey line; all other records were >200 km from the survey area. In addition, one sighting was made in April 1997 in offshore waters to the north of the survey area at 29.1°N, 155.3°W (Barlow and Taylor 2005 in OBIS 2016).

Minke Whale

The common minke whale has a cosmopolitan distribution ranging from the tropics and subtropics to the ice edge in both hemispheres (Jefferson et al. 2008). Three stocks of minke whales are recognized in U.S. Pacific waters: the Alaska, Hawaii, and California/Oregon/Washington stocks (Carretta et al. 2015). The minke whale is generally believed to be uncommon in Hawaiian waters; however, several studies using acoustic detections suggest that minke whales may be more common than previously thought (Rankin et al. 2007; Oswald et al. 2011; Martin et al. 2012). A lack of sightings is likely related to misidentification or low detection capability in poor sighting conditions (Rankin et al. 2007). The minke whale is thought to occur seasonally in Hawaii, from November through March (Rankin and Barlow 2005).

Two minke whale sightings were made west of 167°W, one in November 2002 and one in October 2010 during surveys of the Hawaiian Islands EEZ (Barlow et al. 2004; Bradford et al. 2013; Carretta et al. 2015). Numerous additional sightings in the EEZ were made by observers on Hawaii-based longline fishing vessels, including at least one in the proposed survey area (Carretta et al. 2015). There are 2 records in the OBIS database for the Hawaiian Islands EEZ (OBIS 2016), neither of which is near the proposed survey area. Acoustic detections have been recorded around the Hawaiian Islands during fall– spring surveys in 1997 and 2000–2006 (Rankin and Barlow 2005; Barlow et al. 2008; Rankin et al. 2008), and from seafloor hydrophones positioned ~50 km from the coast of Kauai during February–April 2006 (Martin et al. 2012). Similarly, passive acoustic detections of minke whales have been recorded at ALOHA station (22.75°N, 158°W) from October to May for decades (Oswald et al. 2011).

Bryde's Whale

The Bryde's whale occurs in all tropical and warm temperate waters in the Pacific, Atlantic, and Indian oceans, between 40°N and 40°S (Kato and Perrin 2009). It is one of the least known large baleen whales, and its taxonomy is still under debate (Kato and Perrin 2009). B. brydei is commonly used to refer to the larger form or "true" Bryde's whale and B. edeni to the smaller form; however, some authors apply the name B. edeni to both forms (Kato and Perrin 2009).

Although there is a pattern of movement toward the Equator in the winter and the poles during the summer, Bryde's whale does not undergo long seasonal migrations, remaining in warm (>16°C) water year-round (Kato and Perrin 2009). Bryde's whales are known to occur in both shallow coastal and deeper offshore waters (Jefferson et al. 2008).

In Hawaii, Bryde's whales are typically seen offshore (e.g., Barlow et al. 2004; Barlow 2006), but Hopkins et al. (2009) reported a Bryde's whale within 70 km of the Main Hawaiian Islands. During summer–fall surveys of the Hawaiian Islands EEZ, 13 sightings were made in 2002 (Barlow 2006) and 32 sightings were made during 2010 (Bradford et al. 2013). Bryde's whales were primarily sighted in the western half of the Hawaiian Islands EEZ, with the majority of sightings associated with the Northwestern Hawaiian Islands; none was made in or near the proposed survey area (Barlow et al. 2004; Barlow 2006; Bradford et al. 2013; Carretta et al. 2015). There are no records for the Hawaiian Islands EEZ in the OBIS database (OBIS 2016).

Pygmy and Dwarf Sperm Whales

Pygmy and dwarf sperm whales are distributed widely throughout tropical and temperate seas, but their precise distributions are unknown because much of what we know of the species comes from strandings (McAlpine 2009). They are difficult to sight at sea, because of their dive behavior and perhaps because of their avoidance reactions to ships and behavior changes in relation to survey aircraft (Würsig et al. 1998). The two species are often difficult to distinguish from one another when sighted, but dwarf sperm whales may be more pelagic with a preference for deeper water (McAlpine 2009).

Both Kogia species are sighted primarily along the continental shelf edge and slope and over deeper waters off the shelf (Hansen et al. 1994; Davis et al. 1998; Jefferson et al. 2008). Barros et al. (1998), on the other hand, suggested that dwarf sperm whales could be more pelagic and dive deeper than pygmy sperm whales. It has also been suggested that the pygmy sperm whale is more temperate and the dwarf sperm whale more tropical, based at least partially on live sightings at sea from a large database from the ETP (Wade and Gerrodette 1993). During small-boat surveys around the Hawaiian Islands in 2000–2012, dwarf sperm whales were sighted in all water depth categories up to 5000 m deep, but the highest sighting rates were in water 500–1000 m deep (Baird et al. 2013).

Although there are few useful estimates of abundance for pygmy or dwarf sperm whales anywhere in their range, they are thought to be fairly common in some areas. In the Hawaiian Islands, an insular resident population of dwarf sperm whales occurs within ~20 km from shore (Baird et al. 2013). During summer–fall surveys of the Hawaiian Islands EEZ in 2002, 2 sightings of pygmy sperm whales, 5 sightings of dwarf sperm whales, and 1 sighting of an unidentified Kogia sp. were made; all sightings were made in the western portion of the EEZ (Barlow et al. 2004; Barlow 2006). During summer–fall surveys of the Hawaiian Islands EEZ in 2010, 1 dwarf sperm whale and 1 unidentified Kogia sp. were sighted (Bradford et al. 2013). No sightings were made in or near the proposed survey area (Carretta et al. 2015). There are 6 pygmy sperm whale records for the Hawaiian Islands EEZ in the OBIS database, none north of the Hawaiian Islands (OBIS 2016). There are 74 records of dwarf sperm whales for the Hawaiian EEZ, none in the proposed survey area (OBIS 2016).

Cuvier's Beaked Whale

Cuvier's beaked whale is the most widespread of the beaked whales, occurring in almost all temperate, subtropical, and tropical waters and even some sub-polar and polar waters (MacLeod et al. 2006). It is likely the most abundant of all beaked whales (Heyning and Mead 2009). Cuvier's beaked whale is found in deep water over and near the continental slope (Jefferson et al. 2008). Ferguson et al. (2006) reported that in the ETP, the mean water depth where Cuvier's beaked whales were sighted was ~3.4 km. During small-boat surveys around the Hawaiian Islands in 2000–2012, sightings were made in water depths of 500–4000 m (Baird et al. 2013).

During summer–fall surveys of the Hawaiian Islands EEZ, 3 sightings of Cuvier's beaked whale were made in the western portion of the EEZ in 2002 (Barlow 2006) and 23 were made in the EEZ in 2010 (Bradford et al. 2013). Most of the sightings in 2010 were made in nearshore waters of the Northwestern Hawaiian Islands, none in or near the proposed survey area (Carretta et al. 2015). Resighting and telemetry data suggest that a resident insular population may exist, distinct from offshore, pelagic Cuvier's beaked whales (e.g. McSweeney et al 2007; Baird et al. 2013). There are 65 records for the Hawaiian Islands EEZ, none to the north of the Hawaiian Islands (OBIS 2016).

