BILLING CODE 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648-XF330

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Geophysical Survey in the Central Pacific Ocean

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received a request from the University of Hawaii (UH) for authorization to take marine mammals incidental to a marine geophysical survey in the Central Pacific Ocean. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to incidentally take marine mammals during the specified activities. NMFS will consider public comments prior to making any final decision on the issuance of the requested MMPA authorization and agency responses will be summarized in the final notice of our decision.

DATES: Comments and information must be received no later than [*insert date 30 days after date of publication in the FEDERAL REGISTER*].

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.Carduner@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Comments received electronically, including all attachments, must not exceed a 25-megabyte file size. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. All comments received are a part of the public record and will generally be posted online at *www.nmfs.noaa.gov/pr/permits/incidental/research.htm* without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Jordan Carduner, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *www.nmfs.noaa.gov/pr/permits/incidental/research.htm*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 et seq.) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

NMFS has defined "negligible impact" in 50 CFR 216.103 as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

The MMPA states that the term "take" means to harass, hunt, capture, kill or attempt to harass, hunt, capture, or kill any marine mammal.

Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 et seq.) and NOAA Administrative Order (NAO) 216-6A, NMFS must review our proposed action (i.e., the issuance of an incidental harassment authorization) with respect to potential impacts on the human environment. Accordingly, NMFS is preparing an Environmental Assessment (EA) to consider the environmental impacts associated with the issuance of the proposed IHA. NMFS' EA is available at *www.nmfs.noaa.gov/pr/permits/incidental/research.htm*. We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the IHA request.

Summary of Request

On March 15, 2016, NMFS received a request from the UH for an IHA to take marine mammals incidental to conducting a marine geophysical survey in the central Pacific Ocean. On May 16, 2017, we deemed UH's application for authorization to be adequate and complete. UH's request is for take of a small number of 24 species of marine mammals by Level B harassment and Level A harassment. Neither UH nor NMFS expects mortality to result from this activity, and, therefore, an IHA is appropriate. The planned activity is not expected to exceed one year, hence, we do not expect subsequent MMPA incidental harassment authorizations would be issued for this particular activity.

Description of Proposed Activity

Overview

UH, in collaboration with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), proposes to conduct a marine seismic survey north of Hawaii in the central Pacific Ocean over the course of five and a half days in September 2017. The proposed survey would occur north of the Hawaiian Islands, in the approximate area 22.6–25.0°N and 153.5–157.4°W (See Figure 1 in IHA application). The project area is partly within the exclusive economic zone (EEZ) of the United States and partly in adjacent international waters. Water depths in the area range from 4000 to 5000 m. The survey would involve one source vessel, the Japan-flagged R/V (research vessel) *Kairei*. The *Kairei* would deploy a 32-airgun array with a total volume of ~7800 cubic inches (in^3) as an energy source.

Dates and Duration

The seismic survey would be carried out for approximately five and a half days, including three and half days within the Hawaiian Islands EEZ and two days in international waters. The survey would start on approximately September 15, 2017. Exact dates of the activities are not known as they are dependent on logistics and weather conditions. Seismic activities would occur 24 hours per day during the proposed survey.

Specific Geographic Region

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 Hawaii, partly within the Hawaiian Islands EEZ and partly in international waters. Water depth in the survey area ranges from approximately 4000 to 5000 m. Representative survey track lines are shown in Figure 1 in the IHA application. However, some deviation in actual track lines could be necessary for reasons such as poor data quality, inclement weather, or mechanical issues with the research vessel and/or equipment. The *Kairei* would likely depart from Honolulu, Hawaii and return to Honolulu.

Detailed Description of Specific Activity

Conventional seismic methodology would be used to image a typical/stable oceanic crust, mantle, and the boundary between the Earth's crust and the mantle (called the Mohorovičić discontinuity (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 (IODP). The total survey effort would consist of ~1083 kilometers (km) of transect lines (Figure 1 in IHA application).

The R/V *Kairei* has a length of 106.0 meters (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 (rpm). The operation speed during seismic acquisition would be ~8.3 km/hour (~4.5 knots (kn)). When not towing seismic survey gear, the *Kairei* typically cruises at 30 km/ hour (~16.2 kn) and has a range of ~18,000 km.

During the survey, the *Kairei* would deploy an airgun array (*i.e.*, a certain number of airguns of varying sizes in a certain arrangement) as an energy source (Table 1). An airgun is a device used to emit acoustic energy pulses into the seafloor and generally consists of a steel cylinder that is charged with high-pressure air. Release of the compressed air into the water column generates a signal that reflects (or refracts) off the seafloor and/or subsurface layers having acoustic impedance contrast. When fired, a brief (~0.1 second) pulse of sound is emitted by all airguns nearly simultaneously. The airguns are silent during the intervening periods with the array typically fired on a fixed distance (or shot point) interval. The return signal is recorded by a listening device and later analyzed with computer interpretation and mapping systems used to depict the subsurface.

The airgun array to be used 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" (See Figure 2 in the IHA application for a visual representation of the strings). Each string would have 8 airguns; the first and last airguns in the strings would be spaced 10 m apart. All 8 airguns in each string would be fired simultaneously. The 4 airgun strings would be towed behind the *Kairei* and would be distributed across an area ~40 m × 10 m. The shot interval would be ~22 seconds. The firing pressure of the array would be ~2000 psi. During firing, a brief (~0.1 s) pulse of sound would be emitted. The airguns would be silent during the intervening periods. The array would be towed at a depth of 10 m. It is expected that the aigun array would be active 24 hours per day during seismic activities. Specifications of the *Kairei*'s airgun array are shown in Table 1. Source levels of the *Kairei*'s airgun array are shown in Table 6.

Table 1: 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	~22 seconds

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 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. After completion of seismic operations, the OBSs would be recovered by UH via a separate vessel; the recovery cruise would be funded by the National Science Foundation.

Survey protocols generally involve a predetermined set of survey, or track, lines. The seismic acquisition vessel (source vessel) travels down a linear track for some distance until a line of data is acquired, then turn and acquire data on a different track. In the case of the proposed survey, the two shorter north-south lines would each be surveyed once, while the longer west-east line would be surveyed twice (see Figure 1 in the IHA application).

In addition to the operations of the airgun array, a SeaBeam 3012 multibeam echosounder (MBES) would also be operated from the *Kairei* continuously throughout the survey. The MBES would operate at 12 kilohertz (kHz) and would be hull-mounted on the *Kairei*. The transmitting beamwidth of the MBES would be 2° fore–aft and 150° (max.) athwartship, or 120° (in water up to 4500 m deep), and 100° (in water up to 8000 m).

Proposed mitigation, monitoring, and reporting measures are described in detail later in this document (please see "Proposed Mitigation" and "Proposed Monitoring and Reporting").

Description of Marine Mammals in the Area of Specified Activities

Section 4 of the application summarizes available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS' Stock Assessment Reports (SAR; *www.nmfs.noaa.gov/pr/sars/*), and more general information about these species (e.g., physical and behavioral descriptions) may be found on NMFS' website (*www.nmfs.noaa.gov/pr/species/mammals/*).

Table 2 lists all species with expected potential for occurrence in the central Pacific Ocean and summarizes information related to the population or stock, including regulatory status under the MMPA and ESA and potential biological removal (PBR), where known. For taxonomy, we follow Committee on Taxonomy (2016). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS' SARs). While no mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS' stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS' U.S. Pacific SARs (e.g., Carretta *et al*. 2017). All values presented in Table 2 are the most recent available at the time of publication and are available in the 2016 SARs (Carretta *et al.* 2017), available online at: *www.nmfs.noaa.gov/pr/sars*, except where noted otherwise.

Table 2. Marine Mammals that Could Occur in the Project Area.

Species	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Stock abundance[2] (CV, Nmin, most recent abundance survey)[3]	PBR[4]	Relative Occurrence in Project Area
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)					
Family: Balaenopteridae					
Humpback whale (*Megaptera novaeangliae*)[5]	Central North Pacific	-/-; N	10,103 (0.300; 7,890; 2006)	83	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 (1.14; 38; 2010)	0.1	Seasonal; infrequent winter migrant; few sightings, mainly fall and winter; considered rare
Fin whale (*Balaenoptera physalus*	Hawaii	E/D; Y	58 (1.12; 27; 2010)	0.1	Seasonal, mainly fall and winter; considered rare
Sei whale (*Balaenoptera borealis)*	Hawaii	E/D; Y	178 (0.90; 93; 2010)	0.2	Rare; limited sightings of seasonal migrants that feed at higher latitudes
Bryde's whale (*Balaenoptera brydei/edeni)*	Hawaii	-/-; N	798 (0.28; 633; 2010)	6.3	Uncommon; distributed throughout the Hawaiian Exclusive Economic Zone
Minke whale (*Balaenoptera acutorostrata)*	Hawaii	-/-; N	n/a (n/a; n/a; 2010)	Undet.	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 (0.34; 2,539; 2010)	10.2	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 (2.91; n/a; 2006)	Undet.	Widely distributed year round
Dwarf sperm whale[6] (*Kogia sima*)	Hawaii	-/-; N	17,519 (7.14; n/a; 2006)	Undet.	Widely distributed year round
Order Cetartiodactyla – Cetacea – Superfamily Odontoceti (toothed whales, dolphins, and porpoises)					
Family delphinidae					
Killer whale (*Orcinus orca*)	Hawaii	-/-; N	101 (1.00; 50; 2010)	1	Uncommon; infrequent sightings
False killer whale (*Pseudorca crassidens*)	Hawaii Pelagic	-/-; N	1,540 (0.66; 928; 2010)	9.3	Regular
Pygmy killer whale (*Feresa attenuata*)	Hawaii	-/-; N	3,433 (0.52; 2,274; 2010)	23	Year-round resident
Short-finned pilot whale (*Globicephala macrorhynchus*)	Hawaii	-/-; N	12,422 (0.43; 8,872; 2010)	70	Commonly observed around Main Hawaiian Islands and Northwestern Hawaiian Islands
Melon headed whale (*Peponocephala electra)*	Hawaiian Islands	-/-; N	5,794 (0.20; 4,904; 2010)	4	Regular
Bottlenose dolphin (*Tursiops truncatus*)	Hawaii pelagic	-/-; N	5,950 (0.59; 3,755; 2010)	38	Common in deep offshore waters
Pantropical spotted dolphin (*Stenella attenuata*)	Hawaii pelagic	-/-; N	15,917 (0.40; 11,508; 2010)	115	Common; primary occurrence between 100 and 4,000 m depth
Striped dolphin (*Stenella coeruleoala*)	Hawaii	-/-; N	20,650 (0.36; 15,391; 2010)	154	Occurs regularly year round but infrequent sighting during survey
Spinner dolphin[6] (*Stenella longirostris*)	Hawaii pelagic	-/-; N	3,351 (0.74; n/a; 2006)	Undet.	Common year-round in offshore waters
Rough-toothed dolphin (*Steno bredanensis*)	Hawaii	-/-; N	6,288 (0.39; 4,581; 2010)	46	Common throughout the Main Hawaiian Islands and Hawaiian Islands EEZ
Fraser's dolphin (*Lagenodelphis hosei*)	Hawaii	-/-; N	16,992 (0.66; 10,241; 2010)	102	Tropical species only recently documented within Hawaiian Islands EEZ (2002 survey)
Risso's dolphin (*Grampus griseus*)	Hawaii	-/-; N	7,256 (0.41; 5,207; 2010)	42	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 (n/a; 1,142; 2010)	11.4	Year-round occurrence but difficult to detect

					due to diving behavior
Blainville's beaked whale (*Mesoplodon densirostris*)	Hawaii	-/-; N	2,338 (1.13; 1,088; 2010)	11	Year-round occurrence but difficult to detect due to diving behavior
Longman's beaked whale (*Indopacetus pacificus*)	Hawaii	-/-; N	4,571 (0.65; 2,773; 2010)	28	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 (see footnote 3) 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 Carretta *et al.* (2017) unless otherwise noted.
[3]CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For certain stocks, abundance estimates are actual counts of animals and there is no associated CV. The most recent abundance survey that is reflected in the abundance estimate is presented; there may be more recent surveys that have not yet been incorporated into the estimate.
[4]Potential biological removal (PBR), defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population size (OSP).
[5]Values for humpback whale are from the 2015 Alaska SAR (Muto *et al.* 2015).
[6]Values for spinner dolphin, dwarf and pygmy sperm whale are from Barlow *et al.* (2006).

All species that could potentially occur in the proposed survey area are included in table 2. We have reviewed UH's species descriptions, including life history information, distribution, regional distribution, diving behavior, and acoustics and hearing, for accuracy and completeness. We refer the reader to Section 4 of UH's IHA application, rather than reprinting the information here. Below, for the 24 species that are likely to be taken by the activities described, we offer a brief introduction to the species and relevant stock as well as available information regarding population trends and threats, and describe any information regarding local occurrence.

Humpback whale

Humpback whales are found worldwide in all ocean basins. In winter, most humpback whales occur in the subtropical and tropical waters of the Northern and Southern Hemispheres (Muto *et al.,* 2015). These wintering grounds are used for mating, giving birth, and nursing new calves. Humpback whales migrate nearly 3,000 mi (4,830 km) from their winter breeding grounds to their summer foraging grounds in Alaska.

There are five stocks of humpback whales, one of which occurs in Hawaii: the Central North Pacific Stock, which consists of winter/spring populations in the Hawaiian Islands, which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands (Muto *et al*., 2015). Humpback whales occur seasonally in Hawaii, with peak sightings between December and May each year; however, sightings have occurred in other months in very low numbers. Most humpback whales congregate off the island of Maui in the shallow protected waters but can be seen off all of the islands including the Northwestern Hawaiian Islands (Baird 2016).

Humpback whales were listed as endangered under the Endangered Species Conservation Act (ESCA) in June 1970. In 1973, the ESA replaced the ESCA, and humpbacks continued to be listed as endangered. NMFS recently evaluated the status of the species, and on September 8, 2016, NMFS divided the species into 14 distinct population segments (DPS), removed the current species-level listing, and in its place listed four DPSs as endangered and one DPS as threatened (81 FR 62259; September 8, 2016). The remaining nine DPSs were not listed. The Hawaii DPS is the only DPS that occurs in the survey area and is not listed under the ESA (81 FR 62259; September 8, 2016). The Central North Pacific stock is still considered a depleted and strategic stock under the MMPA.

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.* 2000). Blue whales belonging to the central Pacific stock appear to feed in summer southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska (Stafford 2003; Watkins *et al.* 2000), and in winter migrate to lower latitudes in the western and central Pacific, including Hawaii (Stafford *et al.* 2001).

From ship line-transect surveys, Wade and Gerrodette (1993) estimated 1,400 blue whales for the eastern tropical Pacific. A 2010 shipboard line-transect survey of the entire Hawaiian Islands EEZ resulted in a summer/fall abundance estimate of 81 (CV = 1.14) blue whales (Bradford *et al.* 2013). This is currently the best available abundance estimate for this stock within the Hawaii EEZ, though the majority of blue whales would be expected to be at higher latitudes feeding grounds at this time of year. Blue whales are listed as endangered under the ESA, and the Central North Pacific Stock of blue whales is considered a depleted and strategic stock under the MMPA.

