UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

AUG 18 2017

Refer to NMFS No.: FPR-2016-9160

Memorandum For: Jolie Harrison
Chief, Permits and Conservation Division

From: Cathryn E. Tortorici
Chief, Endangered Species Act Interagency Cooperation Division

Subject: Biological Opinion on the U.S. Air Force's 2017-2021 Long Range Strike Weapons Systems Evaluation Program offshore of Kauai, Hawaii, Pursuant to Section 7 of the Endangered Species Act of 1973

Enclosed is the National Marine Fisheries Service's (NMFS) biological opinion on the effects of the U.S. Air Force's 2017-2021 Long Range Strike Weapons Systems Evaluation Program on endangered and threatened species under NMFS's jurisdiction and critical habitat that has been designated for those species. We have prepared the biological opinion pursuant to section 7(a)(2) of the Endangered Species Act, as amended (ESA; 16 U.S.C. 1536(a)(2)).

Based on our assessment, we concluded that the proposed action is likely to adversely affect , but not likely to jeopardize the continued existence of ESA-listed as endangered sei whales, endangered leatherback sea turtles, or endangered North Pacific Ocean logger head sea turtles.

This biological opinion concludes formal consultation for the U.S. Air Force's 2017-2021 Long Range Strike Weapons Systems Evaluation Program. Consultation on this issue must be reinitiated if: (1) the amount or extent of allowable take is exceeded for the identified action; (2) new information reveals effects of this action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this consultation; or (4) a new species is listed or critical habitat designated that may be affected by the action.

If you have any questions regarding this biological opinion, please contact Cathryn E. Tortorici at 301-427-8495 or cathy.tortorici@noaa.gov.

NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 BIOLOGICAL OPINION

Action Agencies: United States Air Force and NOAA's National Marine Fisheries Service, Office of Protected Resources' Permits and Conservation Division

Activity Considered: (1) The Long Range Strike Weapon Systems Evaluation Program conducted by the United States Air Force in the Barking Sands Underwater Range Expansion area of the Pacific Missile Range Facility off of the western shores of the island of Kauai during 2017-2021; and

(2) the National Marine Fisheries Services' promulgation of regulations pursuant to the Marine Mammal Protection Act for the United States Air Force to "take" marine mammals incidental to Long Range Strike Weapons Systems Evaluation Program activities from August 23, 2017 through August 22, 2021; and

(3) the National Marine Fisheries Services' issuance of a Letter of Authorization to the Navy pursuant to regulations under the Marine Mammal Protection Act to "take" marine mammals incidental to the Long Range Strike Weapons Systems Evaluation Program activities from August 23, 2017 through August 22, 2021.

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service.

Approved:

Donna S. Wieting
Director, Office of Protected Resources

Date: 8/18/17

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1 INTRODUCTION

The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with National Marine Fisheries Service (NMFS) the United States Fish and Wildlife Service (USFWS) or both (the Services), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action. If a Federal agency's action may affect a listed species or designated critical habitat, the agency must consult with NMFS, USFWS, or both (50 CFR §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS, the USFWS, or both concur with that determination, consultation concludes informally (50 CFR §402.14(b)).

Section 7 (b)(3) of the ESA requires that at the conclusion of consultation, NMFS and/or USFWS provide an opinion stating how the Federal agencies' actions will affect ESA-listed species and their critical habitat under their jurisdiction. If an incidental take is expected, section 7 (b)(4) requires the consulting agency to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts.

For the actions described in this document, the action agency is the United States Air Force (U.S. Air Force), which proposes to conduct operational evaluations of live ordnance deployment (long range strike weapons and other munitions) off of the island of Kauai, Hawaii. The consulting agency for this proposal is NMFS Office of Protected Resources, ESA Interagency Cooperation Division.

The biological opinion (opinion) and incidental take statement were prepared by NMFS ESA Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR §402. This document represents NMFS's opinion on the effects of these actions on endangered and threatened species and critical habitat that has been designated for those species. A complete record of this consultation is on file at NMFS Office of Protected Resources in Silver Spring, Maryland.

1.1 Background

This opinion is based on information provided by the U.S. Air Force during the previous formal consultation concluded in 2016 for similar activities (NMFS 2016), a biological assessment (USAF 2016), including supplemental material provided in 2017. The U.S. Air Force proposes to conduct operational evaluations of live long range strike weapons and other munitions in the Barking Sands Underwater Range Expansion (BSURE) area of the Pacific Missile Range

Facility (PMRF) in Hawaii off of the western shores of the island of Kauai. Munitions will be deployed from aircraft. Activities are expected to occur from August 23, 2017 through August 22, 2021. The U.S. Air Force conducted these activities in the PMRF in 2016, and similar activities (i.e., use of explosive ordnance) are conducted on a regular basis in the PMRF by the United States Navy (U.S. Navy).

1.2 Consultation History

On February 29, 2016, NMFS Office of Protected Resources ESA Interagency Cooperation Division received a preliminary draft Environmental Assessment (EA) from the U.S. Air Force on their proposed operational evaluations of live long range strike weapons and other munitions in the BSURE area of the PMRF.

On April 11, 2016, NMFS received updated preliminary documents including marine mammal density estimates, an acoustic modeling appendix, and a marine mammal take summary table.

On April 14, 2016, NMFS provided a recommendation to the U.S. Air Force for the appropriate threshold to use for behavioral harassment of sea turtles.

On June 16, 2016, NMFS received a request for formal consultation pursuant to section 7 of the ESA on proposed Long Range Strike Weapons Systems Evaluation Program (WSEP) operational evaluations to be conducted in the BSURE area on the west coast of the island of Kauai, Hawaii from 2016 through 2021. The request for formal consultation included a biological assessment (BA) of the proposed action.

By letter dated, July 1, 2016, following initial review of the U.S. Air Force's request for formal consultation, NMFS determined there was sufficient information to initiate formal consultation. However, we indicated that we would not be able to complete a formal programmatic consultation on all of the Long Range Strike Weapon Systems Evaluation Program mission activities proposed by the U.S. Air Force (i.e., activities from 2016 through 2021) before September 1, 2016, (i.e., the date 2016 activities were scheduled to commence). Through discussions with the U.S. Air Force, agreement was reached to conduct a consultation on activities proposed in 2016, which are smaller in scope than the activities that will start in 2017; and an additional consultation would be completed at a later date for the activities anticipated to occur from 2017 through 2021.

On August 24, 2016, the U.S. Air Force informed NMFS that the proposed mission for 2016 would not occur in September as originally planned but would be postponed until October 20, 2016, with October 21, 2016 as a back-up date. Due to this change in the proposed action, NMFS informed the U.S. Air Force that we would not complete our biological opinion until the end of September 2016.

On August 30, 2016, the U.S. Air Force submitted an amendment to the Long Range Strike WSEP mission BA (originally submitted June 16, 2016) requesting for NMFS to remove

humpback whales from consideration in both of the consultations if a final rule was issued which revised the listing status of humpback whales (80 FR 22304).

On September 8, 2016 NMFS published a final rule to revise the listing status of the humpback whale under the ESA (81 FR 62259). Consistent with the proposed rule (80 FR 22304), humpback whales from the Hawaii Distinct Population Segment (DPS) are no longer listed under the ESA and were not considered in the 2016 biological opinion.

On September 28, 2016, NMFS issued a biological opinion for the Long Range Strike WSEP mission activities conducted in 2016.

On April 10, 2017, NMFS ESA Interagency Cooperation Division received a request from NMFS Permits and Conservation Division for ESA section 7 consultation on the proposed issuance of an Incidental Harassment Authorization to take marine mammals during implementation of the U.S. Air Force Long Range Strike WSEP in the BSURE waters of the Pacific Missile Range Facility along the coast of Kauai, Hawaii.

On June 27, 2017, the U.S. Air Force provided the NMFS Permits and Conservation Division staff new data regarding a reduction in proposed live munitions to be deployed as well as a reduction for the anticipated number of annual marine mammal takes. The NMFS Permits and Conservation Division provided this information to NMFS ESA Interagency Cooperation Division on July 6, 2017 via electronic mail (email).

On July 20, 2017, the U.S. Air Force provided the NMFS ESA Interagency Cooperation Division with updated daily and annual abundance estimates for marine mammals and sea turtles based upon a reduction in the proposed live munitions expected to be deployed annually.

On July 21, 2017, the U.S. Navy provided NMFS and the U.S. Air Force with a memorandum regarding new sea turtle relative abundance estimates for the action area. This new approach differs from the one used our analyses in the 2016 biological opinion for the Long Range Strike WSEP and the information provided on the 2016 BA for the program. Due to this change, NMFS informed the U.S. Air Force via phone conversation on July 24, 2017, that we would have to recalculate our take estimates for sea turtles for the 2017-2021 proposed actions.

2 DESCRIPTION OF THE PROPOSED ACTION

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies.

The U.S. Air Force proposes to conduct air-to-surface missions which include the deployment of live, long range strike weapons and other munitions (e.g., bombs and missiles) off of the western coast of Kauai, Hawaii from August 23, 2017 through August 22, 2021. The long range strike weapons systems and other munitions would be carried out by the 86th Fighter Weapons Squadron (86 FWS) of the U.S. Air Force. The U.S. Air Force will conduct the mission in the BSURE area of the PMRF. The PMRF is part of the U.S. Navy's Hawaii Range Complex (HRC)

and was chosen because it supports the full range of tasks for the proposed action. The impact area (see Figure 2) will be approximately 44 nautical miles (nm [81 kilometers]) offshore of Kauai, Hawaii in a water depth of approximately 4,645 meters (m [15,240 feet]). There will not be any ground-based or nearshore activities requiring the use of any shoreline in Kauai. Missions will occur primarily during the summer, but may also occur in the fall. Missions will only occur during weekdays and be conducted during daylight hours. Missions will occur on average over four consecutive days per year (five days total; four actual mission days and one day reserved for any weather delays).

The objectives of the program are to evaluate air-to-surface and maritime employment data, evaluate tactics, techniques, and procedures in an operationally realistic environment in order to determine the impact of tactics, techniques and procedures on combat U.S. Air Force training. The munitions associated with the proposed activities are not part of a typical unit's training, therefore the proposed action is considered a military readiness activity and will provide an opportunity for squadrons to receive operational training and evaluation of their ability to effectively execute scenarios that resemble realistic operations during wartime before their actual deployment. The ordnance may be delivered by bombers and fighter aircraft and will detonate and be scored above, at, or just below the surface of the water in the BSURE area. Weapon performance will be evaluated using underwater acoustic hydrophone arrays. More specific details for each munition-type deployment are described below.

2.1 Aircraft Operations

The aircraft used for the proposed action may include bombers and fighter aircraft for the purpose of releasing weapons and range clearance, and the P-3 Orion or the P-8 Poseidon to relay telemetry and flight termination system streams between weapon and ground stations. There will also be support aircraft available for range clearance activities and air-to-air refueling before and during the mission. All aircraft associated with releasing weapons would originate from an out base (i.e., Ellsworth U.S. Air Force Base [AFB], Dyess AFB, Barksdale AFB, Whiteman AFB, Minot AFB, Mountain Home AFB, Nellis AFB, Hill AFB, JB Hickam-Pearl Harbor, JB Elmendorf-Richardson, or JB Langley-Eustis) and fly into military controlled airspace prior to each mission. Due to the long transit times between the out bases and the action area, air-to-air refueling of weapon delivery aircraft may be conducted. An operational flight for each aircraft deploying a munition would consist of delivering the weapons, conducting air-to-air refueling, and returning to their base of origin. Multiple weapon-release aircraft would be used during the mission. All aircraft flight maneuver operations and weapon releases would occur within Warning Area 188A (W-188A), located offshore of Kauai. The aircraft supporting the mission within the warning area would generally fly below 3,000 feet (ft.) for enough time to escort non-military vessels outside of the action area or to monitor the action area for marine protected species (see Section 2.4 for range clearance procedures).

2.2 Long Range Strike Munitions

The proposed program will evaluate the release of live (explosive) and inert (non-explosive) long range strike weapons and other munitions. The mission would release different amounts annually, over the course of four days each year (see Table 1 below). Net explosive weight (NEW) of the live munitions range from 23-300 pounds (lbs). A description of the specific munitions used for the Long Range Strike WSEP mission is provided in the following subsections.

2.2.1 Joint Air-to-Surface Stand-off Missile/Joint Air-to-Surface Stand-off Missile-Extended Range

The Joint Air-to-Surface Stand-off Missile (JASSM) is a precision cruise missile with a range of more than 200 nm (370 kilometers [km]) and the capability to fly a preprogrammed route from launch to a target. It carries a 1,000-pound warhead with approximately 300 pounds of TNT-equivalent net explosive weight. The type of explosive used for the JASSM is AFX-757, which is a type of plastic-bonded explosive. The Joint Air-to-Surface Stand-off Missile Extended Range (JASSM-ER) has additional fuel and a different engine for a greater range than the JASSM (500 nm [926 km]), but it functions the same way as the JASSM.

2.2.2 Small Diameter Bomb-I/II

The Small Diameter Bomb-I (SDB-I) is a 250-pound air-launched guided weapon with Global Positioning System (GPS) technology and an Internal Navigation System (INS). The SDB-II expands the SDB-I capability with network enabling and uses a tri-mode infrared sensor, millimeter, and semi-active laser to attack both fixed and moveable targets. Both munitions have a range of up to 60 nm (111 km) and use AFX-757. The SDB-I contain 37 pounds of 2,4,6-trinitrotoluene (TNT) equivalent net explosive weight (NEW). The SDB-II contains 23 lbs. NEW.

2.2.3 High Speed Anti-Radiation Missile

The High Speed Anti-Radiation Missile (HARM) is a supersonic air-to-surface missile designed to seek and destroy enemy radar equipped air defense systems. The HARM is a proportional guidance system that homes in on enemy radar emissions through fixed antenna and a seeker head in the missile nose. The HARM has a range of up to 80 nm (148 km) and contains 45 lbs. of TNT-equivalent NEW. The specific explosive used is PBXN-107.

2.2.4 Joint Attack Munition/Laser Joint Direct Attack Munition

The Joint Attack Munition/Laser Joint Direct Attack Munition (JDAM/LJDAM) is a smart GPS-INS weapon that is a precision guided munition consisting of an unguided gravity bomb and a guidance and control kit. The LJDAM is a variant with a laser sensor to guide the JDAM to a laser designated target. Both JDAM and LJDAM contain 192 lbs. of TNT-equivalent NEW with

multiple fusing options that can detonate upon impact or with up to a 10-millisecond delay.