Indo-Pacific Beaked Whale

The Indo-Pacific beaked whale, also known as Longman's beaked whale, was until recently one of the least known cetacean species, but it is now one of the more frequently sighted beaked whales (Pitman 2009a). Since 2003, there have been at least 65 at-sea sightings and 8 strandings worldwide. Based on this information, it is now known that the Indo-Pacific beaked whale occurs in tropical waters throughout the Indo-Pacific, with records from 10°S to 40°N. The Indo-Pacific beaked whale is most often sighted in waters with temperatures ≥26°C and depth >2000 m, and sightings have also been reported along the continental slope (Anderson et al. 2006; Pitman 2009a).

During summer–fall surveys of the Hawaiian Islands EEZ, 1 sighting was made in 2002 and 3 were made in 2010, none near the proposed survey area (Barlow et al. 2004; Barlow 2006; Bradford et al. 2013). There is one record in the OBIS database for the Hawaiian EEZ, just to the west of the Big Island (OBIS 2016).

Blainville's beaked whale

Blainville's beaked whale is found in tropical and warm temperate waters of all oceans; it has the widest distribution throughout the world of all mesoplodont species and appears to be common (Pitman 2009b). During small-boat surveys around the Hawaiian Islands in 2000–2012, sightings were made in water up to 4000 m deep, with the highest sighting rates in water 3500–4000 m deep (Baird et al. 2013).

During summer–fall shipboard surveys of the Hawaiian Islands EEZ, 3 sightings were made in 2002 and 2 were made in 2010, all in the western portion of the EEZ (Barlow et al. 2004; Barlow 2006; Bradford et al. 2013). In addition, there were 4 sightings of unidentified Mesoplodon there in 2002 (Barlow et al. 2004; Barlow 2006) and 10 in 2010 (Bradford et al. 2013). Studies by McSweeney et al. (2007), Schorr et al. (2009), and Baird et al. (2013) suggest the existence of separate insular and offshore Blainville's beaked whales in Hawaiian waters. There are 49 records for the Hawaiian EEZ in the OBIS database, none in the proposed survey area (OBIS 2016).

Rough-toothed Dolphin

The rough-toothed dolphin is distributed worldwide in tropical to warm temperate oceanic waters (Miyazaki and Perrin 1994; Jefferson 2009). In the Pacific, it occurs from central Japan and northern Australia to Baja California, Mexico, and southern Peru (Jefferson 2009). It generally occurs in deep, oceanic waters, but can be found in shallower coastal waters in some regions (Jefferson et al. 2008). During small-boat surveys around the Hawaiian Islands in 2000–2012, it was sighted in water as deep as 5000 m, with the highest sighting rates in water >3500 m deep (Baird et al. 2013).

The rough-toothed dolphin is expected to be one of the most abundant cetaceans in the proposed survey area (Barlow et al. 2004; Barlow 2006; Bradford et al. 2013). During summer–fall surveys of the Hawaiian Islands EEZ, rough-toothed dolphins were observed throughout the EEZ and near the proposed survey area; there were 18 sightings in 2002 and 24 sightings in 2010 (Barlow 2006; Barlow et al. 2004; Bradford et al 2013). There are 181 records for the Hawaiian EEZ in the OBIS database, none within the proposed survey area (OBIS 2016). The closest sighting was made at 22.4°N, 157.8°W, ~130 km from the western-most survey line.

Bottlenose Dolphin

The bottlenose dolphin occurs in tropical, subtropical, and temperate waters throughout the World (Wells and Scott 2009). Generally, there are two distinct bottlenose dolphin ecotypes, one mainly found in coastal waters and one mainly found in oceanic waters (Duffield et al. 1983; Hoelzel et al. 1998; Walker et al. 1999). As well as inhabiting different areas, these ecotypes differ in their diving abilities (Klatsky 2004) and prey types (Mead and Potter 1995). Photo-identification studies have suggested that the 1000-m isobath serves as the boundary between resident insular stocks of the Main Hawaiian Islands and the Hawaii pelagic stocks (Martien et al 2012). During small-boat surveys around the Hawaiian Islands in 2000–2012, the bottlenose dolphin was sighted in water as deep as 4000 m, with the highest sighting rates in water >500 m deep (Baird et al. 2013).

Common bottlenose dolphins have been observed during summer–fall surveys of the Hawaiian EEZ, mostly in nearshore waters but also in offshore waters, including near the proposed survey area (see map in Carretta et al. 2015); 15 sightings were made in 2002 (Barlow 2006) and 19 sightings were made in 2010 (Bradford et al. 2013). There is also one bycatch record for fall–winter and one sighting record for spring–summer for the proposed survey area (DoN 2005). There are 213 records for the Hawaiian EEZ in the OBIS database, none within 200 km of the proposed survey area (OBIS 2016).

Pantropical Spotted Dolphin

The pantropical spotted dolphin is one of the most abundant cetaceans and is distributed worldwide in tropical and some subtropical waters (Perrin 2009a), between ~40°N and 40°S (Jefferson et al. 2008). It is found primarily in deeper waters and rarely over the continental shelf or continental shelf edge (Davis et al. 1998), but can also be found in coastal, shelf, and slope waters (Perrin 2009a). During small- boat surveys around the Hawaiian Islands in 2000–2012, it was sighted in all water depth categories, with the lowest sighting rate in water <500 m (Baird et al. 2013).

There are two forms of pantropical spotted dolphin: coastal and offshore. The offshore form inhabits tropical, equatorial, and southern subtropical water masses; the pelagic individuals around the Hawaiian Islands belong to a stock distinct from those in the ETP (Dizon et al 1991; Perrin 2009a). Spotted dolphins are commonly seen together with spinner dolphins in mixed-species groups, e.g., in the ETP (Au and Perryman 1985), off Hawaii (Psarakos et al. 2003), and in the Marquesas Archipelago (Gannier 2002).

The pantropical spotted dolphin is expected to be one of the most abundant cetaceans in the proposed survey area. It has been seen during summer–fall surveys of the Hawaiian Islands EEZ including near the proposed survey area (see map in Carretta et al. 2015); 14 sightings were made in 2002 (Barlow 2006) and 12 sightings were made in 2010 (Bradford et al. 2013). There are >400 records for the Hawaiian Islands EEZ in the OBIS database, none within 200 km of the proposed survey area (OBIS 2016).

Spinner Dolphin

The spinner dolphin is pantropical in distribution, including oceanic tropical and sub-tropical waters between 40oN and 40oS (Jefferson et al. 2008). It is generally considered a pelagic species (Perrin 2009b), but can also be found in coastal waters and around oceanic islands (Rice 1998). During small- boat surveys around the Hawaiian Islands in 2000–2012, it was sighted in water as deep as 3000 m, with the highest sighting rates in water >500 m deep (Baird et al. 2013).

In the ETP, it is associated with warm, tropical surface water, similar in distribution to the pantropical spotted dolphin (Au and Perryman 1985; Reilly 1990; Reilly and Fiedler 1994). Spinner dolphins and pantropical spotted dolphins have been sighted in mixed-species groups in the ETP (Au and Perryman 1985), off Hawaii (Psarakos et al. 2003), and in the Marquesas Archipelago (Gannier 2002). In Hawaii, spinner dolphins belong to a stock (S.l. longirostris; Gray's spinner) that is separate from animals in the ETP (Dizon et al. 1991).