Fin whale

Fin whales are found throughout all oceans from tropical to polar latitudes. They have been considered rare in Hawaiian waters and are absent to rare in eastern tropical Pacific waters (Hamilton *et al.* 2009). 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).

During spring and summer, fin whale 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 two 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). Fin whales are listed as endangered under the ESA, and the Hawaii stock of fin whales is considered depleted under the MMPA.

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).

Sei whales occur seasonally in Hawaii in the winter and spring months and feed in higher latitude feeding grounds in the summer and fall (Carretta *et al*., 2016). Sightings of this species are rare in Hawaii. The species stays offshore of the islands in deeper waters (Baird 2016). Sei whales are listed as endangered under the ESA, and the Hawaii stock of sei whales is considered a depleted and strategic stock under the MMPA.

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). 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). The Bryde's whale is not listed under the ESA, and the Hawaii stock is not listed as depleted or strategic under the MMPA.

Minke whale

The minke whale has a cosmopolitan distribution ranging from the tropics and subtropics to the ice edge in both hemispheres (Jefferson *et al*. 2008) and is thought to occur seasonally in Hawaii, from November through March (Rankin and Barlow 2005), though their migration routes or destinations are unknown. While they are generally believed to be uncommon in Hawaiian waters, 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). 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). 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). 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 not listed under the ESA, and the Hawaii stock is not listed as depleted under the MMPA.

Sperm whale

Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to be south of 40°N in winter (Rice 1974, 1989; Gosho *et al*. 1984; Miyashita *et al*. 1995). The Hawaii stock includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters; however, because data on abundance, distribution, and human-caused impacts are largely lacking for high seas waters, the status of the Hawaii stock is evaluated based on data from U.S. EEZ waters of the Hawaiian Islands (NMFS 2005).

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). Sperm whales are listed as endangered under the ESA, and the Hawaii stock is considered depleted and strategic under the MMPA.

Pygmy sperm whale

Pygmy sperm whales are found in tropical and warm-temperate waters throughout the world (Ross and Leatherwood 1994) and prefer deeper waters with observations of this species in greater than 4,000 m depth (Baird *et al.*, 2013). Sightings are rare of this species. 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). Both pygmy and dwarf sperm whales 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). There is a single stock of Pygmy sperm whales in Hawaii. Current abundance estimates for this stock are unknown. Pygmy sperm whales are not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered strategic or designated as depleted under the MMPA.

Dwarf sperm whale

Dwarf sperm whales are found throughout the world in tropical to warm-temperate waters (Carretta *et al*., 2014). They are usually found in waters deeper than 500 m, most often sighted in depths between 500 and 1,000 m, but they have been documented in depths as shallow as 106 m and as deep as 4,700 m (Baird 2016). This species is often alone or in small groups of up to two to four individuals (Baird 2016). When there are more than two animals together, they are often loosely associated, with up to several hundred meters between pairs of individuals (Baird 2016). There is one stock of dwarf sperm whales in Hawaii. Sighting data suggests a small resident population off Hawaii Island (Baird 2016). It has been suggested that this species is probably one of the more abundant species of cetaceans in Hawaiian waters (Baird 2016), though there are no current abundance estimates for this stock. Dwarf sperm whales are not listed as endangered or threatened under the ESA, and the Hawaii stock is not designated as depleted or strategic under the MMPA.

Killer whale

Killer whales have been observed in all oceans and seas of the world (Leatherwood and Dahlheim 1978). Although reported from tropical and offshore waters (Heyning and Dahlheim 1988), killer whales prefer the colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). High densities of the species occur in high latitudes, especially in areas where prey is abundant.

Killer whales are considered rare in Hawaiian waters (Carretta *et al*. 2017). Twenty one sighting records were reported in Hawaiian waters between 1994 and 2004 (Baird *et al*. 2006). During summer–fall surveys of the Hawaiian Islands EEZ, two sightings were made in 2002 (Barlow *et al*. 2004; Barlow 2006) and one 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*. 2017). 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*. 2017). Killer whales are not listed as endangered or threatened under the ESA (with the exception of the endangered Southern Resident DPS which does not occur in the survey area), and the Hawaii stock is not designated as depleted or strategic under the MMPA.

False killer whale

False killer whales are found worldwide in tropical and warm-temperate waters (Stacey et al. 1994). In the North Pacific, this species is well known from southern Japan, Hawaii, and the eastern tropical Pacific. The species 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).

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). Based on the ranges of these stocks, only the Hawaii pelagic stock is expected to occur in the survey area (Carretta *et al*. 2017). False killer whales are not listed as endangered or threatened under the ESA (with the exception of the endangered Main Hawaiian Islands insular DPS which does not occur in the survey area), and the Hawaii pelagic stock is not designated as depleted or strategic under the MMPA.

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).

Though a small resident population occurs in the main Hawaiian Islands, pygmy killer whales are relatively rare in Hawaiian waters (McSweeney *et al*. 2009). Satellite telemetry data from four tagged pygmy killer whales suggest the resident group remains within 20km of shore (Baird *et al*. 2011) so would be unlikely in the proposed survey area. Movements have been documented between Hawaii Island and Oahu and between Oahu and Lanai (Baird *et al*. 2011a).

Pygmy killer whales are not listed under the ESA, and the Hawaii stock is not listed as is not considered a depleted or strategic stock under the MMPA.

Short-finned pilot whale

Short-finned pilot whales are found in all oceans, primarily in tropical and warm-temperate waters (Carretta *et al.*, 2016). The species prefers deeper waters, ranging from 324 m to 4,400 m, with most sightings between 500 m and 3,000 m (Baird 2016). This stock forms stable social groups, with average group size of 18 individuals but may form large aggregations of close to 200 individuals (Baird 2016). Other research suggests a larger average group size of 40.9 individuals (Bradford *et al.*, 2017), but most of these sightings were farther offshore in pelagic waters.

Short-finned pilot whales are commonly observed around the main Hawaiian Islands and are also present around the Northwestern Hawaiian Islands (Shallenberger 1981, Baird *et al*. 2013). Photo-identification and telemetry studies suggest there may be inshore and pelagic populations of short finned pilot whales in Hawaiian waters. Resighting and social network analyses of individuals photographed off Hawaii Island suggest the occurrence of one large and several smaller social clusters that use those waters, with some individuals within the smaller social clusters commonly resighted off Hawaii Island (Mahaffy 2012). Short-finned pilot whales are not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

Melon-headed whale

Melon-headed whales are found in tropical and warm-temperate waters throughout the world (Carretta *et al.*, 2016). The distribution of reported sightings suggests that the oceanic habitat of this species is primarily equatorial waters (Perryman *et al*. 1994). The species forms large groups, with average group size of almost 250 individuals, with the largest group documented at close to 800 individuals (Baird 2016).

There are two demographically-independent populations in Hawaiian waters, the Hawaiian Islands stock and the Kohala resident stock (Carretta *et al.*, 2016). The Kohala resident stock have a small range restricted to the shallow waters around Hawaii Island, whereas the Hawaiian Islands stock are found throughout the islands and offshore in pelagic areas (Carretta *et al.*, 2016). As such, only the Hawaiian Islands stock may be affected by the proposed activities. This stock prefers waters deeper than 1,000 m (Baird 2016). 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). Melon-headed whales are not listed as endangered or threatened under the ESA and the Hawaiian Islands stock is not considered a depleted or strategic stock under the MMPA.

Bottlenose dolphin

Bottlenose dolphins are widely distributed throughout the world in tropical and warm-temperate waters (Perrin *et al*. 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).

There are four resident insular stocks of bottlenose dolphins around the Main Hawaiian Islands and one pelagic stock (Carretta *et al.*, 2016). 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 stock (Martien *et al*. 2012). Only the pelagic stock may be affected by the proposed activity. Bottlenose dolphins are not listed as endangered or threatened under the ESA, and the Hawaii pelagic stock is not considered a depleted or strategic stock under the MMPA.

Pantropical spotted dolphin

Pantropical spotted dolphins are primarily found in tropical and subtropical waters worldwide (Perrin *et al*. 2009). There are two forms of pantropical spotted dolphin: coastal and offshore. Pantropical spotted dolphins prefer deeper waters between 1,500 m and 3,000 m and forms large groups with average group size of 60 individuals, with the largest group estimated at 400 individuals (Baird 2016).

Pantropical spotted dolphins are common and abundant throughout the Hawaiian archipelago (Baird *et al*. 2013). It is expected that it would be one of the most abundant cetaceans in the proposed survey area. There are four resident coastal stocks in Hawaii in addition to the Hawaii pelagic stock. Due to their ranges, only the pelagic stock is likely to be encountered in the project area (Carretta *et al.,* 2016). Pantropical spotted dolphins are not listed as endangered or threatened under the ESA, and the Hawaii pelagic stock is not considered a depleted or strategic stock under the MMPA.

Striped dolphin

Striped dolphins are found in tropical to warm-temperate waters throughout the world (Carretta *et al.,* 2016). This is a deep water species, preferring depths greater than 3,500 m (Baird 2016). Striped dolphins occur primarily in pelagic waters, but have been observed approaching shore where there is deep water close to the coast (Jefferson *et al*. 2008). This species forms large groups, with an average group size of 28 individuals, and a maximum group size of 100 individuals (Baird 2016).

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 (Carretta *et al*.. 2017). Striped dolphins are not listed as endangered or threatened under the ESA, and the Hawaii stock of striped dolphins is not considered a depleted or strategic stock under the MMPA.

Spinner dolphin

Spinner dolphins are found in tropical and warm-temperate waters worldwide (Carretta *et al.*, 2016). They are pantropical in distribution, including oceanic tropical and sub-tropical waters between 40ºN and 40ºS (Jefferson *et al*. 2008). Generally considered a pelagic species (Perrin 2009b), spinner dolphins can also be found in coastal waters and around oceanic islands (Rice 1998). There are six separate stocks managed within the Hawaiian Islands EEZ (Carretta *et al*. 2017); 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 (Carretta *et al*. 2017). The spinner dolphin is not listed as endangered or threatened under the ESA, and the Hawaii pelagic stock is not considered a depleted or strategic stock under the MMPA.

Rough-toothed dolphin

Rough-toothed dolphins are found in tropical and warm-temperate waters (Carretta *et al.*, 2016). While there is evidence for two island-associated stocks and one pelagic stock in Hawaii, there is only one stock designated for Hawaii (Carretta *et al.*, 2016). Most sightings of this species off Kauai are in water depths of less than 1,000 m; however, it is the most often sighted species in depths greater than 3,000 m (Baird 2016). This species forms stable associations as part of larger groups, with average group sizes of 11 animals and maximum group sizes, observed off Kauai, of 140 individuals (Baird 2016).

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 in 2002 and 2010, rough-toothed dolphins were observed throughout the EEZ and near the proposed survey area. The rough-toothed dolphin is not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

Fraser's dolphin

Fraser's dolphin are found in tropical waters (Carretta *et al.,* 2011). This is a deep water species occurring offshore of the Hawaiian islands, with sightings occurring in water depths between 1,515 m and 4,600 m (Baird 2016). The species forms large groups with average group sizes between 75 and 110 individuals (Baird 2016). Fraser's dolphin is one of the most abundant cetaceans in the Hawaiian Islands EEZ (Barlow 2006; Bradford *et al*. 2013). Fraser's dolphin is not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

Risso's dolphin

Risso's dolphins are found in tropical to warm-temperate waters (Carretta *et al.,* 2016). The species occurs from coastal to deep water but is most often found in depths greater than 3,000 m with the highest sighting rate in depths greater than 4,500 m (Baird 2016). It occurs between 60ºN and 60ºS where surface water temperatures are at least 10ºC (Kruse *et al*. 1999). The species forms small groups with an average group size of 4 individuals, and a maximum group size of 25 individuals off the coast of Hawaii (Baird 2016). Risso's dolphins are not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

Longman's beaked whale

The Longman's beaked whale, also known as Indo-Pacific beaked whale, is considered one of the least known cetacean species (Carretta *et al.*, 2016). Longman's beaked whales are found in tropical waters from the eastern Pacific westward through the Indian Ocean to the eastern coast of Africa (Carretta *et al*., 2016). The species occurs 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 2009). Group sizes range from 18 to 110 individuals (Baird 2016). The Longman's beaked whale is not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

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 found in deep water over and near the continental slope (Jefferson *et al*. 2008). In the eastern tropical Pacific, the mean water depth for sighted Cuvier's beaked whales was ~3.4 km (Ferguson *et al.* 2006). 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). Summer/fall shipboard surveys of the waters within the U.S. EEZ of the Hawaiian Islands resulted in 4 sightings in 2002 and 22 in 2010, including markedly higher sighting rates during nearshore surveys in the Northwestern Hawaiian Islands. (Barlow 2006, Bradford *et al*. 2013). Resighting and movement data of individual Cuvier's beaked whales suggest the existence of insular and offshore populations of this species in Hawaiian waters. A 21-yr study off Hawaii Island suggests long-term site fidelity and year-round occurrence (McSweeney *et al* 2007). The Cuvier's beaked whale is not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

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). Recent analysis of Blainville's beaked whale resightings and movements near the main Hawaiian Islands suggest the existence of insular and pelagic populations of this species in Hawaiian waters (McSweeney *et al*. 2007, Schorr *et al*. 2009, Baird *et al*. 2013). Photo-identification of individual Blainville's beaked whales from Hawaii Island since 1986 reveal repeated use of this area by individuals for over 17 years (Baird *et al*. 2011) and 75% of individuals seen off Hawaii Island link by association into a single social network (Baird *et al*. 2013). Those individuals seen farthest from shore and in deep water (>2100m) have not been resighted, suggesting they may be part of an offshore, pelagic population (Baird *et al*. 2011). The Hawaii stock of Blainville's beaked whales includes animals found both within the Hawaiian Islands EEZ and in adjacent high seas waters. The Blainville's beaked whale is not listed as endangered or threatened under the ESA, and the Hawaii stock is not considered a depleted or strategic stock under the MMPA.

Potential Effects of Specified Activities on Marine Mammals and their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The "Estimated Take by Incidental Harassment" section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The "Negligible Impact Analysis and Determination" section considers the content of this section, the "Estimated Take by Incidental Harassment" section, and the "Proposed Mitigation" section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

Description of Active Acoustic Sound Sources

This section contains a brief technical background on sound, the characteristics of certain sound types, and on metrics used in this proposal inasmuch as the information is relevant to the specified activity and to a discussion of the potential effects of the specified activity on marine mammals found later in this document.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the "loudness" of a sound and is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)) and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) represents the SPL referenced at a distance of 1 m from the source (referenced to 1 μPa) while the received level is the SPL at the listener's position (referenced to 1 μPa).