2.2.5 Miniature Air Launched Decoy/Miniature Air Launched Decoy Jamming

The Miniature Air Launched Decoy (MALD/MALD-J) is an air-launched, expendable decoy that provides the U.S. Air Force with the capability to simulate, deceive, decoy and saturate an enemy's threat integrated air defense system (IADS). The MALD-J has the same function but it also is capable of jamming IADS. Both have ranges up to 500 nm (926 km), including a 200 nm (370 km) dash with a 30-minute loiter mode. The MALD/MALD-J have no warheads and therefore no detonation upon water impact.

Table 1. Number of Proposed Live Weapons Releases

Type of Munition	NEW (lb)	Detonation Scenario	Number of Proposed Live Weapon Releases					
			2017	2018	2019	2020	2021	5-year Total
JASSM/ JASSM-ER	300	Surface	0	2	4	4	4	14
SDB-I	37	Surface	8	14	14	14	14	64
SDB-II	23	Surface	0	0	10	16	20	46
HARM	45	Surface	0	6	6	10	10	32
JDAM/LJDAM	192	Subsurface[1]	0	16	16	16	16	64
MALD/MALD-J**	N/A	N/A	4	4	4	4	4	20
ANNUAL TOTAL			**8**	**38**	**50**	**60**	**64**	**220**

JASSM/JASSM-ER = Joint Air-to-Surface Stand-off Missile/Joint Air-to-Surface Stand-Off Missile-Extended Range; SDB-I/II = Small Diameter Bomb-I/II; HARM = High Anti-radiation Missiles; JDAM/LJDAM = Joint Attack Munition/Laser Joint Direct Attack Munition; MALD/MALD-J = Miniature Air Launched Decoy/Miniature Air Launched Decoy Jamming; ** The MALD/MALD- J are inert and not included in the totals for live munitions; [1)] Assumes a 10-millisecond time-delayed fuse resulting in detonation at an approximate 10-foot water depth (USAF 2016).

2.2.6 Gunnery Rounds and Targets

The 86 FWS wills use targets and 20-mm gunnery rounds during their to their Long Range Strike WSEP operations at PMRF. A maximum of eight target boats are proposed for use each year and would consist of either a sinkable aluminum pontoon boat or a recoverable semi-rigid inflatable boat. A maximum of 5,000 20-mm rounds are also being requested. The targets will be towed by either a remotely controlled boat or by a manned boat. Once all weapons are released, if a sinkable target is used, the U.S. Air Force will sink the boat in place. If a recoverable target is used, the inflatable boat will be towed back to shore by a remotely-controlled or manned boat. The U.S. Air Force expects for most of the targets to be recovered in order to evaluate the accuracy of hitting the determined target point. Only inert weapons would be employed against the target to minimize the potential for fragmentation and creation of marine debris.

2.3 Schedule and Mission Procedures

The evaluation of live long range strike weapons and other munitions is scheduled for August 23, 2017 through August 22, 2021. Releases of live ordinances would result in airbursts, surface, or subsurface detonations (within 10 ft. depth). Up to four SDB-I/II munitions could be released simultaneously with water surface detonations a few seconds apart. Aside from these releases, all other munitions would be released separately, impacting the water surface at different intervals. There will be a total of five mission days per year (four days with weapons deployment and one reserved in the event of a delay).

The mission day would involve pre-mission checks, safety review, crew briefing, weather checks, clearing airspace, range clearance, minimization/monitoring efforts, and other military protocols prior to the launch of weapons. These standard operating procedures usually occur in the morning and live range time may begin in the late morning once all checks are complete and approval is granted from range control. On the day of the mission, the range would be closed to the public for a maximum of four hours. There are several possible factors that could cause a mission delay including, but not limited to, adverse weather conditions leading to unsafe take-off, landing, and aircraft operations; inability to clear the range of non-mission vessels or aircraft; mechanical issues with mission aircraft or munitions; or presence of marine protected species in the impact area.

Long range strike weapons would complete their maximum flight range at an altitude of approximately 18,000 ft. (5,486 m) above mean sea level and terminate at a specified location. The cruise time would vary between munitions but would be at least 45 minutes for JASSM/JASSM-ER, and approximately ten minutes for SDB-I/IIs. Although the time between successive munitions deployment may vary slightly, they could be spaced by approximately one hour to account for the JASSM cruise time. The routes and associated safety profiles would be contained within W-188A boundaries. The JDAM/LJDAM munitions would also be set to impact at the same point on the water surface.

All aspects of the mission would follow applicable flight safety, hazard, and launch parameter requirements established for PMRF. A weapon hazard area would be established, with the size and shape of the area determined by the maximum distance a weapon could travel in any direction during its descent. This hazard area is usually adjusted for potential wind speed and direction, which allows for the maximum composite safety area for the mission (each safety area boundary is at least ten nautical miles from the Kauai coastline). This information will be used to establish a Launch Exclusion Area and Aircraft Hazard Area. These exclusion areas must be verified to be clear of all non-mission and non-essential vessels and aircraft before live weapons are released. Prior to the release of a weapon, a range sweep of the hazard area would be conducted by other aircraft involved in the mission, potentially including S-61N helicopter, C-26 aircraft, fighter aircraft (F-15E, F-16, F-22), or the Coast Guard's C-130 aircraft. Due to the presumably large safety area associated with the mission, it is unlikely that smaller vessels would be able to clear the necessary areas; thus, range clearing activities would be conducted solely by aircraft.

2.4 Minimization Measures, Monitoring, and Reporting

In order to avoid or minimize the risk to protected marine species associated with explosive ordnance detonations, a series of minimization measures will be implemented for each mission. Passive acoustic monitoring and aerial surveys of the impact areas will be conducted before, during, and after each mission to determine the presence of marine mammals and sea turtles. The U.S. Air Force has partnered with the Space and Naval Warfare Systems Center, Pacific Detection, Classification and Localization Lab to obtain passive acoustic data recordings from 62 hydrophones before and after each mission event. Data will be collected approximately 44 hours before each mission, up to eight hours during the day of the mission, and after each event for an additional 44 hours.

The Aircraft used for the surveys may consist of jet aircraft such as F-15, F-16, A-10, and bombers such as B-1 and B-52s. Each Long Range Strike WSEP will use varying types of mission aircraft and also use additional surveillance aircraft such as a C-26 or helicopters to help clear the human safety zones. Because the human safety and mission monitoring zones (8 mile zone) are typically much larger than the zone of acoustic effects affecting marine species, the surveys for marine mammals will be conducted concurrent with the clearing of the human safety zones. A specific marine mammal exclusion zone of 2.3 miles is encompassed in the larger mission safety zones. During the visual surveys, mission personnel will use visual look-outs. Additionally, some of the aircraft will be equipped with special sensors that can be used to detect animals and help supplement the visual surveys. These specialized sensors are advanced targeting pods such as SNIPER or LITENING (USAF 2017a). These are frequently used by aircrew to track and identify targets through the use of high-definition forward looking infrared (FLIR) and television modes which provide real-time images to the crew in the cockpit. The U.S. Air Force proposes to use this technology to identify thermal signatures of marine animals located at or near the surface of the water. The following sections describe the specific procedures that will be implemented before, during, and after Long Range Strike WSEP missions (USAF 2017b).

The primary means of mitigating for impacts to marine animals is mission delay if an animal is observed within the 2.3 mile exclusion zone. For the 2017-2021 missions, the exclusion zone extends 2.3 miles from the edge of the weapon impact area for all species. If a marine animal is sighted within 2.3 miles of the weapon target location, missions will be delayed. This exclusion zone will avoid any mortality or tissue damage, avoid PTS and TTS for sei whales (and reduce the potential for these effects on other marine mammal species not covered in this opinion).

The U. S. Air Force has also committed to delaying deployment of munitions if an animal is sighted anywhere within the 8 mile (13 km) monitoring area (see Monitoring and Reporting section below). However, delaying missions until an animal leaves the entire monitoring area may not be practicable or necessarily warranted because of the transit time it may take for an animal to leave the area. In these cases, the U.S. Air Force will relocate the detonation site to the farthest area possible from the sighting. The target sight will be shifted away from an animal

sighting, to the farthest distance possible from the sighting but is still confined to the two-mile wide weapon impact area.

2.4.1 Pre-Mission Procedures

- Passive Acoustic Monitoring (44 hours prior to a mission).
- At least 30 minutes prior to a planned weapon release, survey aircraft will arrive at the mission location and prepare for deployment. Personnel will be provided with the GPS coordinates of the impact location.
- If adverse weather conditions impair the ability of aircraft to operate safely, missions will either be delayed until the weather clears or cancelled for the day.
- Aerial surveys of the impact area will be conducted by searching the water surface for the presence of marine mammals and sea turtles. These surveys will be conducted from mission aircraft operating at minimum safe altitudes and airspeeds (from 1,000 to 25,000 ft. at approximately 300 knots) for circling directly over the survey area.
- The aerial survey area will encompass an 8 mile (13 km) radius around the planned detonation point. A specific marine mammal exclusion zone will encompass an area of 2.3 miles within the larger monitoring zone.
- Visual monitoring from aerial surveys will last for 30 minutes. Aircrew will visually scan the water surface of the survey area in a closely-spaced line-transect pattern using dedicated lookouts and the aircraft's targeting pods.
- Supplemental visual monitoring will be conducted by other range assets, such as camera's located along Makaha Ridge (where the PMRF has facilities used for surveillance), if available.
- If mission aircraft are unable to conduct the pre-mission surveys, a helicopter will be used for the aerial surveys.
- Any marine mammal or sea turtle sighting information will be documented. If a protected species is observed in the survey area, the following steps will be taken:
    - If a protected species is observed from the cameras at Makaha Ridge, PMRF mission personnel will communicate the sighting to the Project Engineer and the information will be relayed to mission aircraft conducting the aerial survey for confirmation.
    - Survey aircraft will visually confirm the location of the sighting, and sighting information will be documented.
    - If an animal is observed, weapon release will be delayed until one of the following conditions is met:
        - The animal(s) is observed exiting the exclusion area.

- The observed animal has not been re-sighted after 30 minutes and is thought to have exited the survey area based on its speed and transit direction.
- The survey area has been clear of any additional sightings for a period of 30 minutes.
- If a mission delay is not possible, the target impact area will be shifted the furthest possible distance from the animal to maintain the 2.3 mile exclusion zone.

2.4.2 Procedures During the Mission

- Passive Acoustic Monitoring (up to eight hours during the day of each event)
- Weapon-releasing aircraft will conduct one final visual and targeting pod check of the target/impact area before employing the weapon
- Chase aircraft will continue to visually monitor the survey area for the duration of the mission
- All weapon releases will be tracked, and their water entry points will be documented.
- If a protected marine species is observed during the mission, the following steps will be taken:
  - All weapon releases will cease immediately.
  - Sighting information will be reported to PMRF mission personnel and documented.

2.4.3 Post-Mission Procedures

- Passive Acoustic Monitoring (approximately 44 hours post each mission)
- Using the weapon impact point as a reference, post-mission visual surveys will begin immediately after the mission is complete.
- Post-mission surveys will be conducted from the mission aircraft and will follow the same survey pattern as pre-mission surveys but will focus on the area down current of the impact point.
- Aircrew lookouts will scan the water surface (visually and using the targeting pods) for the presence of protected species and to determine if protected species were impacted by the mission (observation of dead or injured animals). If a dead or injured whale, dolphin, seal, or turtle is observed in the survey area, one of the following actions will be carried out:

  1) If the death or injury is clearly caused by mission activities (i.e., observed immediately after detonations):

- Immediately cease activities and report the incident to the NMFS Office of Protected Resources (301-427-8496) and NMFS Pacific Islands Regional Stranding Coordinator (808-354-2956).
- Submit a report to NMFS that includes the following information:
    - Time and date of incident
    - Description of the incident
    - Environmental condition (wind speed and direction, Beaufort sea state, cloud cover, visibility)
    - Description of any marine mammal or sea turtle observations in the 24 hours preceding the incident
    - Species identification or description of the animal(s) involved
    - Fate of the animal(s)
    - Photographs or video footage of the animal(s)
- Long Range Strike WSEP missions will not resume until NMFS reviews the circumstances and, in cooperation with U.S. Air Force, determines measures to minimize the likelihood of further incidents.
- The draft report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS. The draft report will be considered the final report for this activity under the LOA if NMFS has not provided comments and recommendations within 90 days of receipt of the draft report.

2) If the cause of the death or injury is unknown but the death or injury appears to have occurred recently (for example, there is little or no decomposition):
    - Immediately report the incident to the NMFS Office of Protected Resources and NMFS Pacific Islands Regional Stranding Coordinator.
    - Submit a report to NMFS that includes the same information listed in number one above.
    - Mission activities may continue while NMFS reviews the circumstances with U.S. Air Force to determine whether additional mitigation measures are necessary.

3) If the death or injury is clearly not caused by mission activities (for example, if wounds are old, the carcass has moderate to advanced decomposition, or there are scavenger marks):

- Within 24 hours of discovery, report the incident to the NMFS Office of Protected Resources and NMFS Pacific Islands Regional Stranding Coordinator.
- Provide photographs, video footage, or other documentation of the sighting to NMFS.

2.5 NMFS' Promulgation of Regulations Pursuant to the Marine Mammal Protection Act

Under the MMPA, the Navy may obtain authorization to "take" marine mammals only if the "take" occurs incidental to training activities within the BSURE of the PMRF. In order to authorize incidental take under the MMPA, NMFS must determine that the incidental taking of marine mammals will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant). 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."

NMFS Permits Division determined that the U.S. Air Force's proposed action (summarized above) would result in the take of ESA-listed species and that such take would be in the form of exposure to sound or pressure waves in the water. The specific activity and geographic region where take may occur, the dates when take may occur, and permissible method of taking that are set by the proposed regulations are all consistent with the U.S. Air Force's action described previously in this opinion so they will not be repeated here.

2.5.1 Taking of Marine Mammals Incidental to the U.S. Air Force's Long Range Strike WSEP

The take of ESA-listed species by harassment incidental to the U.S. Air Force's training activities in the BSURE area of the PMRF authorized pursuant to NMFS Permit Division's proposed MMPA rule is presented in the following sections.