There are six separate stocks managed within the Hawaiian Islands EEZ (Carretta et al. 2015); only individuals of the Hawaii pelagic stock are expected to overlap with the proposed survey area. Spinner dolphins have been sighted near the proposed survey area during summer–fall surveys of the Hawaiian Islands EEZ (see map in Carretta et al. 2015); 8 sightings were made in 2002 (Barlow 2006) and 4 were made in 2010 (Bradford et al. 2013). There are 221 records for the Hawaiian Islands EEZ in the OBIS database, none within 200 km of the proposed survey area (OBIS 2016).

Striped Dolphin

The striped dolphin has a cosmopolitan distribution in tropical to warm temperate waters from ~50°N to 40°S (Perrin et al. 1994a; Jefferson et al. 2008). It is typically found in waters outside the continental shelf and is often associated with convergence zones and areas of upwelling (Archer 2009). It occurs primarily in pelagic waters, but has been observed approaching shore where there is deep water close to the coast (Jefferson et al. 2008). During small-boat surveys around the Hawaiian Islands in 2000–2012, sightings were made in water depths of 1000–5000 m, with the highest sighting rates in water deeper than 3000 m (Baird et al. 2013).

The striped dolphin is expected to be one of the most abundant cetaceans in the proposed survey area. It has been sighted near the proposed survey area during summer–fall shipboard surveys of the Hawaii Islands EEZ (see map in Carretta et al. 2015); 15 sightings were made in 2002

(Barlow 2006) and 25 sightings were made in 2010 (Bradford et al. 2013). There are 30 records for the Hawaiian Islands EEZ in the OBIS database, none within 200 km of the proposed survey area (OBIS 2016).

Fraser's Dolphin

Fraser's dolphin is a tropical oceanic species distributed between 30°N and 30°S that generally inhabits deeper, offshore water (Dolar 2009). It occurs rarely in temperate regions and then only in relation to temporary oceanographic anomalies such as El Niño events (Perrin et al. 1994b). In the ETP, they were sighted at least 15 km from shore in waters 1500–2500 m deep (Dolar 2009).

Fraser's dolphin is one of the most abundant cetaceans in the Hawaiian Islands EEZ (Barlow 2006; Bradford et al. 2013). Summer–fall shipboard surveys of the EEZ resulted in 2 sightings of Fraser's dolphin in 2002 and 4 in 2010, all in the western portion of the EEZ (Barlow 2006; Bradford et al. 2013; Carretta et al. 2015). There are 2 records for the Hawaiian Islands EEZ in the OBIS database, none in the proposed survey area (OBIS 2016).

Risso's Dolphin

Risso's dolphin is primarily a tropical and mid-temperate species distributed worldwide (Kruse et al. 1999). It occurs between 60oN and 60oS, where surface water temperatures are at least 10oC (Kruse et al. 1999). Water temperature appears to be an important factor affecting its distribution (Kruse et al. 1999). Although it occurs from coastal to deep water, it shows a strong preference for mid-temperate waters of the continental shelf and slope (Jefferson et al. 2014). During small-boat surveys around the Hawaiian Islands in 2000–2012, sighting rates were highest in water >3000 m deep (Baird et al. 2013).

During summer–fall surveys of the Hawaiian Islands EEZ, 7 sightings were made in 2002 (Barlow 2006) and 10 were made in 2010 (Bradford et al. 2013). The majority of sightings were south of 20oN, but some were made near the proposed survey area (see map in Carretta et al. 2015). There are 10 records for the Hawaiian EEZ in the OBIS database, none within the proposed survey area (OBIS 2016). One sighting was made at 22.4°N, 157.8°W, ~130 km from the proposed survey area (Barlow and Taylor 2005).

Melon-headed Whale

The melon-headed whale is an oceanic species found worldwide in tropical and subtropical waters from ~40°N to 35°S (Jefferson et al. 2008). It is commonly seen in mixed groups with other cetaceans (Jefferson and Barros 1997; Huggins et al. 2005). It occurs most often in deep offshore waters and occasionally in nearshore areas where deep oceanic waters occur near the coast (Perryman 2009). During small-boat surveys around the Hawaiian Islands in 2000–2012, sightings were made in all water depths up to 5000 m (Baird et al. 2013).

Photo-identification and telemetry studies have revealed that there are two distinct populations of melon-headed whales in Hawaiian waters, the Hawaiian Islands stock and a resident stock associated with the western coast of the Big Island (Aschettino et al. 2012; Oleson et al. 2013). Aschettino (2010) provided an abundance estimate of 5794 for the main Hawaiian Islands population and 447 for Hawaii residents. Bradford et al. (2013) provided an estimate of 2860 for the Hawaiian population. Satellite telemetry data revealed distant pelagic movements, associated with feeding, nearly to the edge of the Hawaiian Islands EEZ; the most distal telemetry locations were near the proposed survey area at ~22.3°N, 154.0°W (Oleson et al. 2013).

During summer–fall surveys of the Hawaiian Islands EEZ in 2002 and 2010 there was a single sighting each year; neither was located near the proposed survey area (Barlow et al. 2004;

Bradford et al. 2013). There are 53 records for the Hawaiian EEZ in the OBIS database; all sightings were >200 km from the proposed survey area (OBIS 2016).

Pygmy Killer Whale

The pygmy killer whale has a worldwide distribution in tropical and subtropical waters (Donahue and Perryman 2009), generally not ranging south of 35°S (Jefferson et al. 2008). In warmer water, it is usually seen close to the coast (Wade and Gerrodette 1993), but it is also found in deep waters. In Hawaiian waters, the pygmy killer whale is found in nearshore waters but rarely offshore (Carretta et al. 2015). During small-boat surveys around the Hawaiian Islands in 2000–2012, sightings were made in water up to 3000 m deep (Baird et al. 2013).

Pygmy killer whales were recorded during summer–fall surveys of the Hawaiian Islands EEZ: 3 sightings in 2002 (Barlow et al. 2004; Barlow 2006) and 5 in 2010 (Bradford et al. 2013), none near the proposed survey area (Barlow et al. 2004; Bradford et al. 2013). There are 46 records for the Hawaiian Islands EEZ in the OBIS database; all sightings were >200 km from the proposed survey area (OBIS 2016).

False Killer Whale

The false killer whale is found worldwide in tropical and temperate waters, generally between 50oN and 50oS (Odell and McClune 1999). It is widely distributed, but generally uncommon throughout its range (Baird 2009). It is gregarious and forms strong social bonds, as is evident from its propensity to strand en masse (Baird 2009). The false killer whale generally inhabits deep, offshore waters, but sometimes is found over the continental shelf and occasionally moves into very shallow water (Jefferson et al. 2008; Baird 2009). During small-boat surveys around the Hawaiian Islands in 2000–2012, the highest sighting rates occurred in water >3500 m deep (Baird et al. 2013).

Telemetry, photo-identification, and genetic studies have identified three independent populations of false killer whales in Hawaiian waters: main (insular) Hawaiian Islands, Northwestern Hawaiian Islands, and surrounding pelagic stock (Chivers et al. 2010; Baird et al. 2010, 2013; Bradford et al. 2014). The population size of the Hawaii pelagic stock based on 2002 line-transect survey data was estimated at 484 (Barlow and Rankin 2007). Analysis of 2010 survey data resulted in an estimate of 1540 outside of 40 km of the Main Hawaiian Islands; however, this estimate may be positively biased because of increased sighting rates attributable to vessel attraction (Bradford et al. 2015). The population of false killer whales inhabiting the Main Hawaiian Islands is thought to have declined dramatically since 1989; the reasons for this decline are still uncertain, although interactions with longline fisheries have been suggested (Reeves et al. 2009; Bradford and Forney 2014). During 2008–2012, 26 false killer whales were observed hooked or entangled by longline gear within the Hawaiian Islands EEZ or adjacent high- seas waters; 22 of those were assessed as seriously injured (Bradford and Forney 2014).