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Root mean square is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Root mean square accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy contained within a puls and considers both intensity and duration of exposure. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-p) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source and is represented in the same units as the rms sound pressure. Another common metric is peak-to-peak sound pressure (pk-pk), which is the algebraic difference between the peak positive and peak negative sound pressures. Peak-to-peak pressure is typically approximately 6 dB higher than peak pressure (Southall *et al*., 2007).

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for pulses produced by the airgun arrays considered here. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson *et al*., 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.*, wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.*, sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.*, vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including the following (Richardson *et al*., 1995):

- Wind and waves: The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient sound for frequencies between 200 Hz and 50 kHz (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Surf sound becomes important near shore, with measurements collected at a distance of 8.5 km from shore showing an increase of 10 dB in the 100 to 700 Hz band during heavy surf conditions.

- Precipitation: Sound from rain and hail impacting the water surface can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times.

- Biological: Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz.

- Anthropogenic: Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly. Sound from identifiable anthropogenic sources other than the activity of interest (*e.g.*, a passing vessel) is sometimes termed background sound, as opposed to ambient sound.

The sum of the various natural and anthropogenic sound sources at any given location and time—which comprise "ambient" or "background" sound—depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson *et al*., 1995). The result is that, depending on the source type and its intensity, sound from a given activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals. Details of source types are described in the following text.

Sounds are often considered to fall into one of two general types: pulsed and non-pulsed (defined in the following). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.*, Ward, 1997 in Southall *et al*., 2007). Please see Southall *et al*. (2007) for an in-depth discussion of these concepts.

Pulsed sound sources (*e.g.*, airguns, explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.*, rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems (such as those used by the U.S. Navy). The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

Airgun arrays produce pulsed signals with energy in a frequency range from about 10-2,000 Hz, with most energy radiated at frequencies below 200 Hz. The amplitude of the acoustic wave emitted from the source is equal in all directions (*i.e.*, omnidirectional), but airgun arrays do possess some directionality due to different phase delays between guns in different directions. Airgun arrays are typically tuned to maximize functionality for data acquisition purposes, meaning that sound transmitted in horizontal directions and at higher frequencies is minimized to the extent possible.

As described above, a SeaBeam 3012 MBES would also be operated from the *Kairei* continuously throughout the survey. Due to the lower source level of the MBES relative to the *Kairei's* airgun array (241 dB re 1 μPa · m for the MBES versus 259 dB re 1 μPa · m (rms) for the airgun array), the sounds from the MBES are expected to be effectively subsumed by the sounds from the airgun array. In addition, given the movement and speed of the vessel, the intermittent and narrow downward-directed nature of the sounds emitted by the MBES would result in no more than one or two brief ping exposures of any individual marine mammal, if any exposure were to occur. For these reasons, any marine mammal that was exposed to sounds from the MBES would already have been exposed to sounds from the airgun array, which are expected to propagate further in the water. As such, the MBES is not expected to result in the take of any marine mammal that has not already been taken by the sounds from the airgun array, and therefore we do not consider noise from the MBES further in this analysis.

Acoustic Effects

Here, we first provide background information on marine mammal hearing before discussing the potential effects of the use of active acoustic sources on marine mammals.

Marine Mammal Hearing – Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al*., 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al*. (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans). Subsequently, NMFS (2016) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al*. (2007) retained. Pinniped functional hearing is not discussed here, as no pinnipeds are expected to be affected by the specified activity. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency cetaceans (mysticetes): generalized hearing is estimated to occur between approximately 7 Hz and 35 kHz, with best hearing estimated to be from 100 Hz to 8 kHz;
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz, with best hearing from 10 to less than 100 kHz;
- High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; including two members of the genus *Lagenorhynchus,* on the basis of recent echolocation data and genetic data): generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz.

Table 3. Marine Functional Mammal Hearing Groups and Their Generalized Hearing Ranges

Hearing Group	Generalized Hearing Range*
Low frequency (LF) cetaceans (baleen whales)	7Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, Kogia, river dolphins, cephalorhynchid, Lagenorhynchus cruciger and L. australis)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al*., 2007) and PW pinniped (approximation).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2016) for a review of available information. Twenty four marine mammal species (all cetaceans) have the reasonable potential to co-occur with the proposed survey activities. Please refer to Table 2. Of the cetacean species that may be present, six are classified as low-frequency cetaceans (*i.e*., all mysticete species), 16 are classified as mid-frequency cetaceans (*i.e*., all delphinid and ziphiid species and the sperm whale), and two are classified as high-frequency cetaceans (*i.e*., Kogia spp.).

Potential Effects of Underwater Sound – Please refer to the information given previously ("Description of Active Acoustic Sources") regarding sound, characteristics of sound types, and metrics used in this document. Note that, in the following discussion, we refer in many cases to a recent review article concerning studies of noise-induced hearing loss conducted from 1996-2015 (*i.e.*, Finneran, 2015). For study-specific citations, please see that work. Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can potentially result in one or more of the following: temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al*., 1995; Gordon *et al*., 2004; Nowacek *et al*., 2007; Southall *et al*., 2007; Götz *et al*., 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. We first describe specific manifestations of acoustic effects before providing discussion specific to the use of airgun arrays.

Richardson *et al*. (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal, but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.*, when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

We describe the more severe effects certain non-auditory physical or physiological effects only briefly as we do not expect that use of airgun arrays are reasonably likely to result in such effects (see below for further discussion). Potential effects from impulsive sound sources can range in severity from effects such as behavioral disturbance or tactile perception to physical discomfort, slight injury of the internal organs and the auditory system, or mortality (Yelverton *et al*., 1973). Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (*e.g.*, change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al*., 2006; Southall *et al*., 2007; Zimmer and Tyack, 2007; Tal *et al*., 2015). The survey activities considered here do not involve the use of devices such as explosives or mid-frequency tactical sonar that are associated with these types of effects.

1. *Threshold Shift* – Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Finneran, 2015). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al*., 2007). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985).

When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.*, tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al*., 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.*, Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals, and there is no PTS data for cetaceans but such relationships are assumed to be similar to those in humans and other terrestrial mammals. PTS typically occurs at exposure levels at least several decibels above (a 40-dB threshold shift approximates PTS onset; *e.g.*, Kryter *et al*., 1966; Miller, 1974) that inducing mild TTS (a 6-dB threshold shift approximates TTS onset; *e.g.*, Southall *et al*. 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS thresholds for impulse sounds (such as airgun pulses as received close to the source) are at least 6 dB higher than the TTS threshold on a peak-pressure basis and PTS cumulative sound exposure level thresholds are 15 to 20 dB higher than TTS cumulative sound exposure level thresholds (Southall *et al*., 2007). Given the higher level of sound or longer exposure duration necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

For mid-frequency cetaceans in particular, potential protective mechanisms may help limit onset of TTS or prevent onset of PTS. Such mechanisms include dampening of hearing, auditory adaptation, or behavioral amelioration (*e.g.*, Nachtigall and Supin, 2013; Miller *et al*., 2012; Finneran *et al*., 2015; Popov *et al*., 2016).

TTS is the mildest form of hearing impairment that can occur during exposure to sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.*, recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts.

Finneran *et al*. (2015) measured hearing thresholds in three captive bottlenose dolphins before and after exposure to ten pulses produced by a seismic airgun in order to study TTS induced after exposure to multiple pulses. Exposures began at relatively low levels and gradually increased over a period of several months, with the highest exposures at peak SPLs from 196 to 210 dB and cumulative (unweighted) SELs from 193-195 dB. No substantial TTS was observed. In addition, behavioral reactions were observed that indicated that animals can learn behaviors that effectively mitigate noise exposures (although exposure patterns must be learned, which is less likely in wild animals than for the captive animals considered in this study). The authors note that the failure to induce more significant auditory effects likely due to the intermittent nature of exposure, the relatively low peak pressure produced by the acoustic source, and the low-frequency energy in airgun pulses as compared with the frequency range of best sensitivity for dolphins and other mid-frequency cetaceans.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale, harbor porpoise, and Yangtze finless porpoise) exposed to a limited number of sound sources (*i.e.*, mostly tones and octave-band noise) in laboratory settings (Finneran, 2015). In general, harbor porpoises have a lower TTS onset than other measured cetacean species

(Finneran, 2015). Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes.

Critical questions remain regarding the rate of TTS growth and recovery after exposure to intermittent noise and the effects of single and multiple pulses. Data at present are also insufficient to construct generalized models for recovery and determine the time necessary to treat subsequent exposures as independent events. More information is needed on the relationship between auditory evoked potential and behavioral measures of TTS for various stimuli. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Southall *et al*. (2007), Finneran and Jenkins (2012), Finneran (2015), and NMFS (2016).

2. *Behavioral Effects* – Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.*, minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.*, species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.*, Richardson *et al*., 1995; Wartzok *et al*., 2003; Southall *et al*., 2007; Weilgart, 2007; Archer *et al*., 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al*., 2012), and can vary depending on characteristics associated with the sound source (*e.g.*, whether it is moving or stationary, number of sources,

distance from the source). Please see Appendices B-C of Southall *et al*. (2007) for a review of studies involving marine mammal behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al*., 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a "progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial," rather than as, more generally, moderation in response to human disturbance (Bejder *et al*., 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al*., 1995; NRC, 2003; Wartzok *et al*., 2003). Controlled experiments with captive marine mammals have showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al*., 1997). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; see also Richardson *et al*., 1995; Nowacek *et al*., 2007). However, many delphinids approach acoustic source vessels with no apparent discomfort or obvious behavioral change (*e.g.*, Barkaszi *et al*., 2012).

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.*, Lusseau and Bejder, 2007; Weilgart, 2007; NRC, 2005). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely, and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.*, Frankel and Clark, 2000; Ng and Leung, 2003; Nowacek *et al*.; 2004; Goldbogen *et al*., 2013a, b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.*, foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.*, bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.*, Croll *et al*., 2001; Nowacek *et al*.; 2004; Madsen *et al*., 2006; Yazvenko *et al*., 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Visual tracking, passive acoustic monitoring, and movement recording tags were used to quantify sperm whale behavior prior to, during, and following exposure to airgun arrays at received levels in the range 140-160 dB at distances of 7-13 km, following a phase-in of sound intensity and full array exposures at 1-13 km (Madsen *et al*., 2006; Miller *et al*., 2009). Sperm whales did not exhibit horizontal avoidance behavior at the surface. However, foraging behavior may have been affected. The sperm whales exhibited 19 percent less vocal (buzz) rate during full exposure relative to post exposure, and the whale that was approached most closely had an extended resting period and did not resume foraging until the airguns had ceased firing. The remaining whales continued to execute foraging dives throughout exposure; however, swimming movements during foraging dives were 6 percent lower during exposure than control periods (Miller *et al*., 2009). These data raise concerns that seismic surveys may impact foraging behavior in sperm whales, although more data are required to understand whether the differences were due to exposure or natural variation in sperm whale behavior (Miller *et al*., 2009).

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.*, Kastelein *et al*., 2001, 2005, 2006; Gailey *et al*., 2007; Gailey *et al*., 2016).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al*., 2000; Fristrup *et al*., 2003; Foote *et al*., 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al*., 2007). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al*., 1994).

Cerchio *et al*. (2014) used passive acoustic monitoring to document the presence of singing humpback whales off the coast of northern Angola and to opportunistically test for the effect of seismic survey activity on the number of singing whales. Two recording units were deployed between March and December 2008 in the offshore environment; numbers of singers were counted every hour. Generalized Additive Mixed Models were used to assess the effect of survey day (seasonality), hour (diel variation), moon phase, and received levels of noise (measured from a single pulse during each ten minute sampled period) on singer number. The number of singers significantly decreased with increasing received level of noise, suggesting that humpback whale breeding activity was disrupted to some extent by the survey activity.

Castellote *et al*. (2012) reported acoustic and behavioral changes by fin whales in response to shipping and airgun noise. Acoustic features of fin whale song notes recorded in the

Mediterranean Sea and northeast Atlantic Ocean were compared for areas with different shipping noise levels and traffic intensities and during a seismic airgun survey. During the first 72 h of the survey, a steady decrease in song received levels and bearings to singers indicated that whales moved away from the acoustic source and out of the study area. This displacement persisted for a time period well beyond the 10-day duration of seismic airgun activity, providing evidence that fin whales may avoid an area for an extended period in the presence of increased noise. The authors hypothesize that fin whale acoustic communication is modified to compensate for increased background noise and that a sensitization process may play a role in the observed temporary displacement.

Seismic pulses at average received levels of 131 dB re 1 μPa^2-s caused blue whales to increase call production (Di Iorio and Clark, 2010). In contrast, McDonald *et al*. (1995) tracked a blue whale with seafloor seismometers and reported that it stopped vocalizing and changed its travel direction at a range of 10 km from the acoustic source vessel (estimated received level 143 dB pk-pk). Blackwell *et al*. (2013) found that bowhead whale call rates dropped significantly at onset of airgun use at sites with a median distance of 41-45 km from the survey. Blackwell *et al*. (2015) expanded this analysis to show that whales actually increased calling rates as soon as airgun signals were detectable before ultimately decreasing calling rates at higher received levels (*i.e.*, 10-minute SEL_{cum} of ~127 dB). Overall, these results suggest that bowhead whales may adjust their vocal output in an effort to compensate for noise before ceasing vocalization effort and ultimately deflecting from the acoustic source (Blackwell *et al*., 2013, 2015). These studies demonstrate that even low levels of noise received far from the source can induce changes in vocalization and/or behavior for mysticetes.

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al*., 1995). For example, gray whales are known to change direction—deflecting from customary migratory paths—in order to avoid noise from seismic surveys (Malme *et al*., 1984). Humpback whales showed avoidance behavior in the presence of an active seismic array during observational studies and controlled exposure experiments in western Australia (McCauley *et al*., 2000). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.*, Bowles *et al*., 1994; Goold, 1996; Stone *et al*., 2000; Morton and Symonds, 2002; Gailey *et al*., 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.*, Bejder *et al*., 2006; Teilmann *et al*., 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.*, directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.*, when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.*, Beauchamp and Livoreil, 1997; Fritz *et al*., 2002; Purser and Radford, 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.*, decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.*, Harrington and Veitch, 1992; Daan *et al*., 1996; Bradshaw *et al*., 1998). However, Ridgway *et al*. (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al*., 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al*., 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

Stone (2015) reported data from at-sea observations during 1,196 seismic surveys from 1994 to 2010. When large arrays of airguns (considered to be 500 in^3 or more) were firing, lateral displacement, more localized avoidance, or other changes in behavior were evident for most odontocetes. However, significant responses to large arrays were found only for the minke whale and fin whale. Behavioral responses observed included changes in swimming or surfacing behavior, with indications that cetaceans remained near the water surface at these times. Cetaceans were recorded as feeding less often when large arrays were active. Behavioral observations of gray whales during a seismic survey monitored whale movements and respirations pre-, during and post-seismic survey (Gailey *et al*., 2016). Behavioral state and water depth were the best 'natural' predictors of whale movements and respiration and, after considering natural variation, none of the response variables were significantly associated with seismic survey or vessel sounds.