§ 218.50 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the U.S. Air Force (86 Fighter Weapons Squadron) and those persons it authorizes to conduct activities on its behalf, for the taking of marine mammals as outlined in paragraph (b) of this section and incidental to Long Range Strike WSEP missions.

(b) The taking of marine mammals by U.S. Air Force pursuant to a Letter of Authorization (LOA) is authorized only if it occurs at the Barking Sands Underwater Range

Expansion (BSURE) area of the Pacific Missile Range Facility (PMRF) off Kauai, Hawaii.

§ 218.52 Permissible methods of taking.

Under a LOA issued pursuant to § 216.106 of this chapter and § 218.56, the Holder of the LOA (e.g., the U.S. Air Force) may incidentally, but not intentionally, take marine mammals by Level A and Level B harassment associated with Long Range Strike WSEP activities within the area described in § 218.50, provided the activities are in compliance with all terms, conditions, and requirements of these regulations in this subpart and the associated LOA.

§ 218.53 Prohibitions.

Notwithstanding takings contemplated in § 218.50 and authorized by an LOA issued under § 216.106 of this chapter and § 218.56, no person in connection with the activities described in § 218.50 may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or the LOA issued under § 216.106 of this chapter and § 218.56.

(b) Take a marine mammal species or stock not specified in the LOA; and

(c) Take a marine mammal species or stock specified in the LOA in any manner other than as specified.

§ 218.54 Mitigation requirements.

When conducting activities identified in § 218.50, the mitigation measures contained in the LOA issued under § 216.106 of this chapter and § 218.56 must be implemented. These mitigation measures shall include but are not limited to the following general conditions:

(a) Execute missions during day-light hours only, no more than four hours per day, no more than one day during 2017, no more than four days per year for 2018 through 2022 over a five-day period, on weekdays, and only during summer (June through August) or fall (September through November) months.

(b) Delay live munition detonations if a marine mammal is observed within the designated exclusion zone (2.3 miles from the weapon impact site), resuming only after the animal is observed exiting the exclusion zone or the exclusion zone has been clear of any additional sightings for a period of 30 minutes.

(c) Delay live munition detonations if a marine mammal is observed in an impact zone but outside of the 2.3 mile exclusion zone and if the manner of taking is not authorized (e.g., animal is observed in Level A impact zone for that species and no Level A take is authorized), resuming only after the animal is observed exiting the zone.

(d) Shift the target site as far as possible from an observed marine mammal's location (but within the two-mile wide weapon impact area) if a marine mammal is observed during the pre-mission survey or during missions and continuing the mission will not result in an unauthorized take of a marine mammal.

(e) Suspend live munition detonations if an unauthorized take of a marine mammal

occurs, and report the incident to NMFS Office of Protected Resources (OPR), NMFS Pacific Islands Regional Office (PIRO), and the Pacific Islands Region Marine Mammal Stranding Network representative immediately followed by a report to NMFS within 24 hours.

(f) Implement a best management practice, on a daily basis, of conducting inert munition training or small bomb detonations prior to detonating large bombs if the Project Engineer/Commanding Office determines this practice does not interfere with mission training.

(g) Additional mitigation measures as contained in an LOA.

§ *218.55 Requirements for monitoring and reporting.*

(a) Holders of LOAs issued pursuant to § 218.56 for activities described in § 218.50(a) are required to cooperate with NMFS, and any other Federal, state, or local agency with authority to monitor the impacts of the activity on marine mammals. Unless specified otherwise in the LOA, the Holder of the LOA must notify the Pacific Islands Region Stranding Coordinator, NMFS, by email, at least 72 hours prior to Long Range Strike WSEP missions**.**

(b) All marine mammal monitoring will be carried out in compliance with the U.S Air Force's Marine Mammal Mitigation and Monitoring Plan, dated August 2017 and described above in section 2.4 of this biological opinion.

§ 218.56 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations, U.S. Air Force must apply for and obtain an LOA.

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed the expiration date of these regulations.

(c) If an LOA expires prior to the expiration date of these regulations, U.S. Air Force must apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA, U.S. Air Force must apply for and obtain a modification of the LOA as described in § 218.57.

(e) The LOA will set forth:

(1) Permissible methods of incidental taking;

(2) The number of marine mammals, by species and stock, authorized to be taken;

(3) Means of effecting the least practicable adverse impact (i.e., mitigation) on the species of marine mammals authorized for taking, on its habitat, and on the availability of the species for subsistence uses; and

(4) Requirements for monitoring and reporting.

(f) Issuance of an LOA shall be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under these regulations.

(g) Notice of issuance or denial of an LOA will be published in the Federal Register

within 30 days of a determination.

§ 218.57 Renewals and Modifications of Letters of Authorization.

(a) An LOA issued under § 216.106 of this chapter and § 218.56 for the activity identified in § 218.50(a) will be renewed or modified upon request by the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section), and

(2) NMFS determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

(b) For an LOA modification or renewal request by the applicant that include changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that do not change the findings made for the regulations or result in no more than a minor change in the total estimated number of takes (or distribution by species or years), NMFS may publish a notice of proposed LOA in the Federal Register, including the associated analysis illustrating the change, and solicit public comment before issuing the LOA.

(c) An LOA issued under § 216.106 of this chapter and § 218.56 for the activity identified in § 218.50(a) may be modified by NMFS under the following circumstances:

(1) Adaptive Management - NMFS may modify and augment the existing mitigation, monitoring, or reporting measures (after consulting with the U.S. Air Force regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring.

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, and reporting measures in an LOA include, but is not limited to:

(A) Results of new range-to-effects models based on maximum amount of weapons, by type, utilized during each mission;

(B) Results from U.S. Air Force's monitoring from the previous year(s);

(C) Results from other marine mammal and/or sound research or studies; or

(D) Any information that reveals marine mammals may have been taken in a manner, extent, or number not authorized by the regulations or subsequent LOA.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, NMFS will publish a notice of proposed LOA in the Federal Register and solicit public comment.

(2) Emergencies - If NMFS determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in the LOA issued pursuant to § 216.106 of this chapter and 218.50, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the Federal Register within 30

days of the action.

2.6 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action and not just the immediate area involved in the action (50 CFR 402.02).

The action area for this opinion is the PMRF, which is part of the HRC, and is located off the western shores of the island of Kauai, Hawaii in the Pacific Ocean and includes marine areas to the north, south, and west (Figures 1 and 2). The HRC is a major range and test facility base that supports the full spectrum of the Department of Defense test and evaluation requirements. The HRC consists of ocean areas located around the major islands of the Hawaiian Island chain and consists of surface and subsurface ocean areas and special use airspace. The PMRF is the world's largest instrumented, multi-environment military training and testing range capable of supporting subsurface, surface, air, and space operations. The PMRF includes 1,020 nm^2 of instrumented ocean areas at depths between 549 – 4,572 m (1,800 – 15,000 ft.) and 42,000 nm^2 of controlled airspace, and a temporary operating area covering 2.1 million nm^2 of ocean area.

Within the PMRF, activities will occur in the BSURE area, which lies within W-188A (Figure 2). The BSURE area is comprised of approximately 900 nm^2 of instrumented underwater ranges, encompassing the deep water portion of the PMRF and providing over 80 percent of PMRF's underwater scoring capability (with regards to scoring missions). The impact area is approximately 44 nm (81 km) offshore of Kauai, Hawaii, in a water depth of approximately 4,645 m (15,240 ft.). All aspects of the operational evaluations of live long range strike weapons and other munitions missions will take place over open ocean areas. There will be no ground or nearshore activities requiring the use of any shoreline areas of Kauai.

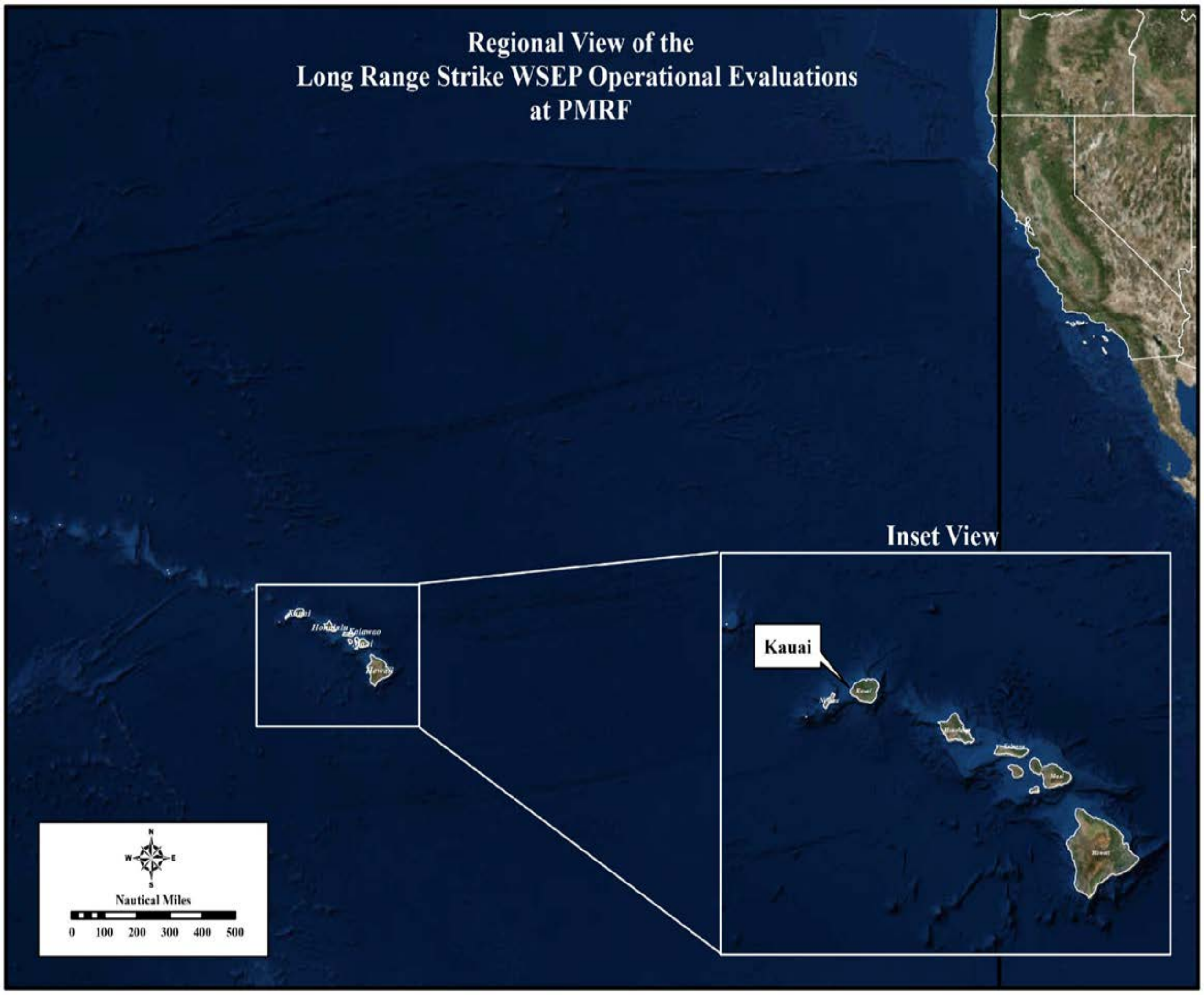

Figure 1. A regional view of the Hawaiian Islands with a close up of the location of the island of Kauai. All Long Range Strike Weapon Systems Evaluation Program mission operations from 2017 – 2021 will take place off of the west coast of Kauai (USAF 2016)

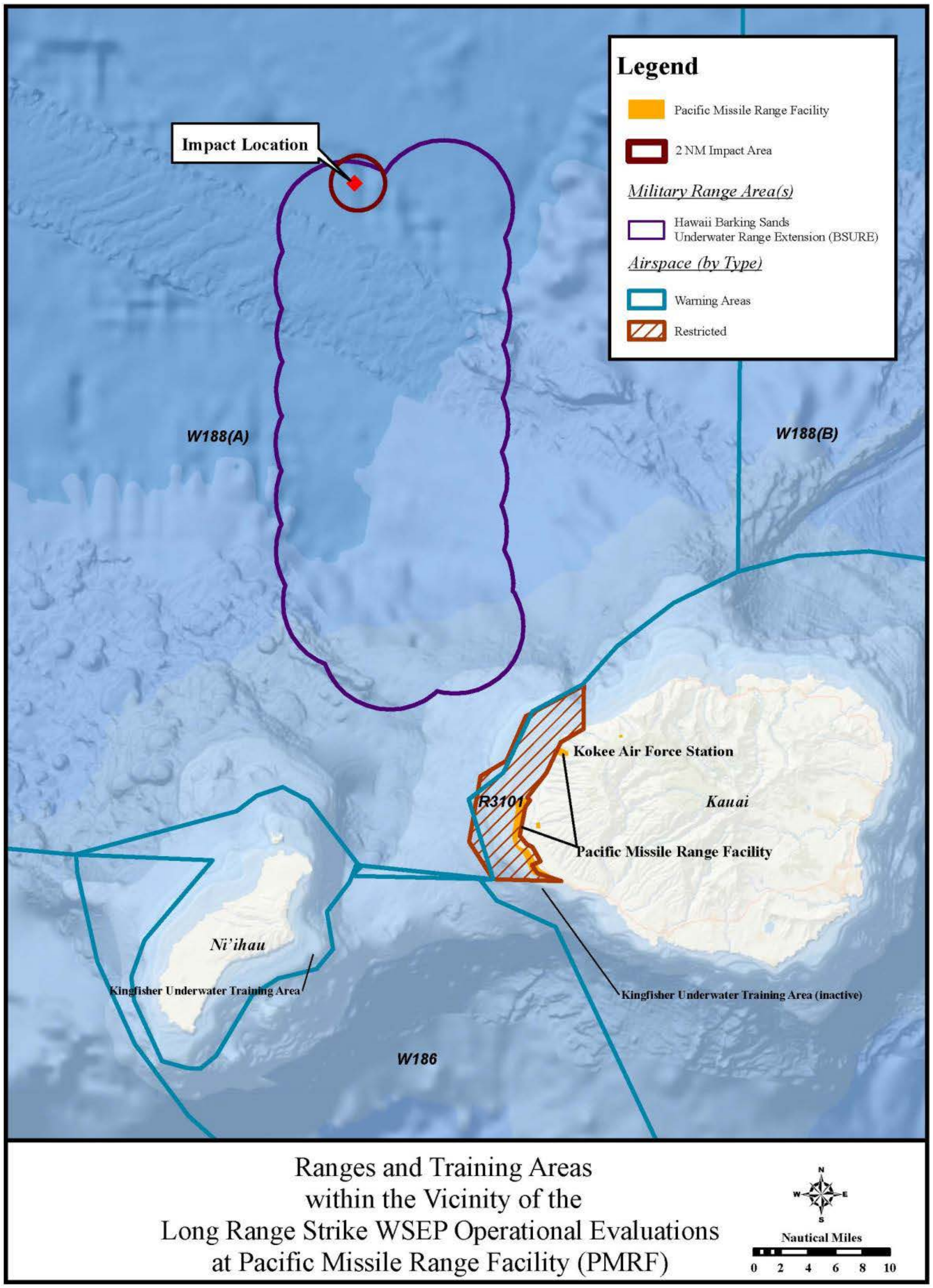

Figure 2. Map of the Pacific Missile Range Facility off of the coast of Kauai, including the Hawaii Barking Sounds Underwater Range Expansion area, the 2 nm (3.7 km) area of impact, and the impact location (Department of the USAF 2016, 2017b).