During summer–fall surveys of the Hawaiian Islands EEZ, 2 sightings were made in 2002 (Barlow et al. 2004; Barlow 2006) and 14 were made in 2010 (Bradford et al. 2013), none of the on-effort sightings was near the proposed survey area (see map in Carretta et al. 2015). However, locations of false killer whale and unidentified blackfish takes observed during the 2008–2012 Hawaii-based longline fisheries have been reported in the proposed survey area (Bradford and Forney 2014; see map in Carretta et al. 2015). There are 47 records for the Hawaiian EEZ in the OBIS database; none of the sightings was made north of the Hawaiian Islands (OBIS 2016).

Killer Whale

The killer whale is cosmopolitan and globally fairly abundant; it has been observed in all oceans of the World (Ford 2009). It is very common in temperate waters and also frequents tropical waters, at least seasonally (Heyning and Dahlheim 1988). High densities of the species occur in high latitudes, especially in areas where prey is abundant. Killer whale movements generally appear to follow the distribution of their prey, which includes marine mammals, fish, and squid.

Killer whales are rare in the Hawaii Islands EEZ. Baird et al. (2006) reported 21 sighting records in Hawaiian waters between 1994 and 2004. During summer–fall surveys of the Hawaiian Islands EEZ, 2 sightings were made in 2002 (Barlow et al. 2004; Barlow 2006) and 1 was made in 2010 (Bradford et al. 2013), none near the proposed survey area (Barlow et al. 2004; Bradford et al. 2013; Carretta et al. 2015). Numerous additional sightings in and north of the EEZ have been made by observers on longliners, some in and near the proposed survey area (Carretta et al. 2015). There is one record for the Hawaiian Islands EEZ in the OBIS database, west of Oahu (OBIS 2016).

Short-finned Pilot Whale

The short-finned pilot whale is found in tropical and warm temperate waters; it is seen as far south as ~40oS but is more common north of ~35oS. It is generally nomadic, but may be resident in certain locations, including Hawaii. Pilot whales occur on the shelf break, over the slope, and in areas with prominent topographic features (Olson 2009). During small-boat surveys around the Hawaiian Islands in 2000–2012, it was sighted in water as deep as 5000 m, with the highest sighting rates in water depths of 500–2500 m (Baird et al. 2013).

Photo-identification and telemetry studies suggest there may be insular and pelagic populations of short-finned pilot whales in Hawaiian waters (Mahaffy 2012; Oleson et al. 2013). Genetic research is also underway to assist in delimiting population stocks for management (Carretta et al. 2015). During summer–fall surveys of the Hawaiian Islands EEZ, 25 sightings were made in 2002 (Barlow 2006) and 36 were made in 2010 (Bradford et al. 2013), including near the proposed survey area in and outside the EEZ (Barlow et al. 2004; Carretta et al. 2015). One fall–winter sighting has been reported for the area (DoN 2005), and possible takes have also been reported by observers on Hawaii-based longliners during 2007– 2011 in and near the proposed survey area (Carretta et al. 2015).

There are 532 records for the Hawaiian EEZ in the OBIS database, none in the proposed survey area (OBIS 2016); the closest sighting was made at 22.3°N, 158.1°W, ~160 km away (Barlow and Taylor 2005).

3.3. Socioeconomic Environment

3.3.1. Subsistence

There are no subsistence harvests for marine mammals in this area of the central Pacific Ocean. Therefore, we anticipate no impacts to the subsistence harvest of marine mammals in the region.

Chapter 4 Environmental Consequences

The National Marine Fisheries Service (NMFS) reviewed all possible direct, indirect, cumulative, short-term, long-term impacts to protected species and their environment, associated with NMFS proposed action and alternatives. Based on this review, this section describes the potential environmental consequences for the affected resources described in Chapter 3.

4.1. Effects of Alternative 1 – Issuance of an IHA with Mitigation Measures

Under the Preferred Alternative, we would propose to issue an IHA to UH allowing the take, by Level A and Level B harassment, of 24 species of marine mammals incidental to the proposed seismic survey, subject to the mandatory mitigation and monitoring measures and reporting requirements set forth in the Authorization. We would incorporate the mitigation and monitoring measures and reporting described earlier in this EA into a final Authorization.

4.1.1. Impacts to Marine Mammal Habitat

The proposed action (i.e., the issuance of an IHA for the take of marine mammals) would not result in any permanent impacts to marine mammals' habitat and would have only minimal, short-term effects on prey species. The proposed survey would not result in substantial damage to ocean and coastal habitats that constitute marine mammal habitats as airgun sounds do not result in physical impacts to habitat features, including substrates and/or water quality, and no anchoring of the vessel will occur during the survey as the survey is planned in water depths where anchoring is not practicable. The primary potential impacts to marine mammal habitat associated with elevated sound levels produced by the seismic airguns would have a limited effect on prey species.

The overall response of fishes and squids from seismic surveys is to exhibit responses including no reaction or habituation (Peña, Handegard, & Ona, 2013) to startle responses and/or avoidance (Fewtrell & McCauley, 2012) and vertical and horizontal movements away from the sound source. McCauley et al. (2017) reported that experimental exposure to a 150 in^3 airgun pulse decreased zooplankton abundance when compared with controls, and caused a two- to threefold increase in dead adult and larval zooplankton. Impacts to marine mammal prey are expected to be limited due to the relatively small temporal and spatial overlap between the proposed survey and any areas used by marine mammal prey species. The proposed survey would occur over a relatively short time period (5.5 days) and would occur over a very small area relative to the area available as marine mammal habitat in the Central Pacific Ocean. The proposed survey area is not known as a significant feeding area for any marine mammals and any impacts to marine mammal prey would be insignificant due to the limited spatial and temporal impact of the proposed survey. We expect that the seismic survey would have no more than a temporary and minimal adverse effect on any fish or invertebrate species. Although there is a potential for injury to fish or marine life in close proximity to the vessel, we expect that the impacts of the seismic survey on fish and other marine life specifically related to acoustic activities would be temporary in nature, negligible, and would not result in substantial impact to these species' role in the ecosystem.

4.1.2. Impacts to Marine Mammals

We expect that UH's seismic survey has the potential to take marine mammals by harassment, as defined by the MMPA. Acoustic stimuli generated by the airgun array may affect marine mammals in one or more of the following ways: behavioral disturbance, tolerance, masking of natural sounds, and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson, Greene, Malme, & Thomson, 1995).

Our Federal Register notice of proposed Authorization (82 FR 34352, July 24, 2017) and UH's application (LGL, 2017) provide detailed descriptions of these potential effects of seismic surveys on marine mammals. Potentinal effects are outlined below.