3. *Stress Responses* – An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.*, Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones.

Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.*, Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al*., 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and "distress" is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficiently to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.*, Holberton *et al*., 1996; Hood *et al*., 1998; Jessop *et al*., 2003; Krausman *et al*., 2004; Lankford *et al*., 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al*., 2002b) and, more rarely, studied in wild populations (*e.g.*, Romano *et al*., 2002a). For example, Rolland *et al*. (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as "distress." In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

4. *Auditory Masking* – Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.*, those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al*., 1995; Erbe *et al*., 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.*, snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.*, shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.*, signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.*, sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions.

Under certain circumstances, marine mammals experiencing significant masking could also be impaired from maximizing their performance fitness in survival and reproduction. Therefore, when the coincident (masking) sound is man-made, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.*, Clark *et al*., 2009) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.*, Miller *et al*., 2000; Foote *et al*., 2004; Parks *et al*., 2007; Di Iorio and Clark, 2009; Holt *et al*., 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al*., 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (*e.g.*, Erbe, 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.*, Branstetter *et al*., 2013).

Masking affects both senders and receivers of acoustic signals and can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.*, from vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

Ship Strike

Vessel collisions with marine mammals, or ship strikes, can result in death or serious injury of the animal. Wounds resulting from ship strike may include massive trauma, hemorrhaging, broken bones, or propeller lacerations (Knowlton and Kraus, 2001). An animal at the surface may be struck directly by a vessel, a surfacing animal may hit the bottom of a vessel, or an animal just below the surface may be cut by a vessel's propeller. Superficial strikes may not kill or result in the death of the animal. These interactions are typically associated with large whales (*e.g.*, fin whales), which are occasionally found draped across the bulbous bow of large commercial ships upon arrival in port. Although smaller cetaceans are more maneuverable in relation to large vessels than are large whales, they may also be susceptible to strike. The severity of injuries typically depends on the size and speed of the vessel, with the probability of death or serious injury increasing as vessel speed increases (Knowlton and Kraus, 2001; Laist *et al*., 2001; Vanderlaan and Taggart, 2007; Conn and Silber, 2013). Impact forces increase with speed, as does the probability of a strike at a given distance (Silber *et al*., 2010; Gende *et al*., 2011).

Pace and Silber (2005) also found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 kn, and exceeded 90 percent at 17 kn. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death through increased likelihood of collision by pulling whales toward the vessel (Clyne, 1999; Knowlton *et al*., 1995). In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing that the greatest rate of change in the probability of a lethal injury to a large whale as a function of vessel speed occurs between 8.6 and 15 kn. The chances of a lethal injury decline from approximately 80 percent at 15 kn to approximately 20 percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below 50 percent, while the probability asymptotically increases toward one hundred percent above 15 kn.

The *Kairei* travels at a speed of ~8.3 km/hour while towing seismic survey gear (LGL 2017). At this speed, both the possibility of striking a marine mammal and the possibility of a strike resulting in serious injury or mortality are discountable. At average transit speed, the probability of serious injury or mortality resulting from a strike is less than 50 percent. However, the likelihood of a strike actually happening is again discountable. Ship strikes, as analyzed in the studies cited above, generally involve commercial shipping, which is much more common in both space and time than is geophysical survey activity. Jensen and Silber (2004) summarized ship strikes of large whales worldwide from 1975-2003 and found that most collisions occurred in the open ocean and involved large vessels (*e.g.*, commercial shipping). Commercial fishing vessels were responsible for three percent of recorded collisions, while no such incidents were reported for geophysical survey vessels during that time period.

It is possible for ship strikes to occur while traveling at slow speeds. For example, a hydrographic survey vessel traveling at low speed (5.5 kn) while conducting mapping surveys off the central California coast struck and killed a blue whale in 2009. The State of California determined that the whale had suddenly and unexpectedly surfaced beneath the hull, with the result that the propeller severed the whale's vertebrae, and that this was an unavoidable event. This strike represents the only such incident in approximately 540,000 hours of similar coastal mapping activity ($p = 1.9 \times 10^{-6}$; 95% CI = 0-5.5 x 10^{-6}; NMFS, 2013b). In addition, a research vessel reported a fatal strike in 2011 of a dolphin in the Atlantic, demonstrating that it is possible for strikes involving smaller cetaceans to occur. In that case, the incident report indicated that an animal apparently was struck by the vessel's propeller as it was intentionally swimming near the vessel. While indicative of the type of unusual events that cannot be ruled out, neither of these instances represents a circumstance that would be considered reasonably foreseeable or that would be considered preventable.

Although the likelihood of the vessel striking a marine mammal is low, we require a robust ship strike avoidance protocol (see "Proposed Mitigation"), which we believe eliminates any foreseeable risk of ship strike. We anticipate that vessel collisions involving a seismic data acquisition vessel towing gear, while not impossible, represent unlikely, unpredictable events for which there are no preventive measures. Given the required mitigation measures, the relatively slow speed of the vessel towing gear, the presence of bridge crew watching for obstacles at all times (including marine mammals), the presence of marine mammal observers, and the short duration of the survey (5.5 days), we believe that the possibility of ship strike is discountable and, further, that were a strike of a large whale to occur, it would be unlikely to result in serious injury or mortality. No incidental take resulting from ship strike is anticipated, and this potential effect of the specified activity will not be discussed further in the following analysis.

Stranding – When a living or dead marine mammal swims or floats onto shore and becomes "beached" or incapable of returning to sea, the event is a "stranding" (Geraci *et al*., 1999; Perrin and Geraci, 2002; Geraci and Lounsbury, 2005; NMFS, 2007). The legal definition for a stranding under the MMPA is that "(A) a marine mammal is dead and is (i) on a beach or shore of the United States; or (ii) in waters under the jurisdiction of the United States (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the United States and is unable to return to the water; (ii) on a beach or shore of the United States and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the United States (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance."

Marine mammals strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series. However, the cause or causes of most strandings are unknown (Geraci *et al*., 1976; Eaton, 1979; Odell *et al*., 1980; Best, 1982). Numerous studies suggest that the physiology, behavior, habitat relationships, age, or condition of cetaceans may cause them to strand or might pre-dispose them to strand when exposed to another phenomenon. These suggestions are consistent with the conclusions of numerous other studies that have demonstrated that combinations of dissimilar stressors commonly combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other does not produce the same result (Chroussos, 2000; Creel, 2005; DeVries *et al.*, 2003; Fair and Becker, 2000; Foley *et al*., 2001; Moberg, 2000; Relyea, 2005a; 2005b, Romero, 2004; Sih *et al*., 2004).

Use of military tactical sonar has been implicated in a majority of investigated stranding events, although one stranding event was associated with the use of seismic airguns. This event occurred in the Gulf of California, coincident with seismic reflection profiling by the R/V *Maurice Ewing* operated by Columbia University's Lamont-Doherty Earth Observatory and involved two Cuvier's beaked whales (Hildebrand, 2004). The vessel had been firing an array of 20 airguns with a total volume of 8,500 in^3 (Hildebrand, 2004; Taylor *et al*., 2004). Most known stranding events have involved beaked whales, though a small number have involved deep-diving delphinids or sperm whales (*e.g.*, Mazzariol *et al*., 2010; Southall *et al*., 2013). In general, long duration (~1 second) and high-intensity sounds (>235 dB SPL) have been implicated in stranding events (Hildebrand, 2004). With regard to beaked whales, mid-frequency sound is typically implicated (when causation can be determined) (Hildebrand, 2004). Although seismic airguns create predominantly low-frequency energy, the signal does include a mid-frequency component. We have considered the potential for the proposed survey to result in marine mammal stranding and have concluded that, based on the best available information, stranding is not expected to occur.

Other Potential Impacts – Here, we briefly address the potential risks due to entanglement and contaminant spills. We are not aware of any records of marine mammal entanglement in towed arrays such as those considered here. The discharge of trash and debris is prohibited (33 CFR §§ 151.51-77) unless it is passed through a machine that breaks up solids such that they can pass through a 25-mm mesh screen. All other trash and debris must be returned to shore for proper disposal with municipal and solid waste. Some personal items may be accidentally lost overboard. However, U.S. Coast Guard and Environmental Protection Act regulations require operators to become proactive in avoiding accidental loss of solid waste items by developing waste management plans, posting informational placards, manifesting trash sent to shore, and using special precautions such as covering outside trash bins to prevent accidental loss of solid waste. There are no meaningful entanglement risks posed by the described activity, and entanglement risks are not discussed further in this document.

Marine mammals could be affected by accidentally spilled diesel fuel from a vessel associated with proposed survey activities. Quantities of diesel fuel on the sea surface may affect marine mammals through various pathways: surface contact of the fuel with skin and other mucous membranes, inhalation of concentrated petroleum vapors, or ingestion of the fuel (direct ingestion or by the ingestion of oiled prey) (*e.g.*, Geraci and St. Aubin, 1980, 1985, 1990).

However, the likelihood of a fuel spill during any particular geophysical survey is considered to be remote, and the potential for impacts to marine mammals would depend greatly on the size and location of a spill and meteorological conditions at the time of the spill. Spilled fuel would rapidly spread to a layer of varying thickness and break up into narrow bands or windrows parallel to the wind direction. The rate at which the fuel spreads would be determined by the prevailing conditions such as temperature, water currents, tidal streams, and wind speeds. Lighter, volatile components of the fuel would evaporate to the atmosphere almost completely in a few days. Evaporation rate may increase as the fuel spreads because of the increased surface area of the slick. Rougher seas, high wind speeds, and high temperatures also tend to increase the rate of evaporation and the proportion of fuel lost by this process (Scholz *et al*., 1999). We do not anticipate potentially meaningful effects to marine mammals as a result of any contaminant spill resulting from the proposed survey activities, and contaminant spills are not discussed further in this document.

Anticipated Effects on Marine Mammal Habitat

Effects to Prey – Marine mammal prey varies by species, season, and location and, for some, is not well documented. Fish react to sounds which are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005) identified several studies that suggest fish may relocate to avoid certain areas of sound energy. Additional studies have documented effects of pulsed sound on fish, although several are based on studies in support of construction projects (*e.g.*, Scholik and Yan, 2001, 2002; Popper and Hastings, 2009). Sound pulses at received levels of 160 dB may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Pearson *et al*., 1992; Skalski *et al*., 1992).

SPLs of sufficient strength have been known to cause injury to fish and fish mortality. The most likely impact to fish from survey activities at the project area would be temporary avoidance of the area. The duration of fish avoidance of a given area after survey effort stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated.

Information on seismic airgun impacts to zooplankton, which represent an important prey type for mysticetes, is limited. However, McCauley *et al.* (2017) reported that experimental exposure to a pulse from a 150 $inch^3$ airgun decreased zooplankton abundance when compared with controls, as measured by sonar and net tows, and caused a two- to threefold increase in dead adult and larval zooplankton. Although no adult krill were present, the study found that all larval krill were killed after air gun passage. Impacts were observed out to the maximum 1.2 km range sampled.

In general, 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. We do not have any information to suggest the proposed survey area represents a significant feeding area for any marine mammal, and we believe any impacts to marine mammals due to adverse affects to their prey would be insignificant due to the limited spatial and temporal impact of the proposed survey. However, adverse impacts may occur to a few species of fish and to zooplankton.

Acoustic Habitat – Acoustic habitat is the soundscape—which encompasses all of the sound present in a particular location and time, as a whole—when considered from the perspective of the animals experiencing it. Animals produce sound for, or listen for sounds produced by, conspecifics (communication during feeding, mating, and other social activities), other animals (finding prey or avoiding predators), and the physical environment (finding suitable habitats, navigating). Together, sounds made by animals and the geophysical environment (*e.g.*, produced by earthquakes, lightning, wind, rain, waves) make up the natural contributions to the total acoustics of a place. These acoustic conditions, termed acoustic habitat, are one attribute of an animal's total habitat.

Soundscapes are also defined by, and acoustic habitat influenced by, the total contribution of anthropogenic sound. This may include incidental emissions from sources such as vessel traffic, or may be intentionally introduced to the marine environment for data acquisition purposes (as in the use of airgun arrays). Anthropogenic noise varies widely in its frequency content, duration, and loudness and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please see also the previous discussion on masking under "Acoustic Effects"), which may range from local effects for brief periods of time to chronic effects over large areas and for long durations. Depending on the extent of effects to habitat, animals may alter their communications signals (thereby potentially expending additional energy) or miss acoustic cues (either conspecific or adventitious). For more detail on these concepts see, *e.g.*, Barber *et al*., 2010; Pijanowski *et al*., 2011; Francis and Barber, 2013; Lillis *et al*., 2014.

Problems arising from a failure to detect cues are more likely to occur when noise stimuli are chronic and overlap with biologically relevant cues used for communication, orientation, and predator/prey detection (Francis and Barber, 2013). Although the signals emitted by seismic airgun arrays are generally low frequency, they would also likely be of short duration and transient in any given area due to the nature of these surveys. As described previously, exploratory surveys such as these cover a large area but would be transient rather than focused in a given location over time and therefore would not be considered chronic in any given location.

In summary, activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat or populations of fish species or on the quality of acoustic habitat. Thus, any impacts to marine mammal habitat are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, which will inform both NMFS' consideration of whether the number of takes is "small" and the negligible impact determination.

Harassment is the only type of take expected to result from these activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Authorized takes would primarily be by Level B harassment, as use of the seismic airguns have the potential to result in disruption of behavioral patterns for individual marine mammals. There is also some potential for auditory injury (Level A harassment) to result, primarily for mysticetes and high frequency cetaceans (i.e., kogiidae spp.), due to larger predicted auditory injury zones for those functional hearing groups. Auditory injury is unlikely to occur for mid-frequency species given very small modeled zones of injury for those species. The proposed mitigation and monitoring measures are expected to minimize the severity of such taking to the extent practicable.

As described previously, no mortality is anticipated or proposed to be authorized for this activity. Below we describe how the take is estimated.

Described in the most basic way, we estimate take by considering: 1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; 2) the area or volume of water that will be ensonified above these levels in a day; 3) the density or occurrence of marine mammals within these ensonified areas; and 4) and the number of days of activities. Below, we describe these components in more detail and present the exposure estimate and associated numbers of take proposed for authorization.

Acoustic Thresholds

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment for non-explosive sources – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (e.g., frequency, predictability, duty cycle), the environment (e.g., bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.*, 2007, Ellison *et al.* 2011). Based on the best available science and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider to fall under Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (e.g. vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (e.g., seismic airguns) or intermittent (e.g., scientific sonar) sources. UH's proposed activity includes the use of impulsive seismic sources. Therefore, the 160 dB re 1 μPa (rms) criteria is applicable for analysis of level B harassment.

Level A harassment for non-explosive sources - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS, 2016) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). The Technical Guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity for all underwater anthropogenic sound sources, reflects the best available science, and better predicts the potential for auditory injury than does NMFS' historical criteria.