3 OVERVIEW OF ASSESSMENT FRAMEWORK

Section 7 (a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure that their actions either are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat.

"To jeopardize the continued existence of an ESA-listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). The jeopardy analysis considers both survival and recovery of the species.

Section 7 assessment involves the following steps:

1) We identify the proposed action and those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors.

2) We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.

3) We describe the environmental baseline in the action area including past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation; and impacts of state or private actions that are contemporaneous with the consultation in process.

4) We identify the number, age (or life stage), and gender of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. This is our exposure analysis.

5) We evaluate the available evidence to determine how those ESA-listed species are likely to respond given their probable exposure. This is our response analyses.

6) We assess the consequences of these responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. This is our risk analysis.

7) The adverse modification analysis considers the impacts of the proposed action on the critical habitat features and conservation value of designated critical habitat.

8) We describe any cumulative effects of the proposed action in the action area.

Cumulative effects, as defined in our implementing regulations (50 CFR §402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation.

9) We integrate and synthesize the above factors by considering the effects of the action to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

    a) Reduce appreciably the likelihood of both survival and recovery of the ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or

    b) Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the status of the species and critical habitat.

10) We state our conclusions regarding jeopardy and the destruction or adverse modification of critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative (RPA) to the action. The RPA must not be likely to jeopardize the continued existence of ESA-listed species nor destroy or adversely modify their designated critical habitat, and it must meet other regulatory requirements.

Evidence Available for the Consultation

To conduct these analyses, we considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. A considerable body of scientific information on anthropogenic sounds and their effects on marine mammals, sea turtles, fishes, and other aquatic organisms is available. NMFS's status reviews for ESA-listed species also provide information on the status of the species including, but not limited to, their resiliency, population trends, and specific threats to recovery that contributes to our *Status of ESA-Listed Species*, *Environmental Baseline,* and *Effects of the Action on Listed Species and Critical Habitat* sections.

To comply with our obligation to use the best scientific and commercial data available, we conducted electronic literature searches throughout the consultation, including within NMFS Office of Protected Resource's electronic library. We examined the literature that was cited in the submittal documents and any articles we collected through our electronic searches. We also considered the documents provided to NMFS by the U.S. Air Force, including the 2016 BA, acoustic modelling methodology, and marine species depth distribution appendices. We also evaluated the U.S. Air Force's 2016 monitoring report and the previous biological opinion to

assess the effectiveness of mitigation and actual take incidental to training activity levels where feasible.

Considering the information that was available, this consultation and our opinion include uncertainty about the basic hearing capabilities of some ESA-listed species, how these taxa use sounds as environmental cues, how they perceive acoustic features of their environment, the importance of sound to the normal behavioral and social ecology of species, the mechanisms by which human-generated sounds affect the behavior and physiology (including the non-auditory physiology) of exposed individuals, and the circumstances that are likely to produce outcomes that have adverse consequences for individuals and populations of exposed species.

3.1 The U.S. Air Force's Exposure Analysis

To estimate potential exposure of marine mammals and sea turtles to sounds from detonations, the U.S. Air Force used acoustic modeling and marine mammal and sea turtle density information. We summarize the U.S. Air Force's exposure analysis below. A comprehensive description of this analysis is included in the U.S. Air Force Long Range Strike WSEP BA and appendices as well as additional information provided in 2017 (USAF 2016, 2017a, 2017b). We verified the methodology and data used by the U.S. Air Force for their exposure analysis and accept the modeling conclusions on exposure of marine mammals and sea turtles.

Three sources of information were used to estimate potential detonation effects on marine mammals and sea turtles: (1) the zone of influence; (2) the density of animals within the zone of influence; and (3) the number of detonations (events). The zone of influence is the area or volume of ocean in which marine mammals or sea turtles could be exposed to various pressure or acoustic energy levels caused by exploding ordnance. To determine the zone of influence, the U.S. Air Force used acoustic modeling (thoroughly described in Appendix A of (USAF 2016), which incorporated the criteria and thresholds presented in Finneran and Jenkins (2012), and then modified for the 2017-2021 missions to include the marine mammal auditory thresholds (e.g., PTS and TTS) provided in NMFS' *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing.*

Thresholds are those sound pressure levels that are reached or exceeded that could result in adverse effects on ESA-listed species. The possible effects on ESA-listed species include mortality, harm, (i.e., physical and auditory injury), and harassment. Possible injuries include slight lung injury, or permanent threshold shifts (PTS) in hearing. Other harm or harassment could result from temporary threshold shifts (TTS) in hearing or other adverse behavioral effects.

The acoustic modeling calculated the maximum estimated range, or radius, from the detonation point to which the various thresholds extend for all munitions proposed to be released during the 2017-2021 missions. Table 2 lists the estimated distances to reach the thresholds that correspond to specific injury or effects. These were then used calculate the total area (circle) of the zones of influence for each criterion/threshold. To eliminate "double counting" of animals, impact areas from higher impact categories (e.g., mortality) were subtracted from areas associated with lower

impact categories (e.g., PTS). The estimated number of marine mammals and sea turtles potentially exposed to the various impact thresholds were then calculated as the product of the adjusted impact area (i.e., zone of influence), animal density, and the number of events per year. Since the acoustic model accumulates energy from all detonations within a 24-hour timeframe, it is assumed the same population of animals is being impacted within that time period. For metrics with multiple criteria (e.g., PTS), the criterion and/or threshold that results in the higher exposure estimate was used.

Table 2. Distance to reach species thresholds (in meters) for Long Range Strike Weapon Systems Evaluation Program mission used to calculate effects from maximum daily explosive ordnance use (USAF 2016, 2017a).

Species	Mortality	Slight Lung Injury	GI Tract Injury	Onset PTS (SEL[1])	Onset PTS (SPL[2])	Onset TTS (SEL)	Onset TTS (SPL)	Behavioral (SEL)
Blue whale	74	149	204	5,415	1,241	55,464	2,266	59,039
Fin whale	76	157	204	5,415	1,241	55,464	2,266	59,039
Sei whale	101	83	204	2,161	330	55,464	2,266	59,039
Sperm whale	91	177	204	1,575	413	8,019	763	11,948
False Killer Whale (MHI[3] DPS)	177	340	204	1,575	413	8,019	763	11,948
Hawaiian Monk Seal	306	564	204	4,621	1,394	55,687	2,549	58,736
Pacific sea turtles[4]	340	631	204	4,336	413	15,340	763	12,010

[1]Sound exposure level
[2]Sound pressure level
[3]Main Hawaiian Islands
[4]Pacific sea turtles includes a combined group of green, hawksbill, olive ridley, loggerhead, and leatherback sea turtles.

This exposure analysis is conservative because it does not take into account the minimization measures employed by the U.S. Air Force (described in Section 2.4) to minimize impacts to marine mammals and sea turtles. These measures would be expected to decrease the probability of adverse effects on species from exposure to injurious sound levels during weapons deployment. In addition, exposure calculations are based on the assumption that all animals would occupy the same depth within the water column and do not take into account diving behavior, which could further decrease exposure risks.

3.1.1 Density estimates

The U.S. Air Force used density estimates for acoustic analysis from the DRAFT U.S. Navy's Marine Species Density Database (NMSDD) Phase III for the Hawaii-Southern California Training and Testing Study Area (Navy 2016, 2017). The U.S. Navy database includes a compilation of the best available density data from several primary sources and published works,

including NMFS survey data within the Hawaiian Islands Exclusive Economic Zone (EEZ). NMFS publishes annual stock assessment reports for various regions of U.S. waters, which cover all stocks of marine mammals within those waters. Other researchers often publish density data or research covering a particular marine mammal species or geographic area, which is integrated into the stock assessment reports. Density is typically reported for an area (e.g., animals per km^2), and the U.S. Air Force assumed that animals are uniformly distributed within the affected area for the purpose of analyzing the proposed action. Based on current regulatory guidance, density is assumed to be two-dimensional, and exposure estimates are calculated as the product of affected area, animal density, and number of events.

Marine Mammal Densities

For most marine mammal species, abundance is estimated using line-transect methods that derive densities based on sighting data collected during ship or aerial surveys. Habitat-based models may also be used to model density as a function of environmental variables. Uncertainty in published density estimation is typically large because of the low number of sightings collected during surveys, and some density estimation methods result in greater uncertainty than others. For this analysis, the U.S. Navy provided their most recent information on the type of model used to estimate density, along with the sources of uncertainty (expressed as a coefficient of variation), for each marine mammal species in the Hawaii region as part of their latest updates to the NMSDD. For additional information on the data used to estimate marine species densities see USAF (2016).

The NMSDD consists of the most relevant information available for the Hawaii area and has been endorsed by NMFS for use in impacts analyses of previous military actions conducted near the action area. For some species, density estimates are uniform throughout the Hawaii region. For others, densities are provided in multiple, smaller blocks. In these cases, the U.S. Air Force used density estimates corresponding to the block containing the impact location. The resulting marine mammal seasonal density estimates used in this document are shown in Table 3. The operational evaluations of live long range strike weapons and other munitions missions are scheduled to occur in the summer (June – August) and fall (September – November). Most of the activities are expected to occur in the summer months, and environmental conditions at that time result with a larger area of impact compared to other seasons due to sound propagation parameters. However, animal densities are highest in the other seasons (e.g., fall), so for our analyses we conservatively used the highest number of potential animals present at any time and used the larger area boundaries likely to occur in the summer to conduct our impact analyses of effects on ESA-listed species.

Table 3. Marine mammal and sea turtle density estimates in the action area distributed across square kilometers (USAF 2016).

Species	Density Estimates (animals per km^2)	
	Fall	Summer
Blue whale	0.00005	0
Fin whale	0.00006	0
Sei whale	0.00016	0
Sperm whale	0.00156	0.00156
False killer whale (MHI insular DPS)	0.00080	0.00080
Hawaiian monk seal	0.00003	0.00003
Pacific sea turtles[1]	0.00429	0.00429

[1]As noted below, the Pacific sea turtle guild includes green, hawksbill, loggerhead, leatherback, and olive ridley sea turtles.

Sea Turtle Densities

In-water occurrence data for sea turtles are severely limited (Navy 2014). Many studies assess turtle abundance by counting nesting individuals or number of eggs, or by recording bycatch, but in-water densities may not be accurately represented by estimates from such information. Accordingly, past density estimates for the HRC are derived entirely from the U.S. Navy data obtained through dive surveys and projects associated with Integrated Natural Resource Management Plans. Due to the relative scarcity of some species and the lack of density estimates for sea turtles associated with open ocean habitats such as the BSURE area, the U.S. Air Force assessed the impacts of the 2017-2021 Long Range Strike WSEP mission using a single guild (Pacific Sea Turtles), which combined all sea turtle species. This group theoretically encompasses all five species with potential occurrence in the action area but did not provide a break down in densities according to turtle species. More recently, the U.S. Navy updated their assessment approach (Table 4) and developed new species density estimates based on unpublished U.S. Navy survey data and reports from long line fisheries to generate new relative abundance numbers for offshore areas (Navy 2017).

Using this new approach, percentage densities for sea turtles are divided between water depths of 100 meters or less (nearshore) and depths greater than 100 meters (offshore). Historically, green and hawksbill turtles have primarily been observed by the U.S. Navy divers and contractors within the 100-m and shallower waters around the islands of Kauai, Lanai, Molokai, and Oahu; but specific species densities in open ocean waters was largely unknown, although thought to be much lower.

The U.S. Navy used a mean density of turtles around the islands reduced by two orders of magnitude to generate distribution numbers for all sea turtle species. Using these estimates, resulted in a density estimate for the U.S. Air Force impacts analysis of 0.00429 turtles per km^2. This density value corresponds to all life stages of the Pacific sea turtle guild occurring in the open ocean (beyond the 100-m isobath) where all activities will occur during each season. Combining this data with the specific species percentage estimates, results with the majority of

sea turtles expected to be in the action to be comprised of leatherback, loggerhead and olive ridley sea turtles. While green and hawksbill sea turtles could occur in the action area beyond the 100-m isobaths, these occurrences would be very low compared to the other species as these species would only likely be temporarily migrating through that portion of the action area.

Table 4: Relative Abundance Percentages for Pacific Sea Turtle Distributions

Relative Abundance Percentages	Nearshore (within the 100-meter isobath)	Offshore (beyond the 100-meter isobath)
Green sea turtles	99%	4%
Hawksbill sea turtles	0.9%	1%
Olive Ridley sea turtles	0.1%	19%
Loggerhead sea turtles	0%	37%
Leatherback sea turtles	0%	39%

U.S Department of the Navy 2017

4 STATUS OF ESA-LISTED SPECIES

This section identifies the ESA-listed species that occur within the action area that may be affected by the proposed action (Table). It then summarizes the biology and ecology of those species and what is known about their life histories in the action area.