The effects of noise on marine mammals are highly variable, ranging from minor and negligible to potentially significant, depending on the intensity of the source, the distances between the animal and the source, and the overlap of the source frequency with the animals' audible frequency. Nevertheless, monitoring and mitigation measures required by NMFS for UH's proposed activities would effectively reduce any significant adverse effects of these sound sources on marine mammals. The following descriptions summarize acoustic effects resulting from the use of airguns:

Behavioral Disturbance: The studies discussed in the *Federal Register* notice for the proposed Authorization (82 FR 34352, July 24, 2017) note that there is variability in the behavioral responses of marine mammals to noise exposure. It is important to consider context in predicting and observing the level and type of behavioral response to anthropogenic signals (Ellison, Southall, Clark, & Frankel, 2012).

Marine mammals may react to sound when exposed to anthropogenic noise. These behavioral reactions are often shown as: changing durations of surfacing and dives number of blows per surfacing; changing direction and/or speed; reduced/increased vocal activities; changing or cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where noise sources are located; and/or flight responses (e.g., pinnipeds flushing into water from haulouts or rookeries). The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the receiving animals (hearing, motivation, experience, demography) and is also difficult to predict (Richardson et al., 1995; Southall et al., 2007).

Studies have shown that underwater sounds from seismic activities are often readily detectable by marine mammals in the water at distances of many kilometers (Castellote, Clark, & Lammers, 2012). Many studies have also shown that marine mammals at distances more than a few kilometers away often show no apparent response when exposed to seismic activities (e.g., Akamatsu, Hatakeyama, & Takatsu, 1993; Harris, Miller, & Richardson, 2001; Madsen & Møhl, 2000; Malme, Miles, Clark, Tyack, & Bird, 1983, 1984; Richardson, Würsig, & Greene Jr., 1986; Weir, 2008). Other studies have shown that marine mammals continue important behaviors in the presence of seismic pulses (e.g., Dunn & Hernandez, 2009; Greene Jr., Altman, & Richardson, 1999; Holst & Beland, 2010; Holst & Smultea, 2008; Holst, Smultea, Koski, & Haley, 2005; Nieukirk, Stafford, Mellinger, Dziak, & Fox, 2004; Richardson et al., 1986; Smultea, Holst, Koski, & Stoltz, 2004).

In a passive acoustic research program that mapped the soundscape in the North Atlantic Ocean, Clark and Gagnon (2006) reported that some fin whales in the northeast Pacific Ocean stopped singing for an extended period starting soon after the onset of a seismic survey in the area. The authors could not determine whether or not the whales left the area ensonified by the survey, but the evidence suggests that most, if not all, of the singers remained in the area. When the survey stopped temporarily, the whales resumed singing within a few hours and the number of singers increased with time. Also, one whale continued to sing while the seismic survey was actively operating (Figure 4, Clark & Gagnon, 2006). The authors concluded that there is not enough scientific knowledge to adequately evaluate whether or not these effects on singing or mating behaviors are significant or would alter survivorship or reproductive success.

MacLeod et al. (2006) discussed the possible displacement of fin and sei whales related to distribution patterns of the species during a large-scale, offshore seismic survey along the west coast of Scotland in 1998. The authors hypothesized about the relationship between the whale's absence and the concurrent seismic activity, but could not rule out other contributing factors (Macleod et al., 2006; Parsons et al., 2009). We would expect that marine mammals may briefly respond to underwater sound produced by UH's seismic survey by slightly changing their behavior or relocating a short distance. Based on the best available information, we expect short-term disturbance reactions that are confined to relatively small distances and durations (D. R. Thompson, Sjoberg, Bryant, Lovell, & Bjorge, 1998; P. M. Thompson et al., 2013), with no long-term effects on recruitment or survival of marine mammals.

McDonald et al. (1995) tracked blue whales relative to a seismic survey with a 1,600 in3 airgun array. One whale started its call sequence within 15 km (9.3 mi) from the source, then followed a pursuit track that decreased its distance to the vessel where it stopped calling at a range of 10 km (6.2 mi) (estimated received level at 143 dB re: 1 µPa (peak-to-peak)). After that point, the ship increased its distance from the whale which continued a new call sequence after approximately one hour and 10 km (6.2 mi) from the ship. The authors reported that the whale had taken a track paralleling the ship during the cessation phase but observed the whale moving diagonally away from the ship after approximately 30 minutes continuing to vocalize. Because the whale may have approached the ship intentionally or perhaps was unaffected by the airguns, the authors concluded that there was insufficient data to infer conclusions from their study related to blue whale responses (McDonald et al., 1995).

McCauley et al. (2000; 1998) studied the responses of migrating humpback whales off western Australia to a full-scale seismic survey with a 16-airgun array (2,678 in3) and to a single, 20-in3 airgun. Both studies point to a contextual variability in the behavioral responses of marine mammals to sound exposure. The mean received level for initial avoidance of an approaching airgun was 140 dB re: 1 µPa for humpback whale pods containing females. In contrast, some individual humpback whales, mainly males, approached within distances of 100 to 400 m (328 to 1,312 ft), where sound levels were 179 dB re: 1 µPa (McCauley et al., 2000). The authors hypothesized that the males gravitated towards the single operating air gun possibly due to its similarity to the sound produced by humpback whales breaching. Despite the evidence that some humpback whales exhibited localized avoidance reactions at received levels below 160 dB re: 1 µPa, the authors found no evidence of any gross changes in migration routes, such as inshore/offshore displacement during seismic operations (McCauley et al., 2000; McCauley et al., 1998).

DeRuiter et al. (2013) recently observed that beaked whales (considered a particularly sensitive species) exposed to playbacks (i.e., simulated) of U.S. Navy tactical mid-frequency active sonar from 89 to 127 dB re: 1 µPa at close distances responded notably by altering their dive patterns. In contrast, individuals showed no behavioral responses when exposed to similar received levels from actual U.S. Navy tactical mid-frequency active sonar operated at much further distances (DeRuiter et al., 2013). As noted earlier, one must consider the importance of context (e.g., the distance of a sound source from the animal) in predicting behavioral responses.

Tolerance: With repeated exposure to sound, many marine mammals may habituate to the sound at least partially (Richardson & Wursig, 1997). Bain and Williams (2006) examined the effects of a large airgun array (maximum total discharge volume of 1,100 in3) on six species in shallow waters off British Columbia and Washington: harbor seal, California sea lion (Zalophus californianus), Steller sea lion (Eumetopias jubatus), gray whale (Eschrichtius robustus), Dall's porpoise (Phocoenoides dalli), and the harbor porpoise. Harbor porpoises showed reactions at received levels less than 145 dB re: 1 µPa at a distance of greater than 70 km (43 miles) from the seismic source (Bain & Williams, 2006). However, the tendency for greater responsiveness by harbor porpoise is consistent with their relative responsiveness to boat traffic and some other acoustic sources (Richardson et al., 1995; Southall et al., 2007). In contrast, the authors reported that gray whales seemed to tolerate exposures to sound up to approximately 170 dB re: 1 µPa (Bain & Williams, 2006) and Dall's porpoises occupied and tolerated areas receiving exposures of 170–180 dB re: 1 µPa (Bain & Williams, 2006; Parsons et al., 2009). The authors observed several gray whales that moved away from the airguns toward deeper water where sound levels were higher due to propagation effects resulting in higher noise exposures (Bain & Williams, 2006). However, it is unclear whether their movements reflected a response to the sounds (Bain & Williams, 2006). Thus, the authors surmised that the lack of gray whale responses to higher received sound levels were ambiguous at best because one expects the species to be the most sensitive to the low-frequency sound emanating from the airguns (Bain & Williams, 2006).