These thresholds were developed by compiling and synthesizing the best available science and soliciting input multiple times from both the public and peer reviewers to inform the final product, and are provided in Table 4 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2016 Technical Guidance, which may be accessed at: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm. As described above, UH's proposed activity includes the use of intermittent and impulsive seismic sources.

Table 4. Thresholds Identifying the Onset of Permanent Threshold Shift in Marine Mammals

Hearing Group	PTS Onset Thresholds

	Impulsive*	Non-impulsive
Low-Frequency (LF) Cetaceans	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	$L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	$L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	$L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	$L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	$L_{E,HF,24h}$: 173 dB

Note: *Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (Lpk) has a reference value of 1 μPa, and cumulative sound exposure level (LE) has a reference value of 1μPa2s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.*, varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into estimating the area ensonified above the acoustic thresholds.

The proposed survey would entail use of a 32-airgun array with a total discharge of 7,800 in^3 at a tow depth of 10 m. The distance to the predicted isopleth corresponding to the threshold for Level B harassment (160 dB re 1 μPa) was calculated based on results of modeling performed by Lamont-Doherty Earth Observatory (LDEO) of Columbia University. Received sound levels were predicted by LDEO's model (Diebold *et al.* 2010) as a function of distance from the full 32-airgun array as well as for a single 100 in^3 airgun, which would be used during power-downs. The LDEO modeling approach uses ray tracing for the direct wave traveling from the array to the receiver and its associated source ghost (reflection at the air-water interface in the vicinity of the array), in a constant-velocity half-space (infinite homogeneous ocean layer unbounded by a seafloor). LDEO's modeling methodology is described in greater detail in the

IHA application (LGL 2017) and we refer to the reader to that document rather than repeating it here. The estimated distances to the Level B harassment isopleth for the *Kairei's* full airgun array and for the single 100-in^3 airgun are shown in Table 5.

Table 5. Predicted Radial Distances from R/V Kairei Seismic Source to Isopleth Corresponding to Level B Harassment Threshold

Source and Volume	Predicted Distance to Threshold (160 dB re 1 µPa)
1 airgun, 100 in3	722 m
4 strings, 32 airguns, 7800 in3	9,289 m

Predicted distances to Level A harassment isopleths, which vary based on marine mammal hearing groups (Table 3), were calculated based on modeling performed by LDEO using the Nucleus software program and the NMFS User Spreadsheet, described below. The updated acoustic thresholds for impulsive sounds (such as airguns) contained in the Technical Guidance (NMFS 2016) were presented as dual metric acoustic thresholds using both SEL_{cum} and peak sound pressure metrics. As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded (i.e., metric resulting in the largest isopleth). The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group. In recognition of the fact that the requirement to calculate Level A harassment ensonified areas could be more technically challenging to predict due to the duration component and the use of weighting functions in the new SEL_{cum} thresholds, NMFS developed an optional User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to facilitate the estimation of take numbers.

The values for SEL_{cum} and peak SPL for the *Kairei* airgun array were derived from calculating the modified farfield signature (Table 6). The farfield signature is often used as a theoretical representation of the source level. To compute the farfield signature, the source level is estimated at a large distance below the array (e.g., 9 km), and this level is back projected mathematically to a notional distance of 1 m from the array's geometrical center. However, when the source is an array of multiple airguns separated in space, the source level from the theoretical farfield signature is not necessarily the best measurement of the source level that is physically achieved at the source (Tolstoy *et al.* 2009). Near the source (at short ranges, distances <1 km), the pulses of sound pressure from each individual airgun in the source array do not stack constructively, as they do for the theoretical farfield signature. The pulses from the different airguns spread out in time such that the source levels observed or modeled are the result of the summation of pulses from a few airguns, not the full array (Tolstoy *et al.* 2009). At larger distances, away from the source array center, sound pressure of all the airguns in the array stack coherently, but not within one time sample, resulting in smaller source levels (a few dB) than the source level derived from the farfield signature. Because the farfield signature does not take into account the large array effect near the source and is calculated as a point source, the modified farfield signature is a more appropriate measure of the sound source level for distributed sound sources, such as airgun arrays. UH used the acoustic modeling developed by LDEO (same as used for Level B takes) with a small grid step of 1 m in both the inline and depth directions (for example, see Figure 5 in the IHA application). The propagation modeling takes into account all airgun interactions at short distances from the source, including interactions between subarrays which are modeled using the NUCLEUS software to estimate the notional signature and MATLAB software to calculate the pressure signal at each mesh point of a grid.

Table 6: Modeled source levels for R/V Kairei 7,800 in^3 airgun array and 100 in^3 airgun based on modified farfield signature

Functional Hearing Group	7,800 in^3 airgun array (Peak SPL_{flat})	7,800 in^3 airgun array (SEL_{cum})	100 in^3 airgun (Peak SPL_{flat})	100 in^3 airgun (SEL_{cum})

Low frequency cetaceans ($L_{pk,flat}$: 219 dB; $L_{E,LF,24h}$: 183 dB)	256.36 dB	235.01 dB	229.46 dB	208.41 dB
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB; $L_{E,MF,24h}$: 185 dB)	245.59 dB	235.12 dB	229.47 dB	208.44 dB
High frequency cetaceans ($L_{pk,flat}$: 202 dB; $L_{E,HF,24h}$: 155 dB)	256.26 dB	235.16 dB	229.59 dB	209.01 dB

In order to more realistically incorporate the Technical Guidance's weighting functions over the seismic array's full acoustic band, unweighted spectrum data for the Kairei's airgun array (modeled in 1 Hz bands) was used to make adjustments (dB) to the unweighted spectrum levels, by frequency, according to the weighting functions for each relevant marine mammal hearing group. These adjusted/weighted spectrum levels were then converted to pressures (micropascals) in order to integrate them over the entire broadband spectrum, resulting in broadband weighted source levels by hearing group that could be directly incorporated within the User Spreadsheet (*i.e.*, to override the Spreadsheet's more simple weighting factor adjustment). Using the User Spreadsheet's "safe distance" methodology for mobile sources (described by Sivle *et al*., 2014) with the hearing group-specific weighted source levels, and inputs assuming spherical spreading propagation, a source velocity of 2.315 meters/second, and shot interval of 21.59 seconds (LGL 2017), potential radial distances to auditory injury zones were then calculated for SEL_{cum} thresholds. To estimate Peak SPL thresholds, modeling was run for a single shot and then a high pass filter was applied for each hearing group. A high pass filter is a type of band band-pass filter, which pass frequencies within a defined range without reducing amplitude and attenuate frequencies outside that defined range (Yost 2007). Inputs to the User Spreadsheet are shown in Table 6; outputs from the User Spreadsheet in the form of estimated distances to Level A harassment isopleths are shown in Table 7. The User Spreadsheet used by UH is shown in Table 3 of the IHA application.

Table 7. Modeled radial distances from R/V Kairei 7800 in^3 airgun array and 100 in^3 airgun to isopleths corresponding to Level A harassment thresholds

Functional Hearing Group	**7,800 in^3 airgun array (Peak SPL_{flat})**	**7,800 in^3 airgun array (SEL_{cum})**	**100 in^3 airgun (Peak SPL_{flat})**	**100 in^3 airgun (SEL_{cum})**
Low frequency cetaceans ($L_{pk,flat}$: 219 dB; $L_{E,LF,24h}$: 183 dB)	61.5 m	752.8 m	3.2 m	4.48 m
Mid frequency cetaceans ($L_{pk,flat}$: 230 dB; $L_{E,MF,24h}$: 185 dB)	0.0	0.0 m	0.0	n/a
High frequency cetaceans ($L_{pk,flat}$: 202 dB; $L_{E,HF,24h}$: 155 dB)	14.5 m	1.7 m	3.7 m	n/a

Note that because of some of the assumptions included in the methods used, isopleths produced may be overestimates to some degree, which will ultimately result in some degree of overestimate of Level A take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools and will qualitatively address the output where appropriate. For mobile sources, such as the proposed seismic survey, the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed.

Marine Mammal Occurrence

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations.

The best available scientific information was considered in conducting marine mammal exposure estimates (the basis for estimating take). For most cetacean species, densities calculated by Bradford *et al.* (2017) from summer–fall vessel-based surveys that are part of the Hawaiian

Island Cetacean Ecosystem Assessment Survey (HICEAS) were used. The surveys were conducted by NMFS' Southwest Fisheries Science Center (SWFSC) and Pacific Islands Fisheries Science Center (PIFSC) in 2010 using two NOAA research vessels, one during August 13 – December 1 and the other during September 2 – October 29. The densities were estimated using a multiple-covariate line-transect approach (Buckland *et al.* 2001; Marques and Buckland 2004). Density estimates for pygmy and dwarf sperm whales and spinner dolphins, which were not calculated from the 2010 surveys, were derived from the "Outer EEZ stratum" of the vessel-based HICEAS survey conducted in summer–fall 2002 by SWFSC (Barlow 2006) using line-transect methodology (Buckland *et al.* 2001). The density estimate for the false killer whale was based on the pelagic stock density calculated by Bradford *et al.* (2015) using line-transect methodology (Buckland *et al.* 2001).

All densities were corrected for trackline detection probability bias ($f(0)$) and availability ($g(0)$) bias by the authors. Bradford *et al.* (2017) used $g(0)$ values estimated by Barlow (2015), whose analysis indicated that $g(0)$ had previously been overestimated, particularly for high sea states. Barlow (2006) used earlier estimates of $g(0)$, so densities used here for pygmy and dwarf sperm whales and spinner dolphins likely are underestimates. The density for the "Sei or Bryde's whale" category identified by Bradford *et al.* (2017) was allocated between sei and Bryde's whales according to their proportionate densities. Density estimates for humpback and minke whales were not available.

There is some uncertainty related to the estimated density data and the assumptions used in their calculations, as with all density data estimates. However, the approach used is based on the best available data.

Take Calculation and Estimation

Here we describe how the information provided above is brought together to produce a quantitative take estimate. In order to estimate the number of marine mammals predicted to be exposed to sound levels that would result in Level B harassment or Level A harassment, radial distances to predicted isopleths corresponding to the Level A harassment and Level B harassment thresholds are calculated, as described above. We then use those distances to calculate the area(s) around the airgun array predicted to be ensonified to sound levels that exceed the Level A and Level B harassment thresholds. The total ensonified area for the survey is then calculated, based on the areas predicted to be ensonified around the array and the trackline distance. The marine mammals predicted to occur within these respective areas, based on estimated densities, are expected to be incidentally taken by the proposed survey.

To summarize, the estimated density of each marine mammal species within an area (animals/km^2) is multiplied by the daily ensonified areas (km^2) that correspond to the Level A and Level B harassment thresholds for the species. The product (rounded) is the number of instances of take for each species within one day. The number of instances of take for each species within one day is then multiplied by the number of survey days (plus 25 percent contingency, as described below). The result is an estimate of the number of instances that marine mammals are predicted to be exposed to airgun sounds above the Level B harassment threshold and the Level A harassment threshold over the duration of the proposed survey. Estimated takes for all marine mammal species are shown in Table 8.

The proposed survey would occur both within the U.S. EEZ and outside the U.S. EEZ. We propose to authorize incidental take that is expected to occur as a result of the proposed survey both within and outside the U.S. EEZ.

Table 8. Numbers of Potential Incidental Take of Marine Mammals Proposed for Authorization.

Species	Estimated and Proposed Level A Takes	Estimated Level B Takes	Proposed Level B Takes	Total Proposed Level A and Level B takes	Total Proposed Level A and Level B takes as a Percentage of Population
Humpback whale [1]	0	0	2	2	<0.1
Minke whale [1]	0	0	1	1	n/a
Bryde's whale	2	25	25	27	3.4
Sei whale	0	6	6	6	3.4
Fin whale	0	2	2	2	3.4
Blue whale [1]	0	1	3	3	3.7
Sperm whale	0	51	51	51	1.5
Cuvier's beaked whale	0	8	8	8	<0.1
Longman’s beaked whale	0	85	85	85	1.9
Blainville’s beaked whale	0	76	76	76	3.3
Rough-toothed dolphin	0	812	812	812	12.9
Bottlenose dolphin	0	246	246	246	4.1
Pantropical spotted dolphin	0	639	639	639	4.0
Spinner dolphin [1]	0	23	32	32	0.9
Striped dolphin	0	685	685	685	3.3
Fraser’s dolphin	0	577	577	577	3.4
Risso’s dolphin	0	130	130	130	1.8
Melon-headed whale	0	97	97	97	1.7
Pygmy killer whale	0	119	119	119	3.5
False killer whale	0	16	16	16	1.0
Killer whale [1]	0	2	5	5	4.9
Short-finned pilot whale	0	218	218	218	1.8
Pygmy sperm whale	0	87	87	87	1.2
Dwarf sperm whale	0	214	214	214	1.2

[1] The proposed number of authorized takes (Level B harassment only) for these species has been increased from the calculated take to mean group size. Sources for mean group sizes are as follows: blue whale (Bradford *et al.* 2017); minke whale (Jackson *et al.* 2008); humpback whale (Mobley *et al.* 2001); spinner dolphin (Barlow 2006); killer whale (Bradford *et al.* 2017).

Species with Take Estimates Less than Mean Group Size: Using the approach described above to estimate take, the take estimates for the blue whale, killer whale, and spinner dolphin (Table 8) were less than the average group sizes estimated for these species. However, information on the social structures and life histories of these species indicates it is common for them to be encountered in groups. As the results of take calculations support the likelihood that UH's survey would be expected to encounter and to incidentally take these species, and we believe it is likely that these species may be encountered in groups, it is reasonable to conservatively assume that one group of each of these species will be taken during the proposed survey. We therefore propose to authorize the take of the average (mean) group size for the blue whale, killer whale, and spinner dolphin to account for the possibility that UH's survey encounters a group of any of these species (Table 8).

Species with No Available Density Data: No density data were available for humpback and minke whales. Both species would typically be found further north than the proposed survey area during the time of year that the proposed survey is planned to occur, based on sightings data around the Hawaiian Islands (Carretta *et al*. 2017). However, based on input from subject matter experts, we believe it is reasonable to assume that both species may be encountered by UH during the proposed survey. Humpback whales have typically not been observed in the project area in the fall (Carretta *et al*. 2017). However, there are increasing anecdotal reports of confirmed sightings of humpback whales from early September through October in areas near the planned project area (pers. comm. E. Lyman, NOAA Office of National Marine Sanctuaries, to J. Carduner, NMFS, June 20, 2017). Like humpback whales, sightings data does not indicate that minke whales would typically be expected to be present in the project area in the fall

(Carretta *et al*. 2017). However, detections of minke whales are common in passive acoustic recordings from various locations around the main Hawaiian Islands, including during the fall (pers. comm. E. Oleson, NOAA PIFSC, to J. Carduner, NMFS, June 20, 2017). Additionally, as minke whales in the North Pacific do not have a visible blow, they can be easily missed by visual observers, suggesting a lack of sightings is likely related to misidentification or low detection capability in poor sighting conditions (Rankin *et al*. 2007). Though no density data are available, we believe it is reasonable to conservatively assume that UH's proposed survey may encounter and incidentally take minke and humpback whales. We therefore propose to authorize the take of the average (mean) group size (weighted by effort and rounded up) for the humpback and minke whale (Table 8).