Table 5. Species listed under the Endangered Species Act under NMFS jurisdiction that may occur in the action area during the U.S. Air Force 2017-2021 proposed Long Range Strike WSEP missions

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals – Cetaceans			
Blue Whale (*Balaenoptera musculus*)	E - 35 FR 18319	-- --	07/1998
Fin Whale (*Balaenoptera physalus*)	E - 35 FR 18319	-- --	75 FR 47538
Sei Whale (*Balaenoptera borealis*)	E - 35 FR 18319	-- --	-- --
Sperm Whale (*Physeter macrocephalus*)	E - 35 FR 18619	-- --	75 FR 81584
Main Hawaiian Islands Insular False Killer Whale DPS (*Pseudorca crassidens*)	E- 76 FR 70915	-- --	77 FR 71260
Pinnipeds			
Hawaiian Monk Seal (*Monachus schauinslandi*)	E - 41 FR 51611	-- --	72 FR 46966
Sea Turtles			

Species	ESA Status	Critical Habitat	Recovery Plan
Green Turtle (*Chelonia mydas*) - Central North Pacific DPS - East Indian-West Pacific DPS - Central West Pacific DPS - Southwest Pacific DPS - Central South Pacific DPS - East Pacific DPS	T - 81 FR 20057	-- --	63 FR 28359
Hawksbill Turtle (*Eretmochelys imbricata*)	E - 35 FR 8491	-- --	63 FR 28359
Loggerhead Turtle (*Caretta caretta*) – North Pacific Ocean DPS	E - 76 FR 58868	-- --	63 FR 28359
Olive Ridley Turtle (*Lepidochelys olivacea*) - Breeding populations on the Pacific coast of Mexico - All other populations	E – 43 FR 32800 T – 43 FR 32800	-- --	63 FR 28359
Leatherback Turtle (*Dermochelys coriacea*)	E – 35 FR 8491	-- --	63 FR 28359

4.1 Listed Species Not Likely to be Adversely Affected

As described in the *Overview of the Assessment Framework*, NMFS uses two criteria to identify those endangered or threatened species or critical habitat that are not likely to be adversely affected by the various proposed activities. The first criterion was exposure or some reasonable expectation of a co-occurrence between one or more stressors associated with the U.S. Air Force's activities and a particular listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the activities, we must also conclude that the species or critical habitat is not likely to be adversely affected by those activities. The second criterion is the probability of a response given exposure. An ESA-listed species or designated critical habitat that is exposed to a potential stressor but is likely to be unaffected by the exposure is also not likely to be adversely affected by the proposed action. We applied these criteria to the ESA-listed species in Table 2, and we summarize our results below.

An action warrants a "may affect, not likely to be adversely affected" finding when its effects are wholly *beneficial, insignificant* or *discountable*. *Beneficial* effects have an immediate positive effect without any adverse effects to the species or habitat. Beneficial effects are usually discussed when the project has a clear link to the ESA-listed species or its specific habitat needs, and consultation is required because the species may be affected.

Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. Insignificant is the appropriate conclusion when plausible effects are going to happen, but will not rise to the level of constituting an adverse effect. That means the ESA-listed species may be expected to be affected, but not harmed or harassed.

Discountable effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact an ESA-listed species), but it is very unlikely to occur.

4.1.1 Blue Whale

The blue whale (*Balaenoptera musculus*) is a mysticete (baleen whale) and is the largest animal on Earth, reaching a maximum body length as an adult in the Antarctic of about 33 m and weighing more than 150,000 kg. Blue whales inhabit all oceans and typically occur near the coast over the continental shelf, although they are also found in oceanic waters. Blue whales are highly mobile, and their migratory patterns are not well known (Perry et al. 1999; Reeves et al. 2004). Blue whales migrate toward the warmer waters of the subtropics in the fall to reduce energy costs, avoid ice entrapment, and reproduce (NMFS 1998).

In the North Pacific Ocean, blue whales have been recorded off the island of Oahu in the main Hawaiian Islands and off Midway Island in the western edge of the Hawaiian Archipelago (Barlow 2006; Northrop et al. 1971; Thompson and Friedl 1982b). However, blue whales are rarely sighted in Hawaiian waters and have not been reported to strand in the Hawaiian Islands. Blue whales belonging to the western Pacific stock may feed in summer, south of the Aleutians and in the Gulf of Alaska, and migrate to wintering grounds in lower latitudes in the western Pacific and central Pacific, including Hawaii (Stafford et al. 2004; Watkins et al. 2000a; Watkins et al. 2000b; Watkins et al. 2000c). Bradford et al. 2017 report a uniform density value for blue whales of 0.00005 animals/km^2 (CV = 1.09) that is applicable to the HRC in winter, spring, and fall.

Conclusion

The only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions (see Section 6). Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. As described previously in Section 3.1 of this opinion, the U.S. Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. For blue whales, a density of 0.00005 was used for the period of time during which the action will occur. Therefore, the U.S. Air Force's acoustic analysis resulted in zero blue whale exposures to acoustic stressors from live explosive munitions during proposed mission activities. For this reason, we determined that the likelihood of a blue whale being exposed to acoustic stressors from the proposed action is discountable, and blue whales are not likely to be adversely affected by the proposed action and will not be considered further in this opinion.

4.1.2 Fin Whale

The fin whale (*Balaenoptera physalus*) is a cosmopolitan species of baleen whale (Gambell 1985a). Fin whales are the second-largest whale species by length. Fin whales are long-bodied and slender, with a prominent dorsal fin set about two-thirds of the way back on the body. Fin whales live 70-80 years (Kjeld 1982) and can be found in social groups of two to seven whales. Fin whales are distributed widely in every ocean except the Arctic Ocean. Fin whales undertake migrations from low-latitude winter grounds to high-latitude summer grounds and extensive longitudinal movements both within and between years (Mizroch et al. 1999a). Fin whales are sparsely distributed during November-April, from 60° N, south to the northern edge of the tropics, where mating and calving may take place (Mizroch et al. 1999a). However, fin whales have been sighted as far as 60° N throughout winter (Mizroch et al. 1999b). They are observed feeding in Hawaiian waters during mid-May, and their sounds have been recorded there during the autumn and winter (Balcomb 1987; Northrop et al. 1968; Shallenberger 1981b; Thompson and Friedl 1982a).

Fin whales were observed twice during a NMFS survey of waters within the Hawaiian EEZ in 2010 (Bradford et al. 2013), sighted five times in offshore waters during a NMFS 2002 survey in the same region, and sighted once during aerial surveys conducted between 1993 to 1998 (Mobley Jr. et al. 2000; Barlow 2006; Carretta et al. 2010). There are other known sightings from Kauai and Oahu, and a single stranding record from Maui, (Shallenberger 1981a); the most recent sighting was a single juvenile fin whale reported off Kauai in 2011 (Navy 2011). Based on sighting data and acoustic recordings, fin whales are likely to occur in Hawaiian waters mainly in fall and winter (Barlow 2006). No fin whales were sighted in the HRC during monitoring efforts from 2009 to 2012 (HDR 2012). Bradford et al. 2017 report a uniform density value for fin whales of 0.00006 animals/km^2 (CV = 1.05) that is applicable to the HRC in winter, spring, and fall.

Conclusion

As documented further in Section 6 of this opinion, the only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions. Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. As described previously in Section 3.1 of this opinion, the U.S. Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. For fin whales, a density of 0.00006 was used for the period of time during which the action will occur. Therefore, the U.S. Air Force's acoustic analysis resulted in zero fin whale exposures to acoustic stressors from live explosive munitions during mission activities. For this reason, we determined that the likelihood of a fin whale being exposed to acoustic stressors from the proposed action is discountable, and fin whales are not likely to be adversely affected by the proposed action and will not be considered further in this opinion.

4.1.3 Sperm Whale

Sperm whales (*Physeter macrocephalus*) are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Adult females may grow to lengths of 11 m (36 ft.) and weigh 13, 607 kg (15 tons). Adult males, however, reach about 16 m (52 ft.) and may weigh as much as 40,823 kg (45 tons). The sperm whale is distinguished by its extremely large head, which takes up to 25 to 35 percent of its total body length. Sperm whales are distributed in all of the world's oceans, from equatorial to polar waters, and are highly migratory. During the winter, sperm whales migrate closer to equatorial waters (Kasuya and Miyashita 1988; Waring 1993) where adult males join them to breed. NMFS has divided sperm whales in the North Pacific into three stocks: the California/Oregon/Washington stock, the Hawaii stock, and the North Pacific Stock (comprised largely of animals from the Gulf of Alaska and the Bering Sea). The most recent stock assessment report indicates the best available abundance estimate for the Hawaii stock is 3,354 animals (Carretta et al. 2016).

Conclusion

As documented further in Section 6 of this opinion, the only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions. Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. As described previously in Section 3.1 of this opinion, the U.S. Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. For sperm whales, a density of 0.00156 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The U.S. Air Force's acoustic analysis resulted in zero sperm whale exposures (based upon their hearing frequencies) to acoustic stressors from live explosive munitions during proposed mission activities. For this reason, we determined that the likelihood of a sperm whale being exposed to acoustic stressors from the proposed action at threshold levels above which impact criteria are reached (e.g., thresholds for mortality, permanent threshold shift, slight lung injury, behavioral harassment) is discountable and sperm whales are not likely to be adversely affected by the proposed action and will not be considered further in this opinion.

4.1.4 False Killer Whale – Main Hawaiian Islands Insular Distinct Population Segment

Main Hawaiian Islands (MHI) Insular false killer whales (*Pseudorca crassidens*) are large members of the dolphin family. Females reach lengths of 4.5 m (15 ft.), while males are almost 6 m (20 ft.). In adulthood, false killer whales can weigh approximately 700 kg (1,500 lbs).

The MHI insular false killer whale DPS occurs near the main Hawaiian Islands. The distribution of MHI insular false killer whales has been assessed using data from visual surveys and satellite tag data. Tagging data from seven groups of individuals tagged off the islands of Hawaii and Oahu indicate that the whales move rapidly and semi-regularly throughout the main Hawaiian

Islands and have been documented as far as 112 km offshore over a total range of 82,800 km^2 (Baird et al. 2012a; Baird et al. 2012b). Three high-use areas were identified: (1) off the north half of Hawaii Island, (2) north of Maui and Moloka‘i, and (3) southwest of Lana‘i (Baird et al. 2012a). However, note that limitations in the sampling suggest the range of the population is likely underestimated, and there are probably other high-use areas that have not been identified. For example, a single satellite track suggests the potential for MHI insular false killer whales to use habitat around the Northwestern Hawaiian Islands, where a separate false killer whale DPS tends to occur (Baird et al. 2012a). Other MHI insular false killer whales tagged off of Kauai circumnavigated Ni‘ihau and returned to the northwest side of the island of Kauai.

Photo identification studies also document that the animals regularly use both leeward and windward sides of the islands (Baird et al. 2005; Baird et al. 2012a; Baird et al. 2010; Forney et al. 2010; Oleson et al. 2010). Some individual false killer whales tagged off the island of Hawaii have remained around that island for extended periods (days to weeks), but individuals from all tagged groups eventually were found broadly distributed throughout the main Hawaiian Islands (Baird 2009; Forney et al. 2010). Individuals utilize habitat over varying water depths less than 50 m to greater than 4000 m (Baird et al. 2010). Inter-island movements may depend on the density and movement patterns of their prey species (Baird 2009). Evidence from tags and individual-identifying photographs suggests that the area between Kauai and Ni‘ihau near the PMRF is an area of range overlap between two or three populations of false killer whales, once of which is the MHI insular DPS. It appears that these waters may be at the far northwestern limit of the MHI insular DPS and the southeastern limit of the Northwestern Hawaiian Islands stock (USAF 2016).

Conclusion

As described further in Section 6 of this opinion, the only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions. Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. As described previously in Section 3.1 of this opinion, the U.S. Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. For the MHI insular false killer whale DPS, a density of 0.00080 animals per km^2 was used for the period of time during which mission activities will occur. The U.S. Air Force's acoustic analysis resulted in zero MHI insular false killer whale exposures to acoustic stressors from live explosive munitions during proposed mission activities. For this reason, we determined that the likelihood of a MHI insular false killer whale being exposed to acoustic stressors from the proposed action at threshold levels above which impact criteria are reached (e.g., thresholds for mortality, permanent threshold shift, slight lung injury, behavioral harassment) is discountable, and false killer whales from the MHI insular DPS are not likely to be adversely affected by the proposed action and will not be considered

further in this opinion.

4.1.5 Hawaiian Monk Seal

The Hawaiian monk seal has a silvery-grey colored back with lighter creamy coloration on the underside; newborns are black. Additional light patches and red and green tinged coloration from attached algae are common. The back of the animals may become darker with age, especially in males. Adults generally range in size from 170 to 205 kg (375 lbs to 450 lbs); females are slightly larger than males; pups are approximately 16 kg (35 lbs) at birth. Monk seals grow to approximately two meters (7.0 to 7.5 ft) in length; pups are one meter (3 ft.) at birth. A Monk Seal lifespan is estimated to be from 25 to 30 years.

Hawaiian monk seals are found primarily on the Northwestern Hawaiian Islands, especially on Nihoa, Necker, French Frigate Shoals, Pearl and Hermes Reef, Kure Atoll, Laysan, and Lisianski. Sightings on the main Hawaiian Islands have become more common in the past 15 years and monk seals have been born on the Islands of Kauai, Molokaʻi, Niʻihau, and Oahu (Carretta et al. 2005; Johanos and Baker. 2004; Kenyon 1981). Midway was an important breeding rookery, but is now used by a small number of monk seals (Reeves et al. 1992). Hawaiian monk seals breed primarily at Laysan Island, Lisianski Island, and Pearl and Hermes Reefs (Tomich 1986). Monk seals have been reported on at least three occasions at Johnston Island over the past 30 years (not counting nine adult males that were translocated there from Laysan Island in 1984).

During the U.S. Navy-funded marine mammal surveys from 2007 to 2012, there were 41 sightings of Hawaiian monk seals for a total of 58 individuals on (or near) Kauai, Kaʻula, Niʻihau, Oahu, and MolokaʻI (HDR 2012). Forty-seven (81 percent) individuals were seen during aerial surveys, and eleven (19 percent) during vessel surveys. Monk seals were most frequently observed at Niʻihau. Fifty-two (88 percent) individual seals were observed hauled out, and six (10 percent) were in the water as deep as 800m. In addition, six seals were observed on the ledges of Kaula Islet during an aerial survey in 2013 (Normandeau Associates 2013).