Pirotta et al. (2014) observed short-term responses of harbor porpoises to a 2-D seismic survey in an enclosed bay in northeast Scotland which did not result in broad-scale displacement. The harbor porpoises that remained in the enclosed bay area reduced their buzzing activity by 15% during the seismic survey (Pirotta et al., 2014). Thus, animals exposed to anthropogenic disturbance may make trade-offs between perceived risks and the cost of leaving disturbed areas (Pirotta et al., 2014). However, unlike the semi-enclosed environment described in the Scottish study area, UH's seismic study occurs in the open ocean. Because UH would conduct the survey in an open ocean area, we do not anticipate that the seismic survey would entrap marine mammals between the sound source and the shore as marine mammals can temporarily leave the survey area during the operation of the airgun(s) to avoid acoustic harassment.

Masking: Studies have shown that marine mammals are able to compensate for masking by adjusting their acoustic behavior such as shifting call frequencies and increasing call volume and vocalization rates. For example, blue whales increase call rates when exposed to seismic survey noise in the St. Lawrence Estuary (Di Iorio & Clark, 2010). North Atlantic right whales exposed to high shipping noise increased call frequency (Parks, Clark, & Tyack, 2007), while some humpback whales respond to low-frequency active sonar playbacks by increasing song length (Miller, Biassoni, Samuels, & Tyack, 2000).

Risch et al. (2012) documented reductions in humpback whale vocalizations in the Stellwagen Bank National Marine Sanctuary concurrent with transmissions of the Ocean Acoustic Waveguide Remote Sensing (OAWRS) low-frequency fish sensor system at distances of 200 km from the source. The recorded OAWRS produced series of frequency modulated pulses and the signal received levels ranged from 88 to 110 dB re: 1 µPa (Risch et al., 2012). The authors hypothesized that individuals did not leave the area but instead ceased singing and noted that the duration and frequency range of the OAWRS signals (a novel sound to the whales) were similar to those of natural humpback whale song components used during mating (Risch et al., 2012). Thus, the novelty of the sound to humpback whales in the study area provided a compelling contextual probability for the observed effects (Risch et al., 2012). However, the authors did not state or imply that these changes had long-term effects on individual animals or populations (Risch et al., 2012).

We expect that masking effects of seismic pulses would be limited in the case of smaller odontocetes given the intermittent nature of seismic pulses in addition to the fact that sounds important to them are predominantly at much higher frequencies than are the dominant components of airgun sounds.

Hearing Impairment: Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (Akamatsu et al.), which is the loss of hearing sensitivity at certain frequency ranges (Finneran, Carder, Schlundt, & Ridgway, 2005; Finneran & Schlundt, 2013; Finneran et al., 2000; Kastak & Schusterman, 1998; Kastak, Schusterman, Southall, & Reichmuth, 1999; C. E. Schlundt, J. J. Finneran, B. K. Branstetter, J. S. Trickey, & Jenkins, 2013; C. R. Schlundt, Finneran, Carder, & Ridgway, 2000).

Lucke et al. (2009) found a threshold shift (Akamatsu et al.) of a harbor porpoise after exposing it to airgun noise with a received sound pressure level (SPL) at 200.2 dB (peak –to-peak) re: 1 µPa, which corresponds to a sound exposure level of 164.5 dB re: 1 µPa2 s after integrating exposure. NMFS currently uses the root-mean-square (rms) of received SPL at 180 dB and 190 dB re: 1 µPa as the threshold above which permanent threshold shift (PTS) could occur for cetaceans and pinnipeds, respectively. Because the airgun noise is a broadband impulse, one cannot directly determine the equivalent of rms SPL from the reported peak-to-peak SPLs. However, applying a conservative conversion factor of 16 dB for broadband signals from seismic surveys (McCauley et al., 2000) to correct for the difference between peak-to-peak levels reported in Lucke et al. (2009) and rms SPLs, the rms SPL for TTS would be approximately 184 dB re: 1 µPa, and the received levels associated with PTS (Level A harassment) would be higher. This is still above our current 180 dB rms re: 1 µPa threshold for injury. However, we recognize that TTS of harbor porpoises is lower than other cetacean species empirically tested (Finneran & Schlundt, 2010; Finneran, Schlundt, Carder, & Ridgway, 2002; Kastelein & Jennings, 2012).

Studies by Kujawa and Liberman (2009) and Lin et al. (2011) found that despite completely reversible threshold shifts that leave cochlear sensory cells intact, large threshold shifts could cause synaptic level changes and delayed cochlear nerve degeneration in mice and guinea pigs, respectively. We note that the high level of TTS that led to the synaptic changes shown in these studies is in the range of the high degree of TTS that Southall et al. (2007) used to calculate PTS levels. It is unknown whether smaller levels of TTS would lead to similar changes. We, however, acknowledge the complexity of noise exposure on the nervous system, and will re-examine this issue as more data become available.

A study on bottlenose dolphins (C. E. Schlundt et al., 2013) measured hearing thresholds at multiple frequencies to determine the amount of TTS induced before and after exposure to a sequence of impulses produced by a seismic air gun. The air gun volume and operating pressure varied from 40-150 in3 and 1000-2000 psi, respectively. After three years and 180 sessions, the authors observed no significant TTS at any test frequency, for any combinations of airgun volume, pressure, or proximity to the dolphin during behavioral tests (C. E. Schlundt et al., 2013). Schlundt et al. (2013) suggest that the potential for airguns to cause hearing loss in dolphins is lower than previously predicted, perhaps as a result of the low-frequency content of air gun impulses compared to the high-frequency hearing ability of dolphins.

The avoidance behaviors observed in Thompson et al.'s (1998) study supports our expectation that individual marine mammals would largely avoid exposure at higher levels. Also, it is unlikely that animals would encounter repeated exposures at very close distances to the sound source because UH would implement the required shutdown and power down mitigation measures to ensure that observed marine mammals do not approach the applicable exclusion zone for Level A harassment. We also expect that the required vessel-based visual monitoring of the exclusion zone and implementation of mitigation measures would minimize instances of Level A harassment. However, sounds from airguns could result in PTS in a limited number of marine mammals. As such, NMFS proposes to authorize take, in the form of Level A, harassment of one species of marine mammals, specifically as a result of PTS. However, based on the results of our analyses, though PTS may occur in a small number of animals, there is no evidence that UH's activities could result in serious injury or mortality of marine mammals within the action area. Even in the absence of the required mitigation and monitoring measures, the possibility of serious injury or lethal takes as a result of exposure to sound sources associated with UH's seismic survey is considered extremely unlikely.

Strandings: In 2013, an International Scientific Review Panel (ISRP) investigated a 2008 mass stranding of approximately 100 melon-headed whales in a Madagascar lagoon system (Southall, Rowles, Gulland, Baird, & Jepson, 2013) associated with the use of a high-frequency mapping system. The report indicated that the use of a 12-kHz MBES was the most plausible and likely initial behavioral trigger of the mass stranding event. This was the first time that a relatively high-frequency mapping sonar system had been associated with a stranding event.