It should be noted that the proposed take numbers shown in Table 8 are believed to be conservative for several reasons. First, in the calculations of estimated take, 25% has been added in the form of operational survey days (equivalent to adding 25% to the proposed line km to be surveyed) to account for the possibility of additional seismic operations associated with airgun testing, and repeat coverage of any areas where initial data quality is sub-standard. Additionally, marine mammals would be expected to move away from a sound source that represents an aversive stimulus. However, the extent to which marine mammals would move away from the sound source is difficult to quantify and is therefore not accounted for in take estimates shown in Table 8.

Proposed Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, "and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking" for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

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 measures 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.

UH has reviewed mitigation measures employed during seismic research surveys authorized by NMFS under previous incidental harassment authorizations, as well as recommended best practices in Richardson *et al.* (1995), Pierson *et al.* (1998), Weir and Dolman (2007), Nowacek *et al*. (2013), Wright (2014), and Wright and Cosentino (2015), and has incorporated a suite of proposed mitigation measures into their project description based on the above sources.

To reduce the potential for disturbance from acoustic stimuli associated with the activities, UH has proposed to implement the following mitigation measures for marine mammals:

(1) Vessel-based visual mitigation monitoring;

(2) Vessel-based passive acoustic monitoring;

(3) Establishment of an exclusion zone;

(4) Power down procedures;

(5) Shutdown procedures;

(6) Ramp-up procedures; and

(7) Ship strike avoidance measures.

Vessel-based visual mitigation monitoring

PSO observations would take place during all 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, designated Exclusion Zones (as described below). 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, to allow for comparison of sighting rates and behavior with and without airgun operations and between acquisition periods.

During seismic operations, four visual PSOs would be based aboard the *Kairei*. PSOs would be appointed by JAMSTEC with NMFS approval. During the majority of seismic operations, two PSOs would monitor for marine mammals around the seismic vessel. Use of two simultaneous observers would increase the effectiveness of detecting marine mammals around the source vessel. However, during meal times, only one PSO may be on duty. PSO(s) would be on duty in shifts of duration no longer than 4 hours. Other crew would also be instructed to assist in detecting marine mammals and in implementing mitigation requirements (if practical). Before the start of the seismic survey, the crew would be given additional instruction in detecting marine mammals and implementing mitigation requirements. The *Kairei* is a suitable platform for marine mammal observations. When stationed on the observation platform, the PSO would have a good view around the entire vessel. During daytime, the PSO(s) would scan the area around the vessel systematically with reticle binoculars (e.g., 7×50 Fujinon), Big-eye binoculars (25×150), and with the naked eye.

The PSOs must 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 resumes would be provided to NMFS for approval. At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than eighteen months elapsed since the conclusion of the at-sea experience. One "experienced" visual PSO would be designated as the lead for the entire protected species observation team. The lead would coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO would devise the duty schedule such that "experienced" PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience, to the maximum extent practicable

The PSOs must have successfully completed relevant training, including completion of all required coursework and passing a written and/or oral examination developed for the training program, and must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate training, including (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

In summary, a typical daytime cruise would have scheduled two observers (visual) on duty from the observation platform, and an acoustic observer on the passive acoustic monitoring system.

Vessel-based passive acoustic mitigation monitoring

Passive acoustic monitoring (PAM) would take place to complement the visual monitoring program. Visual monitoring typically is not effective during periods of poor visibility or at night, and even with good visibility, is unable to detect marine mammals when they are below the surface or beyond visual range. Acoustic monitoring can be used in addition to visual observations to improve detection, identification, and localization of cetaceans. The acoustic monitoring would serve to alert visual observers (if on duty) when vocalizing cetaceans are detected. It is only useful when marine mammals vocalize, but it can be effective either by day or by night and does not depend on good visibility. It would be monitored in real time so that visual observers can be alerted when marine mammals are detected acoustically.

The PAM system consists of hardware (i.e., hydrophones) and software. The “wet end” of the system consists of a towed hydrophone array that is connected to the vessel by a tow cable. A deck cable would connect the tow cable to the electronics unit on board where the acoustic station, signal conditioning, and processing system would be located. The acoustic signals received by the hydrophones are amplified, digitized, and then processed by the software.

One acoustic PSO (in addition to the four visual PSOs) would be on board. The towed hydrophones would be monitored 24 hours per day (either by the acoustic PSO or by a visual PSO trained in the PAM system if the acoustic PSO is on break) while at the seismic survey area during airgun operations, and during most periods when the *Kairei* is underway while the airguns are not operating. However, PAM may not be possible if damage occurs to the array or back-up systems during operations. One PSO would monitor the acoustic detection system at any one time, in shifts no longer than six hours, by listening to the signals via headphones and/or speakers and watching the real-time spectrographic display for frequency ranges produced by cetaceans.

When a vocalization is detected, while visual observations are in progress, the acoustic PSO would contact the visual PSOs immediately, to alert them to the presence of marine mammals (if they have not already been detected visually), in order to facilitate a power down or shut down, if required. The information regarding the marine mammal acoustic detection would be entered into a database.

Exclusion Zone and Buffer Zone

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. The PSOs would establish a minimum exclusion zone with a 500 m radius for the full array. 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 (see Power Down Procedures below). In addition to the 500 m EZ for the full array, a 100 m exclusion zone would be established for the single 100 in^3 airgun. 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 shut down entirely (see Shutdown Procedures below).

Potential radial distances to auditory injury zones were calculated on the basis of maximum peak pressure using values provided by the applicant (Table 7). The 500 m radial distance of the standard EZ is intended to be precautionary in the sense that it would be expected to contain sound exceeding peak pressure injury criteria for all cetacean hearing groups, while also providing a consistent, reasonably observable zone within which PSOs would typically be able to conduct effective observational effort. Although significantly greater distances may be observed from an elevated platform under good conditions, we believe that 500 m is likely regularly attainable for PSOs using the naked eye during typical conditions.

An appropriate EZ based on cumulative sound exposure level (SEL_{cum}) criteria would be dependent on the animal's applied hearing range and how that overlaps with the frequencies produced by the sound source of interest (*i.e.*, via marine mammal auditory weighting functions) (NMFS, 2016), and may be larger in some cases than the zones calculated on the basis of the peak pressure thresholds (and larger than 500 m) depending on the species in question and the characteristics of the specific airgun array. In particular, the EZ radii would be larger for low-frequency cetaceans, because their most susceptible hearing range overlaps the low frequencies produced by airguns, but the zones would remain very small for mid-frequency cetaceans (*i.e.*, including the "small delphinoids" described below), whose range of best hearing largely does not overlap with frequencies produced by airguns.

Consideration of exclusion zone distances is inherently an essentially instantaneous proposition – a rule or set of rules that requires mitigation action upon detection of an animal. This indicates that consideration of peak pressure thresholds is most relevant, as compared with cumulative sound exposure level thresholds, as the latter requires that an animal accumulate some level of sound energy exposure over some period of time (*e.g.*, 24 hours). A PSO aboard a mobile source will typically have no ability to monitor an animal's position relative to the acoustic source over relevant time periods for purposes of understanding whether auditory injury is likely to occur on the basis of cumulative sound exposure and, therefore, whether action should be taken to avoid such potential. Therefore, definition of an exclusion zone based on SEL_{cum} thresholds is of questionable relevance given relative motion of the source and receiver (*i.e.*, the animal). Cumulative SEL thresholds are likely more relevant for purposes of modeling the potential for auditory injury than they are for informing real-time mitigation. We recognize the importance of the accumulation of sound energy to an understanding of the potential for auditory injury and that it is likely that, at least for low-frequency cetaceans, some potential auditory injury is likely impossible to mitigate and should be considered for authorization.

In summary, our intent in prescribing a standard exclusion zone distance is to (1) encompass zones for most species within which auditory injury could occur on the basis of instantaneous exposure; (2) provide additional protection from the potential for more severe behavioral reactions (*e.g.*, panic, antipredator response) for marine mammals at relatively close range to the acoustic source; (3) provide consistency for PSOs, who need to monitor and implement the exclusion zone; and (4) to define a distance within which detection probabilities are reasonably high for most species under typical conditions.

Our use of 500 m as the EZ is a reasonable combination of factors. This zone would contain all potential auditory injury for all cetaceans (high-frequency, mid-frequency and low-frequency functional hearing groups) as assessed against peak pressure thresholds (NMFS, 2016) (Table 7), would contain all potential auditory injury for high-frequency and mid-frequency cetaceans as assessed against SEL_{cum} thresholds (NMFS, 2016) (Table 7), and has been proven to be practicable through past implementation in seismic surveys conducted for the oil and gas industry in the Gulf of Mexico (as regulated by BOEM pursuant to the Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. §§1331-1356)). In summary, a practicable criterion such as this has the advantage of simplicity while still providing in most cases a zone larger than relevant auditory injury zones, given realistic movement of source and receiver.

The PSOs would also establish and monitor a 1,000-m buffer zone. During use of the acoustic source, occurrence of marine mammals within the buffer zone (but outside the exclusion zone) would be communicated to the operator to prepare for the potential power down or shutdown of the acoustic source. The buffer zone is discussed further under Ramp Up Procedures below.

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. In contrast, a shutdown occurs when all airgun activity is suspended (shutdown procedures are discussed below). If a marine mammal is detected outside the 500 m EZ but appears likely to enter the 500 m EZ, the airguns would be powered down before the animal is within the 500 m EZ. Likewise, if a mammal is already within the 500 m EZ when first detected, the airguns would be powered down immediately. During a power down of the airgun array, the 100-in^3 airgun would be operated.

Following a power down, airgun activity would not resume until the marine mammal has cleared the 500 m EZ. The animal would be considered to have cleared the 500 m EZ if the following conditions have been met:

- it is visually observed to have departed the 500 m EZ, or
- it has not been seen within the 500 m EZ for 15 min in the case of small odontocetes, or
- it has not been seen within the 500 m 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. As defined here, 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, for example, an animal or group of animals is stationary for some reason (*e.g.*, feeding) and the source vessel approaches the animals, the power down requirement applies. An animal with sufficient incentive to remain in an area rather than avoid an otherwise aversive stimulus could either incur auditory injury or disruption of important behavior. If there is uncertainty regarding identification (*i.e.*, whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, the power down would be implemented.

We propose this small delphinoid exception because power-down / shutdown requirements for small delphinoids under all circumstances represent practicability concerns without likely commensurate benefits for the animals in question. Small delphinoids are generally the most commonly observed marine mammals in the specific geographic region and would typically be the only marine mammals likely to intentionally approach the vessel. As described below, auditory injury is extremely unlikely to occur for mid-frequency cetaceans (*e.g.*, delphinids), as this group is relatively insensitive to sound produced at the predominant frequencies in an airgun pulse while also having a relatively high threshold for the onset of auditory injury (*i.e.*, permanent threshold shift). Please see “Potential Effects of the Specified Activity on Marine Mammals” above for further discussion of sound metrics and thresholds and marine mammal hearing.

A large body of anecdotal evidence indicates that small delphinoids commonly approach vessels and/or towed arrays during active sound production for purposes of bow riding, with no apparent effect observed in those delphinoids (*e.g.*, Barkaszi *et al*., 2012). The potential for increased shutdowns resulting from such a measure would require the *Kairei* to revisit the missed track line to reacquire data, resulting in an overall increase in the total sound energy input to the marine environment and an increase in the total duration over which the survey is active in a given area. Although other mid-frequency hearing specialists (*e.g.*, large delphinoids) are no more likely to incur auditory injury than are small delphinoids, they are much less likely to approach vessels. Therefore, retaining a power-down / shutdown requirement for large delphinoids would not have similar impacts in terms of either practicability for the applicant or corollary increase in sound energy output and time on the water. We do anticipate some benefit for a power-down / shutdown requirement for large delphinoids in that it simplifies somewhat the total range of decision-making for PSOs and may preclude any potential for physiological effects other than to the auditory system as well as some more severe behavioral reactions for any such animals in close proximity to the source vessel.

At any distance, power down of the acoustic source would also be required upon observation of a large whale (*i.e.*, sperm whale or any baleen whale) with a calf, or upon observation of an aggregation of large whales of any species (*i.e.*, sperm whale or any baleen whale) that does not appear to be traveling (*e.g.*, feeding, socializing, etc.). These would be the only two potential situations that would require power down of the array for marine mammals observed beyond the 500 m exclusion zone.

Shut Down Procedures

The single 100-in^3 operating airgun would be 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 if (1) an animal enters the 100 m EZ of the single 100-in^3 airgun after a power down has been initiated, or (2) an animal is initially seen within the 100 m EZ of the single 100-in^3 airgun when more than one airgun (typically the full array) is operating. Airgun activity would not resume until the marine mammal has cleared the 500 m EZ. Criteria for judging that the animal has cleared the 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 only applies if the animals are traveling, including approaching the vessel. If animals are stationary and the source vessel approaches the animals, the shutdown requirement would apply. If there is uncertainty regarding identification (*i.e.*, whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, the shutdown would be implemented.

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. 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. Ramp-up would be required after the array is powered down or shut down for any reason.

Ramp-up would begin by activating a single airgun of the smallest volume in the array and would continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration. This approach to ramp-up (increments of array elements) is proposed because it is relatively simple to implement for the operator and is intended to ensure a perceptible increase in sound output per increment while employing increments that produce similar degrees of increase at each step.

If airguns have been powered down or shut down due to PSO detection of a marine mammal within or approaching the 500 m EZ, ramp-up would not be initiated until all marine mammals have cleared the EZ, during the day or night. Visual and acoustic PSOs would be required to monitor during ramp-up. If a marine mammal were detected by visual PSOs within or approaching the 500 m EZ during ramp-up, a power down (or shut down if appropriate) would be implemented as though the full array were operational. Criteria for clearing the EZ would be as described above.

Thirty minutes of pre-clearance observation are required prior to ramp-up for any power down or shutdown of longer than 30 minutes (*i.e.*, if the array were shut down during transit from one line to another). This 30 minute pre-clearance period may occur during any vessel activity (*i.e.*, transit). If a marine mammal were observed within or approaching the 500 m EZ during this pre-clearance period, ramp-up would not be initiated until all marine mammals cleared the EZ. Criteria for clearing the EZ would be as described above. If the airgun array has been shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for a period of less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the buffer zone and no acoustic detections have occurred.

Ramp-up would be planned to occur during periods of good visibility when possible. However, ramp-up would be allowed at night and during poor visibility if the 500 m EZ and 1,000 m buffer zone have been monitored by visual PSOs for 30 minutes prior to ramp-up and if acoustic monitoring has occurred for 30 minutes prior to ramp-up with no acoustic detections during that period.