The distribution, destinations, routes, food sources, and causes of monk seal movements when they are not traveling between islands are not well known (Johnson and Johnson 1979), but recent tagging studies have shown individuals sometimes travel between the breeding populations in the Northwest Hawaiian Islands. Based on one study, on average, 10 to 15 percent of the monk seals migrate among the northwestern Hawaiian Islands and the main Hawaiian Islands (Carretta et al. 2010). Another source suggests that 35.6 percent of the main Hawaiian Island seals travel between islands throughout the year (Littnan 2011).

U.S. Navy-funded tagging studies in the main Hawaiian Islands demonstrate that mean foraging trip distance and duration, as well as maximum dive depth are similar between seals (Littman 2011). However, there were multiple outlying data points for all seals that varied by individual home ranges. Excluding one seal (R012) extended pelagic foraging trip, none of the seals travelled more than 300 km per trip, and most travelled less than 50 km and remained within the

600-m depth contour near the MHI. The mean dive depth was 27.03 ± 44.97 m with a maximum of 529.4 m and a median depth of 14.4 m. The average dive duration was 5.006 ± 3.10 minutes with a median of 5.07 minutes with 28 percent of the time between dives was spent at the surface. Although foraging trip distances and durations were similar among seals, there were high levels of individual variation in where the seals travelled (Wilson and D'Amico 2012).

Conclusion

As documented further in Section 6 of this opinion, the only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions. Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. As described previously in Section 3.1 of this opinion, the U.S. Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. For Hawaiian monk seals, a density of 0.00003 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The U.S. Air Force's acoustic analysis resulted in zero Hawaiian monk seal exposures to acoustic stressors from live explosive munitions during proposed mission activities. For this reason, we determined that the likelihood of a Hawaiian monk seal being exposed to acoustic stressors from the proposed action at threshold levels above which impact criteria are reached (e.g., thresholds for mortality, permanent threshold shift, slight lung injury, behavioral harassment) is discountable, and Hawaiian monk seals are not likely to be adversely affected by the proposed action and will not be considered further in this opinion.

4.1.6 Hawksbill Sea Turtle

The hawksbill turtle (*Eretmochelys imbricata*) is a small to medium-sized sea turtle; adults typically range between 65 and 90 centimeters (cm [26 to 35 in]) in carapace length and weigh around 80 kg (176 lb) (Witzell 1983). Hawksbills are distinguished from other sea turtles by their hawk-like beaks, posteriorly overlapping carapace scutes, and two pairs of claws on their flippers (NMFS and USFWS 1993).

Hawksbill sea turtles occur in tropical and subtropical seas of the Atlantic, Pacific and Indian Oceans. Hawksbill sea turtles occupy different habitats depending on their life history stage. After entering the sea, hawksbill turtles occupy pelagic waters and occupy weed lines that accumulate at convergence points. When they grow to about 20 to 25 cm carapace length, hawksbill turtles re-enter coastal waters where they inhabit and forage in coral reefs as juveniles, sub-adults and adults. Hawksbill sea turtles also occur around rocky outcrops and high energy shoals, where sponges grow and provide forage, and they are known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent. Hatchling and early juvenile hawksbills have also been found in the open ocean, in floating mats of seaweed (Musick and Limpus 1997). Although information about foraging areas is largely

unavailable due to research limitations, juvenile and adult hawksbills may also be present in open ocean environments (NMFS and USFWS 2007a).

Hawksbills are mostly found in the coastal waters of the eight main islands of the Hawaiian Island chain in nearshore habitats. Stranded or injured hawksbills are occasionally found in the Northwestern Hawaiian Islands (Parker et al. 2009). The lack of hawksbill sightings during aerial and shipboard surveys likely reflects the species' small size and difficulty in identifying them from a distance.

Hawksbills have been captured in Kiholo Bay and Kau (Hawaii), Palaau (Moloka'i), and Makaha (Oahu). Strandings have been reported in Kaneohe and Kahana Bays (Oahu) and throughout the main Hawaiian Islands (Eckert 1993b; NMFS and USFWS 1998b). Hawksbills primarily nest on the southeastern beaches of the Island of Hawaii. Since 1991, 81 nesting female hawksbills have been tagged on the island of Hawaii at various locations. This number does not include nesting females from Maui or Moloka'i, which would add a small number to the total. Post-nesting hawksbills have been tracked moving between Hawaii and Maui over the deep waters of the Alenuihaha Channel (Parker et al. 2009). Only two hawksbills have ever been sighted in the Pearl Harbor entrance channel, and none have been sighted inside the harbor (Smith 2010).

Research suggests that movements of hawksbill turtles are relatively short, with individuals generally migrating through shallow coastal waters and few deep-water transits between the islands. Nine hawksbill turtles were tracked within the Hawaiian Islands using satellite telemetry. Turtles travelled from 89 to 346 km (55 to 215 mi) and took between five and 18 days to complete the trip from nesting to foraging areas (Parker et al. 2009). In addition, recent research from the Navy concluded hawksbill turtles occurrence in the oceanic zone surrounding the Hawaiian islands is very rare, and they are unlikely to be present in waters greater than 100 meters deep (Navy 2017).

Conclusion

As described further in Section 6 of this opinion, the only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions. Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. As described previously in Section 3.1 of this opinion, the U.S. Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region, and sea turtle density percentages according to water depth and location (i.e. nearshore vs offshore). This resulted in a very low probability (less than 1/10th % daily) for hawksbills to be present during any weapons deployment. This factor, coupled with the more recent Navy data indicates this species is uncommon in the deeper waters of the action area. Therefore, due to the relative scarcity of hawksbill sea turtles in open ocean waters beyond the 100 meter contour in the BSURE area during the proposed missions during 2017-2021, we determined that the likelihood of a

hawksbill sea turtle being exposed to acoustic stressors from the proposed action at threshold levels above which impact criteria are reached (e.g., thresholds for mortality, PTS, TTS, slight lung injury, behavioral harassment) is discountable, and hawksbill sea turtles are not likely to be adversely affected by the proposed action and will not be considered further in this opinion.

4.1.7 Green sea turtle – East Indian-West Pacific, Central West Pacific, Southwest Pacific, Central South Pacific, Southwest Pacific, Central South Pacific, East Pacific, and Central North Pacific DPS

Green sea turtles are distributed circumglobally, occurring primarily in tropical waters, and to a lesser extent, subtropical and temperate waters. Green turtles appear to prefer waters that remain around 20 °C in the coldest month (Hirth 1971), but may be found considerably north of these areas during warm water events, such as El Niño. On April 6, 2016 NMFS published a final rule to list 11 DPSs of green sea turtles as threatened or endangered under the ESA (Figure 3; 81 FR 20057).

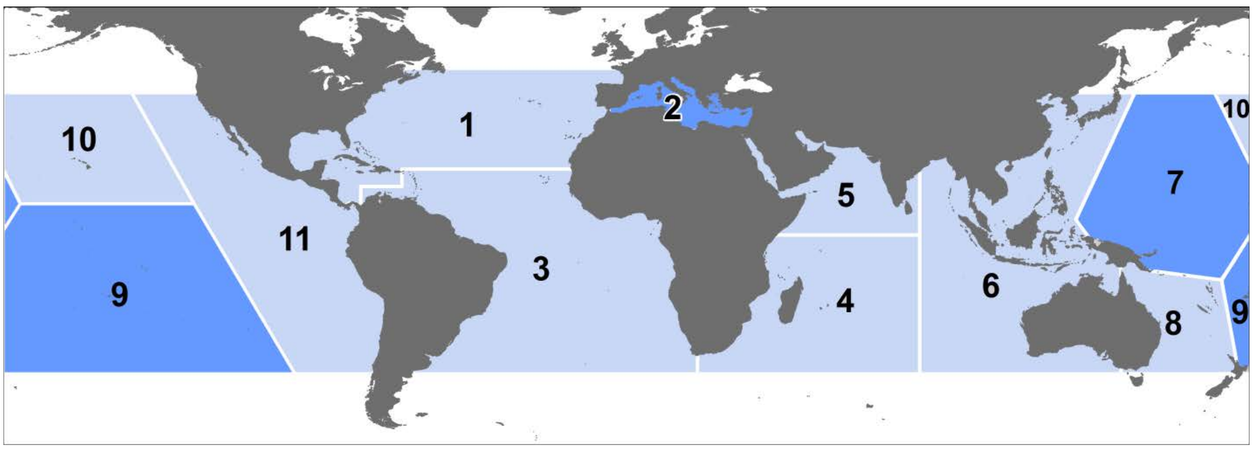

Figure 3. Threatened (light blue) and endangered (dark blue) green turtle Distinct Population Segments : 1) North Atlantic, 2) Mediterranean, 3) South Atlantic, 4) Southwest Indian, 5) North Indian, 6) East Indian-West Pacific, 7) Central West Pacific, 8) Southwest Pacific, 9) Central South Pacific, 10) Central North Pacific, and 11) East Pacific (Map source: 81 FR 20057).

The green turtle is a common sea turtle species in Hawaii, occurring in the coastal waters of the main Hawaiian Islands throughout the year and seasonal migrations to the North-western Hawaiian Islands to reproduce. The first recorded green turtle nest on the Island of Hawaii occurred in 2011. Green sea turtles are found in nearshore waters (within the 100-m isobath) around all of the main Hawaiian Islands and Nihoa Island, where reefs, their preferred habitats for feeding and resting, are most abundant. A large foraging population resides in and returns to the shallow waters surrounding the main Hawaiian Islands (especially around Maui and Kauai), where they are known to come ashore at several locations on all eight of the main Hawaiian Islands for basking or nesting. This area is frequently inhabited by adults migrating to the North-western Hawaiian Islands to reproduce during the summer and by ocean-dwelling individuals that have yet to settle into coastal feeding grounds of the main Hawaiian Islands. Farther offshore, green turtles occur in much lower numbers and densities.

The action area is entirely contained within the DPS delineation of the Central North Pacific DPS. The range of the Central North Pacific DPS covers the Hawaiian Archipelago and Johnston Atoll. It is bounded by a four-sided polygon with open ocean extents reaching to 41° N, 169° E in the northwest corner, 41° N, 143° W in the northeast, 9° N, 125° W in southeast, and 9° N, 175° W in the southwest. While some green turtles from other DPSs could occur within the action area during for foraging and migration (e.g., East Pacific DPS, Central West Pacific, Central South Pacific), we would expect the vast majority of green turtles located within the area to be from the Central North Pacific DPS.

The Hawaiian Archipelago is the most geographically isolated island group on the planet. From 1965 to 2013, 17,536 green turtles were tagged, including all post-pelagic size classes from juveniles to adults. With only three exceptions, the 7,360 recaptures of these tagged turtles have been made within the Hawaiian Archipelago. The three outliers involved a recovery in Japan, one in the Marshall Islands and one in the Philippines.

More than 90 percent of all Hawaiian Island green turtle breeding and nesting occurs at French Frigate Shoals in the Northwestern Hawaiian Islands, the largest nesting colony in the central Pacific Ocean, where 200 to 700 females nest each year (NMFS and USFWS 2007a). A large foraging population resides in and returns to the shallow waters surrounding the main Hawaiian Islands (especially around Maui and Kauai), where they are known to come ashore at several locations on all eight of the main Hawaiian Islands for basking or nesting.

Conclusion

As documented further in Section 6 of this opinion, the only stressor we determined would likely adversely affect ESA-listed species was acoustic stressors from the use of live explosive munitions. Other potential stressors associated with the proposed action (i.e., aircraft and weapons launch noise, ingestion of munitions, secondary stressors, direct physical strike) were determined to not likely adversely affect any ESA-listed species considered in this opinion. We determined that it would be unlikely for any green sea turtle from other Pacific Ocean DPSs (East Indian-West Pacific DPS, Central West Pacific DPS, Southwest Pacific DPS, Central South Pacific DPS, Southwest Pacific DPS, Central South Pacific DPS, and East Pacific DPS) to be present in the action area. For green turtles of the Central North Pacific DPS, the density estimates resulted in a very low probability (less than $1/10^{th}$ % daily) for green turtles of the Central North Pacific DPS to be present during any weapons deployment.

Although green turtles are the most abundant sea turtle within nearshore waters of Hawaii, they are considerably less abundant in the oceanic zone (e.g., beyond the 100 meter isobath) surrounding the Hawaiian Islands. Therefore, farther offshore the islands and within the action area, green turtles occur in much lower numbers and densities (NMFS 2015, Navy 2017). Due to the relative scarcity of green sea turtles in open ocean waters beyond the 100 meter contour in the BSURE area during the proposed missions in 2017-2021, we determined that the likelihood of a green sea turtle being exposed to acoustic stressors from the proposed action at threshold

levels above which impact criteria are reached (e.g., thresholds for mortality, PTS, TTS, slight lung injury, behavioral harassment) is discountable, and are not likely to be adversely affected by the proposed action and will not be considered further in this opinion.

4.2 Species Likely to be Adversely Affected

This opinion examines the status of each species that would be affected by the proposed action. The status is determined by the level of risk that the ESA-listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. More detailed information on the status and trends of these ESA-listed species, and their biology and ecology can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on this NMFS Web site: http://www.nmfs.noaa.gov/pr/species/index.htm.

4.2.1 Sei Whales

Sei whales (*Balaenoptera borealis*) are members of the baleen whale family and are considered one of the "great whales" or rorquals. Two subspecies of sei whales are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere. Sei whales are currently listed as endangered (35 FR 18319) under the ESA.

Life History

Sei whales can reach lengths of about 40-60 ft (12-18 m) and weigh 100,000 lbs (45,000 kg). Females may be slightly longer than males. Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath. The body is often covered in oval-shaped scars (probably caused from cookie-cutter shark and lamprey bites) and sometimes has subtle "mottling". This species has an erect falcate dorsal fin located far down (about two-thirds) the animals back. They often look similar in appearance to Bryde's whales, but can be distinguished by the presence of a single ridge located on the animal's rostrum. Bryde's whales, unlike other rorquals, have three distinct prominent longitudinal ridges on their rostrum. Sei whales have 219-410 baleen plates that are dark in color with gray/white fine inner fringes in their enormous mouths. They also have 30-65 relatively short ventral pleats that extend from below the mouth to the naval area. The number of throat grooves and baleen plates may differ depending on geographic population.