The report notes that there were several site- and situation-specific secondary factors that may have contributed to the avoidance responses that lead to the eventual entrapment and mortality of the whales within the Loza Lagoon system (e.g., the survey vessel transiting in a north-south direction on the shelf break parallel to the shore may have trapped the animals between the sound source and the shore driving them towards the Loza Lagoon). They concluded that for odontocete cetaceans that hear well in the 10-50 kHz range, where ambient noise is typically quite low, high-power active sonars operating in this range may be more easily audible and have potential effects over larger areas than low frequency systems that have more typically been considered in terms of anthropogenic noise impacts (Southall et al., 2013). However, the risk may be very low given the extensive use of these systems worldwide on a daily basis and the lack of direct evidence of such responses previously (Southall et al., 2013).

We have considered the potential for UH's use of the MBES to result in stranding of marine mammals. Given that UH proposes to conduct the seismic survey offshore in depths ranging from 4,000-5,000 m and to transit in a manner that would not entrap marine mammals in shallow water, we believe it is extremely unlikely that the use of the MBES during the seismic survey would entrap marine mammals between the vessel's sound sources and the coastline of the Hawaiian Islands.

Stranding of marine mammals is not anticipated as a result of the planned seismic survey.

We interpret the anticipated effects on all marine mammals of UH's planned seismic survey as falling within the MMPA definition of Level A harassment and Level B harassment. We expect these impacts to be minor because we do not anticipate measurable changes to the population or measurable impacts to rookeries, mating grounds, and other areas of similar significance. Furthermore, UH's proposed activities are not likely to obstruct movements or migration of marine mammals because the survery will occur over a limited time in a relatively small geographic area. Animals would be able to move away from sound soureces without significantly altering migration patterns. We expect that the proposed activities involving use of airguns would result, at worst, in PTS (Level A harassment) to a limited number of marine mammals, as well as temporary modification in behavior and/or temporary changes in animal distribution (Level B harassment) of certain species or stocks of marine mammals. It is likely that sounds from seismic airguns may result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area, as described above. We base these conclusions on the results of the studies described above and on previous monitoring reports for similar activities and anecdotal observations for the same activities conducted in other open ocean environments.

Serious Injury or Mortality: UH did not request authorization to take marine mammals by serious injury or mortality. Based on the results of our analyses, UH's IHA application, and previous monitoring reports for similar seismic survey activities, we do not expect UH's planned activities to result in serious injury or mortality of marine mammals within the action area, even in the absence of mitigation and monitoring measures. The required mitigation and monitoring measures would further minimize potential risks to marine mammals. Due in part to required monitoring measures for detecting marine mammals approaching the exclusion zone, and the required mitigation measures for power downs or shut downs of the airgun array if a marine mammal is likely to enter the exclusion zone, any Level A harassment potentially incurred by marine mammals as a result of the planned seismic survey is expected to be in the form of some small degree of permanent hearing loss. Neither mortality nor complete deafness of marine mammals is expected to result from UH's seismic survey.

Vessel Strikes: Vessel traffic has the potential to result in collisions with marine mammals. Studies have associated ship speed with the probability of a ship strike resulting in an injury or mortality of an animal. However, it is highly unlikely that UH would strike a marine mammal given the *Kairei*'s slow survey speed (8.3 km/hr; 4.5 kt). Additionally, PSOs would be monitoring exclusion zones around the vessel and would be able to warn of any marine mammals that may be in the path of the *Kairei*. Moreover, mitigation measures would be required of UH to reduce speed or alter course if a collision with a marine mammal appears likely. Therefore, it is extremely unlikely that the proposed activities would result in a vessel strike of a marine mammal.

4.1.3. Estimated Takes of Marine Mammals by Level A and Level B Harassment

UH has requested take by Level A harassment and Level B harassment as a result of the acoustic stimuli generated by their proposed seismic survey. As mentioned previously, we estimate that the activities could potentially result in the incidental take of 24 species of marine mammals under NMFS jurisdiction by Level B harassment and of one species of marine mammal under NMFS jurisdiction by Level A harassment. For each species, estimates of take are small numbers relative to the population sizes. Table 4 describes the number of Level A harassment takes and Level B harassment takes that we propose to authorize, and the percentage of each population or stock proposed for the IHA as a result of UH's activities.

Table 4. Proposed authorized Level A harassment and Level B harassment takes and percentage of marine mammal populations proposed for take authorization during the proposed seismic survey in the central Pacific Ocean.

Species	Proposed Level A harassment takes	Proposed Level B harassment takes	Total proposed Level A and Level B harassment takes	Total proposed Level A and Level B harassment takes as a percentage of population
Humpback whale [1]	0	2	2	<0.1
Minke whale [1]	0	1	1	n/a
Bryde's whale	2	25	27	3.4
Sei whale	0	6	6	3.4

Fin whale	0	2	2	3.4
Blue whale [1]	0	3	3	3.7
Sperm whale	0	51	51	1.5
Cuvier's beaked whale	0	8	8	<0.1
Longman’s beaked whale	0	85	85	1.9
Blainville’s beaked whale	0	76	76	3.3
Rough-toothed dolphin	0	812	812	12.9
Bottlenose dolphin	0	246	246	4.1
Pantropical spotted dolphin	0	639	639	4.0
Spinner dolphin [1]	0	32	32	0.9
Striped dolphin	0	685	685	3.3
Fraser’s dolphin	0	577	577	3.4
Risso’s dolphin	0	130	130	1.8
Melon-headed whale	0	97	97	1.7
Pygmy killer whale	0	119	119	3.5
False killer whale	0	16	16	1.0
Killer whale [1]	0	5	5	4.9
Short-finned pilot whale	0	218	218	1.8
Pygmy sperm whale	7	87	94	7.4
Dwarf sperm whale	18	214	232	7.8

Take estimates are based on a consideration of the number of marine mammals that could be within the area around the operating airgun array where received levels of sound exceeding thresholds for Level B harassment and Level A harassment are predicted to occur (Table 5 and Table 6 respectively). Take estimates are based on the densities (numbers per unit area) of marine mammals expected to occur in the area in the absence of a seismic survey. To the extent that marine mammals would be expected to move away from a sound source that represents an aversive stimulus before the sound level reaches the criterion level, these estimates likely overestimate the numbers actually exposed to the specified level of sound.

Table 5. Modeled Distances of Acoustic Sources Associated with UH's Proposed Seismic Survey to Isopleth Corresponding to Level B harassment threshold (160 dB re 1 µPa)

Source and Volume	Distance to Threshold
1 airgun, 100 in3	722 m
4 strings, 32 airguns, 7800 in3	9,289 m

Table 6. Modeled Distances of Acoustic Sources Associated with UH's Proposed Seismic Survey to Isopleths Corresponding to Level A harassment thresholds

Functional Hearing Group (dual Level A thresholds)	Full 7,800 in^3 airgun array		Single 100 in^3 airgun	
	Peak SPL_{flat}	SEL_{cum}	Peak SPL_{flat}	SEL_{cum}
Low frequency cetaceans ($L_{pk,flat}$: 219 dB; $L_{E,LF,24h}$: 183 dB)	72.39 m	759.8 m	3.4 m	1.3 m
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB; $L_{E,MF,24h}$: 185 dB)	6.0	0.1 m	0.0	0.1 m
High frequency cetaceans ($L_{pk,flat}$: 202 dB; $L_{E,HF,24h}$: 155 dB)	516.5 m	6.7 m	3.7 m	0.0

It is assumed that, during simultaneous operations of the airgun array and the other acoustic sources, sounds from the MBES would be subsumed by sounds from the airguns. Therefore, any marine mammal that could potentially be taken by exposure to the MBES would already have been taken by exposure to sounds from the airguns, as any marine mammal close enough to the vessel to be exposed to MBES sound that potentially exceeds take thresholds would already be exposed to sound from airguns that would exceed take thresholds. Take as a result of exposure to sound exclusively from the MBES has therefore not been proposed for authorization.