The operator would be required to notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed. The operator must provide information to PSOs documenting that appropriate procedures were followed. Following deactivation of the array for reasons other than mitigation, the operator would be required to communicate the near-term operational plan to the lead PSO with justification for any planned nighttime ramp-up.

Based on our evaluation of the applicant's proposed measures, NMFS has preliminarily determined that the proposed mitigation measures provide the means effecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth, "requirements pertaining to the monitoring and reporting of such taking." The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of

marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas).

- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors.
- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks.
- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat).
- Mitigation and monitoring effectiveness.

UH submitted a marine mammal monitoring and reporting plan in section XIII of their IHA application. Monitoring that is designed specifically to facilitate mitigation measures, such as monitoring of the EZ to inform potential power downs or shutdowns of the airgun array, are described above and are not repeated here.

UH's monitoring and reporting plan includes the following measures:

Vessel-Based Visual Monitoring

As described above, PSO observations would take place during daytime airgun operations and nighttime start ups (if applicable) of the airguns. During seismic operations, four visual PSOs would be based aboard the *Kairei*. PSOs would be appointed by JAMSTEC with NMFS approval. During the majority of seismic operations, two PSOs would monitor for marine mammals around the seismic vessel. Use of two simultaneous observers would increase the effectiveness of detecting animals around the source vessel. However, during meal times, only one PSO may be on duty. PSOs would be on duty in shifts of duration no longer than 4 hours.

Other crew would also be instructed to assist in detecting marine mammals and in implementing mitigation requirements (if practical). During daytime, PSOs would scan the area around the vessel systematically with reticle binoculars (e.g., 7×50 Fujinon), Big-eye binoculars (25×150), and with the naked eye.

PSOs would record data to estimate the numbers of marine mammals exposed to various received sound levels and to document apparent disturbance reactions or lack thereof. Data would be used to estimate numbers of animals potentially ‘taken’ by harassment (as defined in the MMPA). They would also provide information needed to order a power down or shut down of the airguns when a marine mammal or sea turtle is within or near the EZ.

When a sighting is made, the following information about the sighting would be recorded:

1. 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.), and behavioral pace.

2. Time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare.

All observations and power downs or shutdowns 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. The time, location, heading, speed, activity of the vessel, sea state, visibility, and sun glare would also be recorded at the start and end of each observation watch, and during a watch whenever there is a change in one or more of the variables.

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, which must be reported to NMFS.

3. Data on the occurrence, distribution, and activities of marine mammals and turtles in the area where the seismic study is conducted.

4. Information to compare the distance and distribution of marine mammals and turtles relative to the source vessel at times with and without seismic activity.

5. Data on the behavior and movement patterns of marine mammals and turtles seen at times with and without seismic activity.

Vessel-Based Passive Acoustic Monitoring

PAM would take place to complement the visual monitoring program as described above. Please see the Proposed Mitigation section above for a description of the PAM system and the acoustic PSO's duties. The acoustic PSO would record data collected via the PAM system, including the following: an acoustic encounter identification number, whether it was linked with a visual sighting, date, time when first and last heard and whenever any additional information was recorded, position and water depth when first detected, bearing if determinable, species or species group (e.g., unidentified dolphin, sperm whale), types and nature of sounds heard (e.g., clicks, continuous, sporadic, whistles, creaks, burst pulses, strength of signal, etc.), and any other notable information. Acoustic detections would also be recorded for further analysis.

Reporting

A report would be submitted to NMFS within 90 days after the end of the cruise. The report would describe the operations that were conducted and sightings of marine mammals near the operations. The report would provide full documentation of methods, results, and interpretation pertaining to all monitoring. The 90-day report would summarize the dates and locations of seismic operations, and all marine mammal sightings (dates, times, locations, activities, associated seismic survey activities). The report would also include estimates of the number and nature of exposures that occurred above the harassment threshold based on PSO observations.

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as "an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival" (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, our analysis applies to all the species listed in Table 2, given that NMFS expects the anticipated effects of the proposed seismic survey to be similar in nature. Where there are meaningful differences between species or stocks, or groups of species, in anticipated individual responses to activities, impact of expected take on the population due to differences in population status, or impacts on habitat, NMFS has identified species-specific factors to inform the analysis.

NMFS does not anticipate that serious injury or mortality would occur as a result of UH's proposed seismic survey, even in the absence of proposed mitigation. Thus the proposed authorization does not authorize any mortality. As discussed in the *Potential Effects* section, non-auditory physical effects, stranding, and vessel strike are not expected to occur.

We propose to authorize a limited number of instances of Level A harassment of one marine mammal species (Table 8). However, we believe that any PTS incurred in marine mammals as a result of the proposed activity would be in the form of only a small degree of PTS and not total deafness that would not be likely to affect the fitness of any individuals, because of the constant movement of both the *Kairei* and of the marine mammals in the project area, as well as the fact that the vessel is not expected to remain in any one area in which individual marine mammals would be expected to concentrate for an extended period of time (*i.e.*, since the duration of exposure to loud sounds will be relatively short). Also, as described above, we expect that marine mammals would be likely to move away from a sound source that represents an aversive stimulus, especially at levels that would be expected to result in PTS, given sufficient notice of the *Kairei's* approach due to the vessel's relatively low speed when conducting seismic surveys. We expect that the majority of takes would be in the form of short-term Level B behavioral harassment in the form of temporary avoidance of the area or decreased foraging (if such activity were occurring), reactions that are considered to be of low severity and with no lasting biological consequences (*e.g*., Southall *et al*., 2007).

Potential impacts to marine mammal habitat were discussed previously in this document (see *Potential Effects of the Specified Activity on Marine Mammals and their Habitat*). Marine mammal habitat may be impacted by elevated sound levels, but these impacts would be temporary. Feeding behavior is not likely to be significantly impacted, as marine mammals appear to be less likely to exhibit behavioral reactions or avoidance responses while engaged in feeding activities (Richardson *et al*., 1995). Prey species are mobile and are broadly distributed throughout the project area; therefore, marine mammals that may be temporarily displaced during survey activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise. Because of the temporary nature of the disturbance, the availability of similar habitat and resources in the surrounding area, and the lack of important or unique marine mammal habitat, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations. In addition, there are no mating or calving areas known to be biologically important to marine mammals within the proposed project area.

The activity is expected to impact a very small percentage of all marine mammal stocks that would be affected by UH's proposed survey (less than 2 percent for all marine mammal stocks). Additionally, the acoustic "footprint" of the proposed survey would be very small relative to the ranges of all marine mammals that would potentially be affected. Sound levels would increase in the marine environment in a relatively small area surrounding the vessel compared to the range of the marine mammals within the proposed survey area. The seismic array would be active 24 hours per day throughout the duration of the proposed survey. However, the very brief overall duration of the proposed survey (5.5 days) would further limit potential impacts that may occur as a result of the proposed activity.

The proposed mitigation measures are expected to reduce the number and/or severity of takes by allowing for detection of marine mammals in the vicinity of the vessel by visual and acoustic observers, and by minimizing the severity of any potential exposures via power downs and/or shutdowns of the airgun array. Based on previous monitoring reports for substantially similar activities that have been previously authorized by NMFS, we expect that the proposed mitigation will be effective in preventing at least some extent of potential PTS in marine mammals that may otherwise occur in the absence of the proposed mitigation.

Of the marine mammal species under our jurisdiction that are likely to occur in the project area, the following species are listed as endangered under the ESA: blue, fin, sei, and sperm whales. There are currently insufficient data to determine population trends for blue, fin, sei, and sperm whales (Carretta *et al*., 2016); however, we are proposing to authorize very small numbers of takes for these species (Table 8), relative to their population sizes, therefore we do not expect population-level impacts to any of these species. The other marine mammal species that may be taken by harassment during UH's seismic survey are not listed as threatened or endangered under the ESA. There is no designated critical habitat for any ESA-listed marine mammals within the project area; and of the non-listed marine mammals for which we propose to authorize take, none are considered "depleted" or "strategic" by NMFS under the MMPA.

NMFS concludes that exposures to marine mammal species and stocks due to UH's proposed seismic survey would result in only short-term (temporary and short in duration) effects to individuals exposed. Animals may temporarily avoid the immediate area, but are not expected to permanently abandon the area. Major shifts in habitat use, distribution, or foraging success are not expected. NMFS does not anticipate the proposed take estimates to impact annual rates of recruitment or survival.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from this activity are not expected to adversely affect the marine mammal species or stocks through effects on annual rates of recruitment or survival:

- No mortality is anticipated or authorized;
- The anticipated impacts of the proposed activity on marine mammals would primarily be temporary behavioral changes due to avoidance of the area around the survey vessel. The relatively short duration of the proposed survey (5.5 days) would further limit the potential impacts of any temporary behavioral changes that would occur;
- PTS is only anticipated to occur for one species and the number of instances of PTS that may occur are expected to be very small in number (Table 8). Instances of PTS that are incurred in marine mammals would be of a low level, due to constant movement of the vessel and of the marine mammals in the area, and the nature of the survey design (not concentrated in areas of high marine mammal concentration);
- The availability of alternate areas of similar habitat value for marine mammals to temporarily vacate the survey area during the proposed survey to avoid exposure to sounds from the activity;
- The proposed project area does not contain areas of significance for mating or calving;

- The potential adverse effects on fish or invertebrate species that serve as prey species for marine mammals from the proposed survey would be temporary and spatially limited;
- The proposed mitigation measures, including visual and acoustic monitoring, power-downs, and shutdowns, are expected to minimize potential impacts to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under Section 101(a)(5)(D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers; so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities. Table 8 provides numbers of take by Level A harassment and Level B harassment proposed for authorization. These are the numbers we use for purposes of the small numbers analysis.

The numbers of marine mammals that we propose for authorization to be taken, for all species and stocks, would be considered small relative to the relevant stocks or populations (approximately 13 percent for rough-toothed dolphin, and less than five percent for all other species and stocks). For the blue whale, killer whale, humpback whale, minke whale and spinner dolphin we propose to authorize take resulting from a single exposure of one group of each species or stock, as appropriate (using best available information on mean group size for these species or stocks). We believe that a single incident of take of one group of any of these species represents take of small numbers for that species

Based on the analysis contained herein of the proposed activity (including the proposed mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the population size of the affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has preliminarily determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

Section 7(a)(2) of the Endangered Species Act of 1973 (ESA: 16 U.S.C. § 1531 et seq.) requires that each Federal agency insure 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. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally, in this case with the ESA Interagency Cooperation Division, whenever we propose to authorize take for endangered or threatened species.

The NMFS Permits and Conservation Division is proposing to authorize the incidental take of four species of marine mammals which are listed under the ESA: the sei, fin, blue and sperm whale. We have requested initiation of Section 7 consultation with the Interagency Cooperation Division for the issuance of this IHA. NMFS will conclude the ESA section 7 consultation prior to reaching a determination regarding the proposed issuance of the authorization.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to UH for conducting a seismic survey in the central Pacific Ocean in September, 2017, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. This section contains a draft of the IHA itself. The wording contained in this section is proposed for inclusion in the IHA (if issued).

1. This incidental harassment authorization (IHA) is valid for a period of one year from the date of issuance.

2. This IHA is valid only for marine geophysical survey activity, as specified in the University of Hawaii's (UH) IHA application and using an array aboard the R/V *Kairei* with characteristics specified in the application, in the Central Pacific Ocean.

3. General Conditions

(a) A copy of this IHA must be in the possession of UH, the vessel operator and other relevant personnel, the lead protected species observer (PSO), and any other relevant designees of UH operating under the authority of this IHA.

(b) The species authorized for taking are listed in Table 8. The taking, by Level A and Level B harassment only, is limited to the species and numbers listed in Table 8. Any taking exceeding the authorized amounts listed in Table 8 is prohibited and may result in the modification, suspension, or revocation of this IHA.

(c) The taking by serious injury or death of any species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this IHA.

(d) During use of the airgun(s), if marine mammal species other than those listed in Table 8 are detected by PSOs, the acoustic source must be shut down to avoid unauthorized take.

(e) UH shall ensure that the vessel operator and other relevant vessel personnel are briefed on all responsibilities, communication procedures, marine mammal monitoring protocol, operational procedures, and IHA requirements prior to the start of survey activity, and when relevant new personnel join the survey operations.

4. Mitigation Requirements

The holder of this Authorization is required to implement the following mitigation measures:

(a) UH must use five dedicated, trained, NMFS-approved Protected Species Observers (PSOs), including four visual PSOs and one acoustic PSO. The PSOs must 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 resumes shall be provided to NMFS for approval.

(b) At least two PSOs must have a minimum of 90 days at-sea experience working as PSOs during a deep penetration seismic survey, with no more than eighteen months elapsed since the conclusion of the at-sea experience. At least one of these must have relevant experience as a visual PSO and at least one must have relevant experience as an acoustic PSO. One "experienced" visual PSO shall be designated as the lead for the entire protected species observation team. The lead shall coordinate duty schedules and roles for the PSO team and serve as primary point of contact for the vessel operator. The lead PSO shall devise the duty schedule such that "experienced" PSOs are on duty with those PSOs with appropriate training but who have not yet gained relevant experience, to the maximum extent practicable.

(c) Visual Observation

(i) During survey operations (*e.g.*, any day on which use of the acoustic source is planned to occur; whenever the acoustic source is in the water, whether activated or not), two PSOs must be on duty and conducting visual observations at all times during daylight hours (*i.e.*, from 30 minutes prior to sunrise through 30 minutes following sunset) with the limited exception of meal times during which one PSO may be on duty.

(ii) Visual monitoring must begin not less than 30 minutes prior to ramp-up, including for nighttime ramp-ups of the airgun array, and must continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset.

(iii) Visual PSOs shall coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts and shall conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

(iv) Visual PSOs shall communicate all observations to the acoustic PSO, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(v) Visual PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least one hour between watches and may conduct a maximum of 12 hours observation per 24 hour period.

(vi) During good conditions (*e.g.*, daylight hours; Beaufort sea state 3 or less), visual PSOs shall conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods, to the maximum extent practicable.

(d) Acoustic Observation – The *R/V Kairei* must use a towed passive acoustic monitoring (PAM) system, which must be monitored beginning at least 30 minutes prior to ramp-up and at all times during use of the acoustic source.

(i) One acoustic PSO (in addition to the four visual PSOs) must be on board to operate and oversee PAM operations. Either the acoustic PSO or a visual PSO with training in the PAM system must monitor the PAM system at all times while airguns are operating, and when possible during periods when the airguns are not operating, in shifts lasting no longer than six hours.

(ii) Acoustic PSOs shall communicate all detections to visual PSOs, when visual PSOs are on duty, including any determination by the PSO regarding species identification, distance, and bearing and the degree of confidence in the determination.

(iii) Survey activity may continue for brief periods of time if the PAM system malfunctions or is damaged. Activity may continue for 30 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM system must be repaired to solve the problem, operations may continue for an additional two hours without acoustic monitoring under the following conditions:

(A) Daylight hours and sea state is less than or equal to Beaufort sea state 4;

(B) No marine mammals (excluding small delphinids) detected solely by PAM in the exclusion zone in the previous two hours;

(C) NMFS is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and

(D) Operations with an active acoustic source, but without an operating PAM system, do not exceed a cumulative total of four hours in any 24 hour period.