Sei whales become sexually mature at 6-12 years of age when they reach about 45 ft (13 m) in length, and generally mate and give birth during the winter in lower latitudes. Females breed every 2-3 years, with a gestation period of 11-13 months. Females give birth to a single calf that is about 15 ft (4.6 m) long and weighs about 1,500 lbs (680 kg). Calves are usually nursed for 6-9 months before being weaned on the preferred feeding grounds. Sei whales have an estimated lifespan of 50-70 years.

Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al. 2007). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Mizroch et al. 1984; Rice 1977). Sei whales in the North Pacific feed on euphausiids and copepods, which make up about 95 percent of their diets (Calkins 1986). The dominant food for sei whales off California during June-August is northern anchovy, while in September-October whales feed primarily on krill (Rice 1977). The balance of their diet consists of squid and schooling fish, including smelt, sand lance, Arctic cod, rockfish, pollack, capelin, and Atka mackerel (Nemoto and Kawamura 1977). In the Southern Ocean, analysis of stomach contents indicates sei whales consume Calanus spp. and small-sized euphasiids with prey composition showing latitudinal trends (Kawamura 1974). Evidence indicates that sei whales in the Southern Hemisphere reduce direct interspecific competition with blue and fin whales by consuming a wider variety of prey and by arriving later to feeding grounds (Kirkwood 1992). Rice (1977) suggested that the diverse diet of sei whales may allow them greater opportunity to take advantage of variable prey resources, but may also increase their potential for competition with commercial fisheries.

Little is known about the actual social system of these animals. Groups of 2-5 individuals are typically observed, but sometimes thousands may gather if food is abundant. However, these large aggregations may not be dependent on food supply alone, as they often occur during times of migration. Norwegian workers call the times of great sei whale abundance "invasion years." During mating season, males and females may form a social unit, but strong data on this issue are lacking.

Diving

The Sei whale is regarded as the fastest swimmer among the great whales, reaching bursts of speed in excess of 20 knots. When a sei whale begins a dive it usually submerges by sinking quietly below the surface, often remaining only a few meters deep, leaving a series of swirls or tracks as it move its flukes. When at the water's surface, sei whales can be sighted by a columnar or bushy blow that is about 10-13 feet (3-4 m) in height. The dorsal fin usually appears at the same time as the blowhole, when the animal surfaces to breathe. This species usually does not arch its back or raise its flukes when diving.

Generally, sei whales make 5-20 shallow dives of 20-30 sec duration followed by a deep dive of up to 15 min (Gambell 1985c). The depths of sei whale dives have not been studied; however the composition of their diet suggests that they do not perform dives in excess of 300 meters. Sei whales are usually found in small groups of up to 6 individuals, but they commonly form larger groupings when they are on feeding grounds (Gambell 1985c).

Vocalization and Hearing

Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100-600 hertz (Hz) range with 1.5 s duration and tonal and upsweep

calls in the 200-600 Hz range of 1-3 s durations (McDonald et al. 2005). Differences may exist in vocalizations between ocean basins (Rankin et al. 2009). Vocalizations from the North Atlantic consisted of paired sequences (0.5-0.8 sec, separated by 0.4-1.0 sec) of 10-20 short (4 msec) FM sweeps between 1.5-3.5 kHz (Richardson et al. 1995).

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some modifications to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into the outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by the tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear function to transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low-frequency hearing. While no data on hearing ability for this species are available, Ketten (1997) hypothesized that mysticetes have acute infrasonic hearing. In terms of functional hearing capability, sei whales belong to low-frequency cetaceans which have the best hearing ranging from 7 Hz to 22 kHz (Southall et al., 2007). There are no tests or modeling estimates of specific sei whale hearing ranges.

Recordings made in the presence of sei whales have shown that they produce sounds ranging from short, mid-frequency pulse sequences (Knowlton et al., 1991; Thompson et al., 1979) to low frequency broadband calls characteristic of mysticetes (Baumgartner et al., 2008; McDonald et al., 2005; Rankin and Barlow, 2007). Off the coast of Nova Scotia, Canada, Knowlton et al. (1991) recorded two-phased calls lasting about 0.5–0.8 s and ranging in frequency from 1.5 to 3.5 kHz in the presence of sei whales—data similar to that reported by Thompson et al. (1979). These mid-frequency calls are distinctly different from low-frequency tonal and frequency swept calls recorded in later studies. For example, calls recorded in the Antarctic averaged 0.45 ± 0.3 s in duration at 433 ± 192 Hz, with a maximum source level of 156 ± 3.6 dB re 1 μPa-m (McDonald et al., 2005). During winter months off Hawaii, Rankin and Barlow (2007) recorded down swept calls by sei whales that exhibited two distinct low frequency ranges of 100 to –44 Hz and 39 to 21 Hz, with the former range usually shorter in duration. Similar sei whale calls were also found near the Gulf of Maine in the northwest Atlantic, ranging from 82.3 to 34.0 Hz and averaging 1.38 s in duration (Baumgartner et al., 2008). These calls were primarily single occurrences, but some double or triple calls were noted as well. It is thought that the difference in call frequency may be functional, with the mid-frequency type serving a reproductive purpose and the low frequency calls aiding in feeding/social communication (McDonald et al., 2005). Sei whales have also been shown to reduce their calling rates near the Gulf of Maine at night, presumably when feeding, and increase them during the day, likely for social activity (Baumgartner and Fratantoni, 2008). Off the Mariana Islands, Norris et al. (2012) recorded 32 sei

whale calls, 25 of which were backed up by sightings. The peak mean frequency of these calls ranged from 890.6 to 1,046.9 Hz with a mean duration of 3.5 to 0.2 s.

Distribution

The sei whale occurs in all oceans of the world except the Arctic. The migratory pattern of this species is thought to encompass long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter; however, the location of winter areas remains largely unknown (Perry et al. 1999). Sei whales are often associated with deeper waters and areas along continental shelf edges (Hain et al. 1985). This general offshore pattern is disrupted during occasional incursions into shallower inshore waters (Waring et al. 2004). The species appears to lack a well-defined social structure and individuals are usually found alone or in small groups of up to six whales (Perry et al. 1999). When on feeding grounds, larger groupings have been observed (Gambell 1985c).

In the Pacific Ocean, sei whales occur from the Bering Sea south to California (on the east) and the coasts of Japan and Korea (on the west). During the winter, sei whales are found from 20°-23°N (Gambell 1985c; Masaki 1977). Sasaki et al. (Saski et al. 2013) demonstrated that sei whale in the North Pacific are strongly correlated with sea surface temperatures between 13.1-16.8 degrees C. Near Hawaii, sei whales have been seen in monitoring efforts conducted by the Navy in 2007 and in 2010. Sei whales occur seasonally in Hawaii in the winter and spring months and feed in higher latitude feeding grounds in the summer and fall (Caretta *et al*., 2014). Sightings of this species are rare in Hawaii. This species stays offshore of the islands in deeper waters (Baird 2016). Average group size for this species is 3.1 animals (Bradford *et al.,* 2017).

Population Dynamics

The population structure of sei whales is not well defined, but presumed to be discrete by ocean basin (north and south), except for sei whales in the Southern Ocean, which may form a ubiquitous population or several discrete ones.

Some mark-recapture, catch distribution, and morphological research indicate more than one population may exist – one between 155°-175° W, and another east of 155° W (Masaki 1976; Masaki 1977). Sei whales have been reported primarily south of the Aleutian Islands, in Shelikof Strait and waters surrounding Kodiak Island, in the Gulf of Alaska, and inside waters of southeast Alaska and south to California to the east and Japan and Korea to the west (Leatherwood et al. 1982; Nasu 1974). Sightings have also occurred in Hawaiian waters. In Navy-funded surveys 2007-2012, there were three confirmed sighting of sei whales for a total of five individuals—all made from vessels (HDR 2012). Two sightings were documented northeast of Oahu in 2007 (Smultea et al. 2007), while the third was encountered near Perret Seamount west of the Island of Hawaii in 2010 (HDR 2012). Bottom depths for the sei whale sightings were from 3,100 to 4,500 m. Sightings were made during BSS 2-4. Smultea et al. (2010) noted that the lack of sightings of sei whales in the Hawaiian Islands may be due to misidentification and/or poor sighting conditions. Sei whales have been occasionally reported from the Bering Sea

and in low numbers on the central Bering Sea shelf (Hill and DeMaster 1998). Whaling data suggest that sei whales do not venture north of about 55°N (Gregr et al. 2000). Masaki (1977) reported sei whales concentrating in the northern and western Bering Sea from July-September, although other researchers question these observations because no other surveys have reported sei whales in the northern and western Bering Sea. Harwood (1987) evaluated Japanese sighting data and concluded that sei whales rarely occur in the Bering Sea. Harwood (1987) reported that 75-85 percent of the North Pacific population resides east of 180°. During winter, sei whales are found from 20°-23° N (Gambell 1985c; Masaki 1977). Considering the many British Columbia whaling catches in the early to mid 1900s, sei whales have clearly utilized this area in the past (Gregr et al. 2000; Pike and Macaskie 1969). Masaki (1977) reported sei whales concentrating in the northern and western Bering Sea from July-September, although other researchers question these observations because no other surveys have reported sei whales in the northern and western Bering Sea. Harwood (1987) reported that 75-85 percent of the North Pacific population resides east of 180°.

Sei whales appear to prefer to forage in regions of steep bathymetric relief, such as continental shelf breaks, canyons, or basins situated between banks and ledges (Best and Lockyer 2002; Gregr and Trites 2001; Kenney and Winn 1987), where local hydrographic features appear to help concentrate zooplankton, especially copepods. In their foraging areas, sei whales appear to associate with oceanic frontal systems (Horwood 1987). In the North Pacific, sei whales are found feeding particularly along the cold eastern currents (Perry et al. 1999a). Masaki (1977) presented sightings data on sei whales in the North Pacific from the mid-1960s to the early 1970s. Over that time interval sei whales did not appear to occur in waters of Washington State and southern British Columbia in May or June, their densities increased in those waters in July and August (1.9 - 2.4 and 0.7 - 0.9 whales per 100 miles of distance for July and August, respectively), then declined again in September.

More recently, sei whales have become known for an irruptive migratory habit in which they appear in an area then disappear for time periods that can extend for decades. The first verified sei whale sighting made nearshore of the main Hawaiian Islands occurred in 2007 (Smultea et al. 2010) and included the first subadults seen in the main Hawaiian islands. A line-transect survey conducted in February 2009 by the Cetacean Research Program surrounding the Hawaiian Islands resulted in the sighting of three Bryde's/sei whales. An additional sighting occurred in 2010 of Perret Seamount (Navy 2011a). On March 18, 2011 off Maui, the Hawaiian Islands Entanglement Response Network found a subadult sei whale entangled in rope and fishing gear. A telemetry buoy attached to the entangled gear was reported to have tracked the whale over 21 days as it moved north and over 250 nm from the Hawaiian Islands.

Status

The sei whale was originally listed as endangered in 1970, and this status has remained since the inception of the ESA in 1973. Ohsumi and Fukuda (1975) estimated that sei whales in the North Pacific numbered about 49,000 whales in 1963, had been reduced to 37,000-38,000 whales by

1967, and reduced again to 20,600-23,700 whales by 1973. From 1910-1975, approximately 74,215 sei whales were caught in the entire North Pacific Ocean (Harwood and Harwood and Hembree. 1987; Perry et al. 1999a). From the early 1900s, Japanese whaling operations consisted of a large proportion of sei whales: 300-600 sei whales were killed per year from 1911-1955. The sei whale catch peaked in 1959, when 1,340 sei whales were killed. In 1971, after a decade of high sei whale catch numbers, sei whales were scarce in Japanese waters. Japanese and Soviet catches of sei whales in the North Pacific and Bering Sea increased from 260 whales in 1962 to over 4,500 in 1968-1969, after which the sei whale population declined rapidly (Mizroch et al. 1984). When commercial whaling for sei whales ended in 1974, the population in the North Pacific had been reduced to 7,260-12,620 animals (Tillman 1977).

There have been no direct estimates of sei whale populations for the Eastern Pacific Ocean (or the entire Pacific). However, between 1991 and 2001, during aerial surveys, there were two confirmed sightings of sei whales along the U.S. Pacific coast. The abundance estimate for this population of sei whales from a 2010 survey was 178 animals (Caretta *et al*., 2014). More recent estimates, based on the 2010 survey pooled with sightings collected during previous NMFS surveys of the Eastern Pacific, estimate the Hawaii stock of sei whales to be 391 individuals (Bradford *et al.*, 2017).

Threats

Threats to sei whales include both natural and anthropogenic sources. Natural threats include predation by killer whales. Andrews (1916) suggested that killer whales attacked sei whales less frequently than fin and blue whales in the same areas. Sei whales engage in a flight responses to evade killer whales, which involves high energetic output, but show little resistance if overtaken (Ford and Reeves 2008). Additionally, endoparasitic helminths (worms) are commonly found in sei whales and can result in pathogenic effects when infestations occur in the liver and kidneys (Rice 1977).

Anthropogenic threats known to pose a risk for sei whales include whaling, commercial fishing, maritime vessel traffic, and increasing levels of anthropogenic sound in the ocean (Caretta *et al*., 2014). Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing sei whales as an endangered species. Sei whales are thought to not be widely hunted, although harvest for scientific whaling or illegal harvesting may occur in some areas.

Sei whales, because of their offshore distribution and relative scarcity in U.S. Atlantic and Pacific waters, probably have a lower incidence of entrapment and entanglement than fin whales. Data on entanglement and entrapment in non-U.S. waters are not reported systematically. Heyning and Lewis (1990) made a crude estimate of about 73 rorquals killed/year in the southern California offshore drift gillnet fishery during the 1980s. Some of these may have been fin whales instead of sei whales. Some balaenopterids, particularly fin whales, may also be taken in the drift gillnet fisheries for sharks and swordfish along the Pacific coast of Baja California, Mexico (Barlow et al. 1997). Heyning and Lewis (1990) suggested that most whales killed by

offshore fishing gear do not drift far enough to strand on beaches or to be detected floating in the nearshore corridor where most whale-watching and other types of boat traffic occur. Thus, the small amount of documentation may not mean that entanglement in fishing gear is an insignificant cause of mortality. Observer coverage in the Pacific offshore fisheries has been too low for any confident assessment of species-specific entanglement rates (Barlow et al. 1997). The offshore drift gillnet fishery is the only fishery that is likely to take sei whales from this stock, but no fishery mortalities or serious injuries to sei whales have been observed. Sei whales, like other large whales, may break through or carry away fishing gear. Whales carrying gear may die later, become debilitated or seriously injured, or have normal functions impaired, but with no evidence recorded.