4.2. Effects of Alternative 2- No Action Alternative

Under the No Action Alternative, we would not issue an IHA to UH. As a result, UH would not receive an exemption from the MMPA prohibitions against the take of marine mammals and would be in violation of the MMPA if take of marine mammals were to occur.

The impacts to elements of the human environment resulting from the No Action alternative – conducting the marine geophysical survey in the absence of required protective measures for marine mammals under the MMPA – would be greater than those impacts resulting from Alternative 1, the Preferred Alternative.

4.2.1. Impacts to Marine Mammal Habitat

Under the No Action Alternative, the effects on the physical environment or on components of the biological environment that function as marine mammal habitat would result from UH's planned geophysical survey, are similar to those described in Section 4.1.1.

4.2.2. Impacts to Marine Mammals

Under the No Action Alternative, UH's planned geophysical survey activities could result in increased amounts of Level A harassment and Level B harassment to marine mammals, although no takes by serious injury or mortality would be expected even in the absence of mitigation and monitoring measures. While it is difficult to provide an exact number of takes that might occur under the No Action Alternative, the numbers would be expected to be larger than those presented in Table 4 above because UH would not be required to implement mitigation measures designed to warn marine mammals of the impending increased underwater sound levels, and additional numbers of marine mammals may be incidentally taken because UH would not be required to shut down seismic survey activities if marine mammals occurred in the project vicinity.

If the activities proceeded without the mitigation and monitoring measures required by Alternative 1, the direct, indirect, and cumulative effects on the human or natural environment of not issuing the IHA would include an increases in the number of animals incurring PTS and behavioral responses because of the lack of mitigation measures that would be required in the IHA. Thus, the incidental take of marine mammals would likely occur at higher levels than we identified and evaluated in the proposed IHA; and NMFS would not be able to obtain the monitoring and reporting data needed to assess the anticipated impact of the activity upon the species or stock nor the increased knowledge of the marine mammal species, as required under the MMPA.

4.3. Unavoidable Adverse Impacts

UH's application and our notice of proposed IHA, summarize unavoidable adverse impacts to marine mammals or the populations to which they belong or on their habitats occurring in the proposed project area.

We acknowledge that the incidental take authorized could potentially result in adverse impacts to marine mammals including behavioral responses, alterations in the distribution of local populations, and injury. However, we do not expect UH's activities to have adverse consequences on annual rates of recruitment or survival of marine mammal species or stocks in the central Pacific Ocean, and we do not expect the marine mammal populations in that area to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild. We expect that the numbers of individuals of all species taken by harassment would be small (relative to species or stock abundance), and that the proposed project and the take resulting from the proposed project activities would have a negligible impact on the affected species or stocks of marine mammals.

4.4. Cumulative Effects

NEPA defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR §1508.7). Cumulative impacts can result from individually minor but collectively significant actions that take place over a period of time.

Past, present, and reasonably foreseeable impacts to marine mammal populations in the central Pacific Ocean include the following: seismic surveys; climate change; marine pollution; disease; and increased vessel traffic. These activities account for cumulative impacts to regional and worldwide populations of marine mammals, many of which are a small fraction of their former abundance. However, quantifying the biological costs for marine mammals within an ecological framework is a critical missing link to our assessment of cumulative impacts in the marine environment and assessing cumulative effects on marine mammals (Clark *et al*., 2009). Despite these regional and global anthropogenic and natural pressures, available trend information indicates that most local populations of marine mammals in the central Pacific Ocean are stable or increasing (Carretta *et al*., 2013).

The proposed seismic survey would add another, albeit temporary, activity to the marine environment in the central Pacific Ocean north of the Hawaiian Islands. This activity would be limited to a small area north of the Hawaiian Islands in the central Pacific Ocean and would occur over a relatively short period of time (5.5 days). UH's application (LGL, 2017) summarized the potential cumulative effects to marine mammals or the populations to which they belong to and their habitats within the survey area. This section incorporates UH's application (LGL, 2017) by reference and provides a brief summary of the human-related activities affecting the marine mammal species in the action area.

4.4.1. Future Seismic Survey Activities in the Central Pacific Ocean

There are no other seismic surveys with an IHA issued from us scheduled to occur in the U.S. EEZ north of the Hawaiian Islands or the adjacent international waters north of the Hawaiian Islands in the central Pacific Ocean in September 2017. Therefore, we are unaware of any synergistic impacts to marine resources associated with reasonably foreseeable future actions that may be planned or occur within the same region of influence. The impacts of conducting the seismic survey on marine mammals are specifically related to acoustic activities, and these are expected to be temporary in nature, negligible, and would not result in substantial impacts to marine mammals or to their role in the ecosystem. We do not expect that the issuance of an IHA would have a significant cumulative effect on the human environment, due to the required mitigation and monitoring measures described in Section 2.3.1

NMFS does not expect that UH's 5.5 days of proposed seismic surveys would have effects that could cause significant or long-term consequences for individual marine mammals or their populations alone or in combination with past or present activities discussed above.

4.4.2. Climate Change

Global climate change could significantly affect the marine resources of central Pacific Ocean including Hawaii. Possible impacts include temperature and rainfall changes and potentially rising sea levels and changes to ocean conditions. These changes may affect marine ecosystems in the proposed action area by increasing the vertical stratification of the water column and changing the intensity and rhythms of coastal winds and upwelling. Such modifications could cause ecosystem regime shifts as the productivity of the regional ecosystem undergoes various changes related to nutrients input and coastal ocean process (USFWS 2011).

The precise effects of global climate change on the action area, however, cannot be predicted at this time because the marine ecosystem is highly variable in its spatial and temporal scales.

4.4.3. Coastal Development

UH's planned activities would occur in the open ocean environment for a relatively short period of time far from any land forms. Therefore, the proposed activities would have no cumulative impact on coastal development in Hawaii.

4.4.4. Marine Pollution

Marine mammals are exposed to contaminants via the food they consume, the water in which they swim, and the air they breathe. Point and non-point source pollutants from coastal runoff, offshore mineral and gravel mining, at-sea disposal of dredged materials and sewage effluent, marine debris, and organic compounds from aquaculture are all lasting threats to marine mammals in the project area. The long-term impacts of these pollutants, however, are difficult to measure.

The persistent organic pollutants tend to bioaccumulate through the food chain; therefore, the chronic exposure of persistent organic pollutants in the environment is perhaps of the most concern to high trophic level predators.

UH's activities associated with the marine seismic survey are not expected to cause increased exposure of persistent organic pollutants to marine mammals in the project vicinity due to the relatively small scale and localized nature of the activities.

4.4.5. Disease

Disease is common in many marine mammal populations and has been responsible for major die-offs worldwide, but such events are usually relatively short-lived. UH's survey activities are not expected to affect the disease rate among marine mammals in the project vicinity.

4.4.6. Increased Vessel Traffic

UH's proposed activities would not result in a cumulative increase in vessel traffic beyond any direct impacts associated with the proposed short-term survey by the *Kairei*. As such, ship traffic should remain constant, underwater sound levels should remain stable and ship strikes of marine animals may occur at the levels they have in the recent past.

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