(e) Exclusion Zone and buffer zone – PSOs shall establish and monitor a 500 m exclusion zone (EZ) and 1,000 m buffer zone. The zones shall be based upon radial distance from any element of the airgun array (rather than being based on the center of the array or around the vessel itself). During use of the acoustic source, occurrence of marine mammals outside the EZ but within 1,000 m from any element of the airgun array shall be communicated to the operator to prepare for potential further mitigation measures as described below. During use of the acoustic source, occurrence of marine mammals within the EZ, or on a course to enter the EZ, shall trigger further mitigation measures as described below.

(i) Ramp-up – A ramp-up procedure, involving 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, is required at all times as part of the activation of the acoustic source. Ramp-up shall begin by activating a single airgun of the smallest volume in the array and shall continue in stages by doubling the number of active elements at the commencement of each stage, with each stage of approximately the same duration.

(ii) If the airgun array has been powered down or shut down due to a marine mammal detection, ramp-up shall not occur until all marine mammals have cleared the EZ. A marine mammal is considered to have cleared the EZ if:

(A) It has been visually observed to have left the EZ

(B) It has not been observed within the EZ, for 15 minutes (in the case of small odontocetes) or for 30 minutes (in the case of mysticetes and large odontocetes including sperm, pygmy sperm, dwarf sperm, and beaked whales).

(iii) Thirty minutes of pre-clearance observation of the 500 m EZ and 1,000 m buffer zone are required prior to ramp-up for any power down or shutdown of longer than 30 minutes. This pre-clearance period may occur during any vessel activity. If any marine mammal (including delphinids) is observed within or approaching the 500 m EZ during the 30 minute pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting the buffer zone or until an additional time period has elapsed with no further sightings (*i.e.*, 15 minutes for small odontocetes and 30 minutes for all other species).

(iv) During ramp-up, PSOs shall monitor the 500 m EZ and 1,000 m buffer zone. Ramp-up may not be initiated if any marine mammal (including delphinids) is observed within or approaching the 500 m EZ. If a marine mammal is observed within or approaching the 500 m EZ during ramp-up, a power down or shutdown shall be implemented as though the full array were operational. Ramp-up may not begin again until the animal(s) has been observed exiting the 500 m EZ or until an additional time period has elapsed with no further sightings (*i.e.*, 15 minutes for small odontocetes and 30 minutes for all other species).

(v) If the airgun array has been shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for a period of less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant visual and acoustic observation and no visual detections of any marine mammal have occurred within the buffer zone and no acoustic detections have occurred.

(vi) Ramp-up shall only occur at night and at times of poor visibility where operational planning cannot reasonably avoid such circumstances. Ramp-up may occur at night and during poor visibility if the 500 m EZ and 1,000 m buffer zone have been continually monitored by visual PSOs for 30 minutes prior to ramp-up with no marine mammal detections and if acoustic monitoring has occurred for 30 minutes prior to ramp-up with no acoustic detections during that period.

(vii) The vessel operator must notify a designated PSO of the planned start of ramp-up as agreed-upon with the lead PSO; the notification time should not be less than 60 minutes prior to the planned ramp-up. A designated PSO must be notified again immediately prior to initiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed.

(f) Power Down Requirements – UH shall power-down the airgun array if a PSO detects a marine mammal within, approaching, or entering the 500 m EZ. A power down involves a decrease in the number of operational airguns. During a power down, one 100-in^3 airgun shall be continuously operated.

(i) Any PSO on duty has the authority to call for power down of the airgun array (visual PSOs on duty should be in agreement on the need for power down before requiring such action). When there is certainty regarding the need for mitigation action on the basis of either visual or acoustic detection alone, the relevant PSO(s) must call for such action immediately.

(ii) When both visual and acoustic PSOs are on duty, all detections must be immediately communicated to the remainder of the on-duty PSO team for potential verification of visual observations by the acoustic PSO or of acoustic detections by visual PSOs and initiation of dialogue as necessary.

(iii) The operator must establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the airgun array to ensure that power down commands are conveyed swiftly while allowing PSOs to maintain watch.

(iv) When power down is called for by a PSO, the power down must occur and any dispute resolved only following power down.

(v) The power down requirement is waived for dolphins of the following genera: *Steno*, *Tursiops*, *Stenella* and *Lagenodelphis*. The power down waiver only applies if animals are traveling, including approaching the vessel. If animals are stationary and the vessel approaches the animals, the power down requirement applies. If there is uncertainty regarding identification (*i.e.*, whether the observed animal(s) belongs to the group described above) or whether the animals are traveling, power down must be implemented.

(vi) Upon implementation of a power down, the source may be reactivated under the conditions described at 4(e)(vi). Where there is no relevant zone (*e.g.*, shutdown due to observation of a calf), a 30-minute clearance period must be observed following the last observation of the animal(s).

(vii) Power down of the acoustic source is required upon observation of a whale (*i.e.*, sperm whale or any baleen whale) with calf at any distance, with "calf" defined as an animal less than two-thirds the body size of an adult observed to be in close association with an adult.

(viii) Power down of the acoustic source is required upon observation of an aggregation (*i.e.*, six or more animals) of large whales of any species (*i.e.*, sperm whale or any baleen whale) that does not appear to be traveling (*e.g.*, feeding, socializing, etc.).

(ix) When only the acoustic PSO is on duty and a detection is made, if there is uncertainty regarding species identification or distance to the vocalizing animal(s), the airgun array must be powered down as a precaution.

(g) Shutdown requirements – An exclusion zone of 100 m for the single 100-in^3 airgun shall be established and monitored by PSOs. If a marine mammal is observed within, entering, or approaching the 100 m exclusion zone for the single 100-in^3 airgun, whether during implementation of a power down or during operation of the full airgun array, all airguns including the 100-in^3 airgun shall be shut down.

(i) Upon implementation of a shutdown, the source may be reactivated under the conditions described at 4(e).

(ii) Measures described for power downs under 4(f)(i-v) shall also apply in the case of a shutdown.

(h) Vessel Strike Avoidance – Vessel operator and crew must maintain a vigilant watch for all marine mammals and slow down or stop the vessel or alter course, as appropriate, to avoid striking any marine mammal. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel according to the parameters stated below. Visual observers monitoring the vessel strike avoidance zone can be either third-party observers or crew members, but crew members responsible for these duties must be provided sufficient training to distinguish marine mammals from other phenomena.

(i) The vessel must maintain a minimum separation distance of 100 m from large whales. The following avoidance measures must be taken if a large whale is within 100 m of the vessel:

(A) The vessel must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved outside of the vessel's path and the minimum separation distance has been established.

(B) If the vessel is stationary, the vessel must not engage engines until the whale(s) has moved out of the vessel's path and beyond 100 m.

(ii) The vessel must maintain a minimum separation distance of 50 m from all other marine mammals, with an exception made for animals described in 4(g)(v) that approach the vessel. If an animal is encountered during transit, the vessel shall attempt to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in course.

(iii) Vessel speeds must be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near the vessel.

(i) Miscellaneous Protocols

(i) The airgun array must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Unnecessary use of the acoustic source shall be avoided. Notified operational capacity (not including redundant backup airguns) must not be exceeded during the survey, except where unavoidable for source testing and calibration purposes. All occasions where activated source volume exceeds notified operational capacity must be noticed to the PSO(s) on duty and fully documented. The lead PSO must be granted access to relevant instrumentation documenting acoustic source power and/or operational volume.

(ii) Testing of the acoustic source involving all elements requires normal mitigation protocols (*e.g.*, ramp-up). Testing limited to individual source elements or strings does not require ramp-up but does require pre-clearance.

5. Monitoring Requirements

The holder of this Authorization is required to conduct marine mammal monitoring during survey activity. Monitoring shall be conducted in accordance with the following requirements:

(a) The operator must provide bigeye binoculars (*e.g.*, 25 x 150; 2.7 view angle; individual ocular focus; height control) of appropriate quality (*i.e.*, Fujinon or equivalent) solely for PSO use. These shall be pedestal-mounted on the deck at the most appropriate vantage point that provides for optimal sea surface observation, PSO safety, and safe operation of the vessel. The operator must also provide a night-vision device suited for the marine environment for use during nighttime ramp-up pre-clearance, at the discretion of the PSOs. At minimum, the device should feature automatic brightness and gain control, bright light protection, infrared illumination, and optics suited for low-light situations.

(b) PSOs must also be equipped with reticle binoculars (*e.g.*, 7 x 50) of appropriate quality (*i.e.*, Fujinon or equivalent), GPS, digital single-lens reflex camera of appropriate quality (*i.e.*, Canon or equivalent), compass, and any other tools necessary to adequately perform necessary tasks, including accurate determination of distance and bearing to observed marine mammals.

(c) PSO Qualifications

(i) PSOs must have successfully completed relevant training, including completion of all required coursework and passing a written and/or oral examination developed for the training program.

(ii) PSOs must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences and a minimum of 30 semester hours or equivalent in the biological sciences and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO has acquired the relevant skills through alternate experience. Requests for such a waiver must include written justification. Alternate experience that may be considered includes, but is not limited to (1) secondary education and/or experience comparable to PSO duties; (2) previous work experience conducting academic, commercial, or government-sponsored marine mammal surveys; or (3) previous work experience as a PSO; the PSO should demonstrate good standing and consistently good performance of PSO duties.

(d) Data Collection – PSOs must use standardized data forms, whether hard copy or electronic. PSOs shall record detailed information about any implementation of mitigation requirements, including the distance of animals to the acoustic source and description of specific actions that ensued, the behavior of the animal(s), any observed changes in behavior before and after implementation of mitigation, and if shutdown was implemented, the length of time before any subsequent ramp-up of the acoustic source to resume survey. If required mitigation was not implemented, PSOs should submit a description of the circumstances. We require that, at a minimum, the following information be reported:

(i) PSO names and affiliations

(ii) Dates of departures and returns to port with port name

(iii) Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort

(iv) Vessel location (latitude/longitude) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts

(v) Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change

(vi) Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort sea state, Beaufort wind force, swell height, weather conditions, cloud cover, sun glare, and overall visibility to the horizon

(vii) Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.*, vessel traffic, equipment malfunctions)

(viii) Survey activity information, such as acoustic source power output while in operation, number and volume of airguns operating in the array, tow depth of the array, and any other notes of significance (*i.e.*, pre-ramp-up survey, ramp-up, shutdown, testing, shooting, ramp-up completion, end of operations, streamers, etc.)

(ix) If a marine mammal is sighted, the following information should be recorded:

(A) Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform)

(B) PSO who sighted the animal

(C) Time of sighting

(D) Vessel location at time of sighting

(E) Water depth

(F) Direction of vessel's travel (compass direction)

(G) Direction of animal's travel relative to the vessel

(H) Pace of the animal

(I) Estimated distance to the animal and its heading relative to vessel at initial sighting

(J) Identification of the animal (*e.g.*, genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species

(K) Estimated number of animals (high/low/best)

(L) Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.)

(M) Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics)

(N) Detailed behavior observations (*e.g.*, number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior)

(O) Animal's closest point of approach (CPA) and/or closest distance from the center point of the acoustic source;

(P) Platform activity at time of sighting (*e.g.*, deploying, recovering, testing, shooting, data acquisition, other)

(Q) Description of any actions implemented in response to the sighting (*e.g.*, delays, shutdown, ramp-up, speed or course alteration, etc.); time and location of the action should also be recorded

(x) If a marine mammal is detected while using the PAM system, the following information should be recorded:

(A) An acoustic encounter identification number, and whether the detection was linked with a visual sighting

(B) Time when first and last heard

(C) Types and nature of sounds heard (*e.g.*, clicks, whistles, creaks, burst pulses, continuous, sporadic, strength of signal, etc.)

(D) Any additional information recorded such as water depth of the hydrophone array, bearing of the animal to the vessel (if determinable), species or taxonomic group (if determinable), and any other notable information.

6. Reporting

(a) UH shall submit a draft comprehensive report on all activities and monitoring results within 90 days of the completion of the survey or expiration of the IHA, whichever comes sooner. The report must describe all activities conducted and sightings of marine mammals near the activities, must provide full documentation of methods, results, and interpretation pertaining to all monitoring, and must summarize the dates and locations of survey operations and all marine mammal sightings (dates, times, locations, activities, associated survey activities).

Geospatial data regarding locations where the acoustic source was used must be provided as an ESRI shapefile with all necessary files and appropriate metadata. In addition to the report, all raw observational data shall be made available to NMFS. The report must summarize the data collected as required under condition 5(d) of this IHA. The draft report must be accompanied by a certification from the lead PSO as to the accuracy of the report, and the lead PSO may submit directly to NMFS a statement concerning implementation and effectiveness of the required mitigation and monitoring. A final report must be submitted within 30 days following resolution of any comments from NMFS on the draft report.

(b) Reporting injured or dead marine mammals:

(i) In the event that the specified activity clearly causes the take of a marine mammal in a manner not prohibited by this IHA (if issued), such as serious injury or mortality, UH shall immediately cease the specified activities and immediately report the incident to NMFS. The report must include the following information:

(A) Time, date, and location (latitude/longitude) of the incident;

(B) Vessel's speed during and leading up to the incident;

(C) Description of the incident;

(D) Status of all sound source use in the 24 hours preceding the incident;

(E) Water depth;

(F) Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, and visibility);

(G) Description of all marine mammal observations in the 24 hours preceding the incident;

(H) Species identification or description of the animal(s) involved;

(I) Fate of the animal(s); and

(J) Photographs or video footage of the animal(s).

Activities shall not resume until NMFS is able to review the circumstances of the prohibited take. NMFS will work with UH to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. UH may not resume their activities until notified by NMFS.

(ii) In the event that UH discovers an injured or dead marine mammal, and the lead observer determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.*, in less than a moderate state of decomposition), UH shall immediately report the incident to NMFS. The report must include the same information identified in condition 6(b)(i) of this IHA. Activities may continue while NMFS reviews the circumstances of the incident. NMFS will work with UH to determine whether additional mitigation measures or modifications to the activities are appropriate.

(iii) In the event that UH discovers an injured or dead marine mammal, and the lead observer determines that the injury or death is not associated with or related to the specified activities (*e.g.*, previously wounded animal, carcass with moderate to advanced decomposition, or scavenger damage), UH shall report the incident to NMFS within 24 hours of the discovery. UH shall provide photographs or video footage or other documentation of the sighting to NMFS.

7. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein, or if NMFS determines the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals.

Request for Public Comments

We request comment on our analyses, the draft authorization, and any other aspect of this Notice of Proposed IHA for the proposed seismic survey by UH. Please include with your comments any supporting data or literature citations to help inform our final decision on the request for MMPA authorization.

Dated: July 19, 2017.

Catherine Marzin,

Acting Deputy Director, Office of Protected Resources,

National Marine Fisheries Service.

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