Sei whales are occasionally killed in collisions with vessels. Of three sei whales that stranded along the U.S. Atlantic coast between 1975 and 1996, two showed evidence of collisions (Laist et al. 2001). Between 1999 and 2005, there were three reports of sei whales being struck by vessels along the U.S. Atlantic coast and Canada's Maritime Provinces (Cole et al. 2005; Nelson et al. 2007). Two of these ship strikes were reported as having resulted in death. One sei whale was killed in a collision with a vessel off the coast of Washington in 2003 (Waring et al. 2009). New rules for seasonal (June through December) slowing of vessel traffic in the Bay of Fundy to 10 knots and changing shipping lanes by less than one nautical mile to avoid the greatest concentrations of right whales are predicted to reduce sei whale ship strike mortality by 17 percent.

Sei whales are known to accumulate DDT, DDE, and PCBs (Borrell 1993; Borrell and Aguilar 1987; Henry and Best 1983). Males carry larger burdens than females, as gestation and lactation transfer these toxins from mother to offspring.

Critical Habitat

Sei whale critical habitat has not been designated.

4.2.2 Leatherback Sea Turtles

The leatherback sea turtle is an endangered species (35 FR 8491), and is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 4**).**

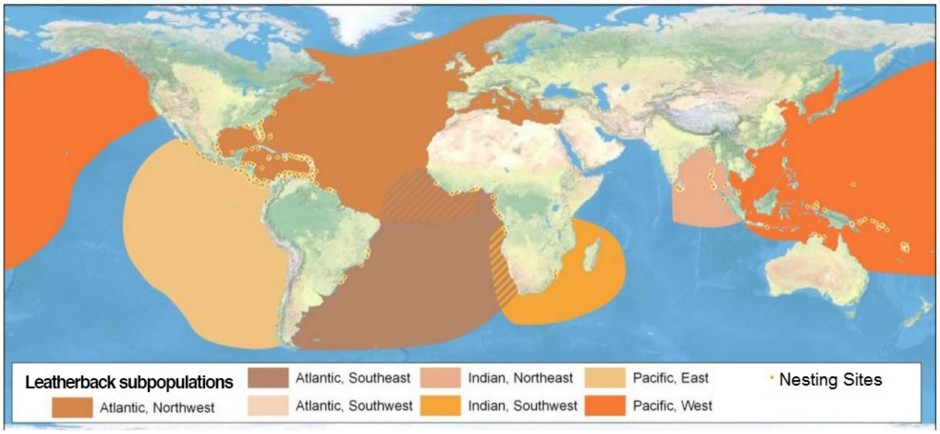

Figure 4. Map identifying the range of the endangered leatherback sea turtle. From NMFS http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.html, adapted from Wallace et al. 2010.

The leatherback sea turtle (*Dermochelys coriacea*) is the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their belly (Figure 5).

Figure 5. Leatherback turtle. Photo: R.Tapilatu

Life History

The leatherback sea turtle age at maturity has been difficult to ascertain, with estimates ranging from five to twenty-nine years (Avens et al. 2009; Spotila et al. 1996). Females lay up to seven clutches per season, with more than sixty-five eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately fifty percent worldwide (Eckert et al. 2012). Females nest every one to seven years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about thirty-three percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

Diving and Social Behavior

The maximum dive depths for leatherbacks have been recorded at over 1,000 m (Doyle et al. 2008), with routine dives recorded between 50 and 84 m. The maximum dive length recorded for such female leatherback turtles was 86.5 minutes (Lopez-Mendilahars et al 2008), while routine dives ranged from 4 to 14.5 minutes (in Lutcavage and Lutz 1997). Leatherback turtles also appear to spend almost the entire portion of each dive traveling to and from maximum depth, suggesting that maximum exploitation of the water column is of paramount importance to the leatherback (Eckert et al. 1989).

A total of six adult female leatherback turtles from Playa Grande, Costa Rica were monitored at sea during their inter-nesting intervals and during the 1995 through 1998 nesting seasons. The turtles dived continuously for the majority of their time at sea, spending 57 to 68 percent of their time submerged. Mean dive depth was 19 ± 1 m and the mean dive duration was 7.4 ± 0.6 minutes (Southwood et al. 1999). Similarly, Eckert (1999) placed transmitters on nine leatherback females nesting at Mexiquillo Beach and recorded dive behavior during the nesting season. The majority of the dives were less than 150 m in depth, although maximum depths ranged from 132 m to over 750 m. Although the dive durations varied between individuals, the majority of them made a large proportion of very short dives (less than two minutes), although Eckert (1999) speculates that these short duration dives most likely represent just surfacing activity after each dive. Excluding these short dives, five of the turtles had dive durations greater than 24 minutes, while three others had dive durations between 12 to 16 minutes.

Migrating leatherback turtles also spend a majority of time at sea submerged, and they display a pattern of continual diving (Standora et al. 1984, cited in Southwood et al. 1999). Based on depth profiles of four leatherbacks tagged and tracked from Monterey Bay, California in 2000 and 2001, using satellite-linked dive recorders, most of the dives were to depths of less than 100 meters and most of the time was spent shallower than 80 meters. Based on preliminary analyses of the data, 75 to 90 percent of the time the leatherback turtles were at depths less than 80 m.

Vocalizations and Hearing

Little is known about sea turtle sound use and production, they do not appear to use sound for communication. Nesting leatherback turtles have been recorded producing sounds (sighs, grunts or belch-like sounds) up to 1,200 Hz with maximum energy from 300 to 500 Hz (Cook and Forrest 2005; Mrosovsky 1972). Although these sounds are thought to be associated with breathing (Cook and Forrest 2005; Mrosovsky 1972). Recent research measuring hatchling leatherback turtle auditory evoked potentials (AEP) has shown that hatchling leatherbacks respond to tonal stimuli between 50 and 1,200 underwater (maximum sensitivity: 100 to 400 Hz) and 50 and 1,600 in air (maximum sensitivity: 50 to 400Hz) (Dow Piniak et al. 2012a).

Distribution

Leatherback sea turtles are globally distributed (Figure 4), and found in four main regions of the world: Pacific, Atlantic, Indian Oceans, and the Caribbean Sea. They have the most extensive range of any living reptile and have been reported in all pelagic waters of the Pacific between 71°N and 47°S latitude and in all other major pelagic ocean habitats (NMFS and USFWS 1998a). Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

Leatherback turtles are highly migratory, exploiting convergence zones and upwelling areas in the open ocean, along continental margins, and in archipelagic waters (Eckert and Eckert 1988; Eckert 1999; Morreale et al. 1994). In a single year, a leatherback may swim more than 10,000 kilometers (Eckert 1998). Leatherback turtles lead a completely pelagic existence, foraging widely in temperate waters except during the nesting season, when gravid females return to tropical beaches to lay eggs

Population Dynamics

Leatherbacks break into four nesting aggregations: Pacific, Atlantic, and Indian oceans, and the Caribbean Sea. Although detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). Population growth rates for leatherback sea turtles vary by ocean basin. Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation has been declining at a rate of almost six percent per year since 1984 (Tapilatu et al. 2013). Leatherback subpopulations in the Atlantic Ocean, however, are showing signs of improvement. Nesting females in South Africa are increasing at an annual rate of four to 5.6 percent, and from nine to thirteen percent in Florida and the U.S. Virgin Islands (TEWG 2007), believed to be a result of conservation efforts.

Analyses of mitochondrial DNA from leatherback sea turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS 2013).

In the Pacific Ocean, leatherback turtles have the most extensive range of any living reptile and have been reported in all pelagic waters of the Pacific between 71° N and 47° S latitude and in

all other major pelagic ocean habitats (NMFS and USFWS 1998a). The primary data available for leatherbacks in the North Pacific Transition Zone come from longline fishing bycatch reports, as well as several satellite telemetry data sets (Benson et al. 2007). Leatherbacks from both the eastern and western Pacific Ocean nesting populations migrate to northern Pacific Ocean foraging grounds, where longline fisheries operate (Dutton et al. 1998). Leatherbacks from nesting beaches in the Indo-Pacific region have been tracked migrating thousands of kilometers through the North Pacific Transition Zone to summer foraging grounds off the coast of northern California (Benson et al. 2007). Genetic sampling of 18 leatherback turtles caught in the Hawaiian longline fishery indicated that about 94 percent originated from western Pacific Ocean nesting beaches (NMFS and USFWS 2007b). The remaining six percent of the leatherback turtles found in the open ocean waters north and south of the Hawaiian Islands represent nesting groups from the eastern tropical Pacific Ocean.

Satellite tracking studies and occasional incidental captures of the species in the Hawaii-based longline fishery indicate that deep ocean waters are the preferred habitat of leatherback turtles in the central Pacific Ocean (NMFS and USFWS 2007b). The primary migration corridors for leatherbacks are across the North Pacific Subtropical Gyre, with the eastward migration route possibly to the north of the westward migration.

The leatherback turtle occurs within the entire Insular Pacific-Hawaiian Large Marine Ecosystem beyond the 101 m (330 ft) isobath; inshore of this isobath is the area of rare leatherback occurrence. Incidental captures of leatherbacks have also occurred at several offshore locations around the main Hawaiian Islands (McCracken 2000). Leatherback turtles are also regularly sighted by fishermen in offshore waters surrounding the Hawaiian Islands, generally beyond the 3,800 ft. (1,158 m) contour, and especially at the southeastern end of the island chain and off the northern coast of Oahu (Balazs 1995a). Leatherbacks encountered in these waters, including those caught accidentally in fishing operations, may be migrating through the Insular Pacific-Hawaiian Large Marine Ecosystem (NMFS and USFWS 1998a). Sightings and reported interactions with the Hawaii longline fishery commonly occur around seamount habitats above the Northwestern Hawaiian Islands (from 35° N to 45° N and 175° W to 180° W) (Skillman and Balazs 1992; Skillman and Kleiber 1998). Although leatherback bycatches are common off the island chain, leatherback-stranding events on Hawaiian beaches are uncommon. Since 1982, only five leatherbacks have stranded in the Hawaiian Islands (Chaloupka et al. 2008a).

Status

The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as Leatherback Sea Turtle. This species' large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population

abundance. Other threats include loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, because of sea-level rise. The species' resilience to additional perturbation is low.

Critical Habitat

There is no critical habitat designated for leatherback sea turtles in the action area.

4.2.3 Loggerhead Sea Turtles – North Pacific Ocean DPS

The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws (Figure 6**)**. The species was first listed as threatened under the Endangered Species Act in 1978. On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles: South Atlantic Ocean and Southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, Northwest Atlantic Ocean, South Pacific Ocean, and Southeast Indo-Pacific Ocean as endangered. The North Pacific Ocean DPS is listed as endangered.

Figure 6. Loggerhead sea turtle. Photo: NOAA

Life History

Mean age at first reproduction for female loggerhead sea turtles is thirty years. Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. At emergence, hatchlings average 45 mm (1.8 in) in length and weigh approximately 20 grams (0.04 lbs). Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (i.e., coastal waters). Small juveniles are found in pelagic waters and the transition from oceanic to neritic juvenile stages can involve trans-oceanic migrations (Bowen et al. 2004).

Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads. Adults and sub-adults occupy nearshore habitat. Adult loggerheads are known to make considerable migrations from nesting beaches to foraging grounds (TEWG 2009); and evidence indicates turtles entering the benthic environment undertake routine migrations along

the coast that are limited by seasonal water temperatures. Individuals from multiple nesting colonies can be found on a single feeding ground.

Diving and Social Behavior

Studies of loggerhead diving behavior indicate varying mean depths and surface intervals, depending on whether they were located in shallow coastal areas (short surface intervals) or in deeper, offshore areas (longer surface intervals). The maximum recorded dive depth for a post-nesting female was 211 to 233 m, while mean dive depths for both a post-nesting female and a subadult were 9 to 22 m. Routine dive times for a post-nesting female were between 15 and 30 minutes, and for a subadult, between 19 and 30 minutes (Sakamot et al. 1990 cited in Lutcavage and Lutz 1997). Two loggerheads tagged by Hawaii-based longline observers in the North Pacific and attached with satellite-linked dive recorders were tracked for about 5 months. Analyses of the dive data indicate that most of the dives were very shallow with 70 percent of the dives no deeper than 5 m. In addition, the loggerheads spent approximately 40 percent of their time in the top meter and nearly all of their time at depths shallower than 100 m. On 5 percent of the days, the turtles dove deeper than 100 m; the deepest daily dive recorded was 178 m (Polovina et al. 2003). In the areas that the loggerheads were diving, there was a shallow thermocline at 50 m. There were also several strong surface temperature fronts the turtles were associated with, one of 20 °C at 28° N latitude and another of 17 °C at 32° N latitude.

Vocalizations and Hearing

Two studies have been conducted to measure loggerhead turtle hearing sensitivity, each using a slightly different methodology. Vibratory stimuli delivered directly to the tympanum produced auditory brainstem responses in loggerheads between 250 Hz and 750 Hz (Bartol et al. 1999b). In another study, underwater tones elicited behavioral responses to frequencies between 50 and 800 Hz and AEP responses between 100 Hz and 1,131 Hz in one adult loggerhead (Martin et al. 2012). The lowest threshold recorded in this study was 98 dB re: 1 μPa at 100 Hz. Lavender et al. (2014) found post-hatchling loggerheads responded to sounds in the range of 50 Hz to 800 Hz while juveniles responded to sounds in the range of 50 Hz to 1,000 Hz. Posthatchlings had the greatest sensitivity to sounds at 200 Hz while juveniles had the greatest sensitivity at 800 Hz (Lavender et al. 2014).

Distribution

Loggerhead sea turtles are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Figure 7), returning to their natal region for mating and nesting. North Pacific Ocean DPS loggerheads are found throughout the Pacific Ocean,

north of the equator. Their range extends from the West Coast of North America to eastern Asia.

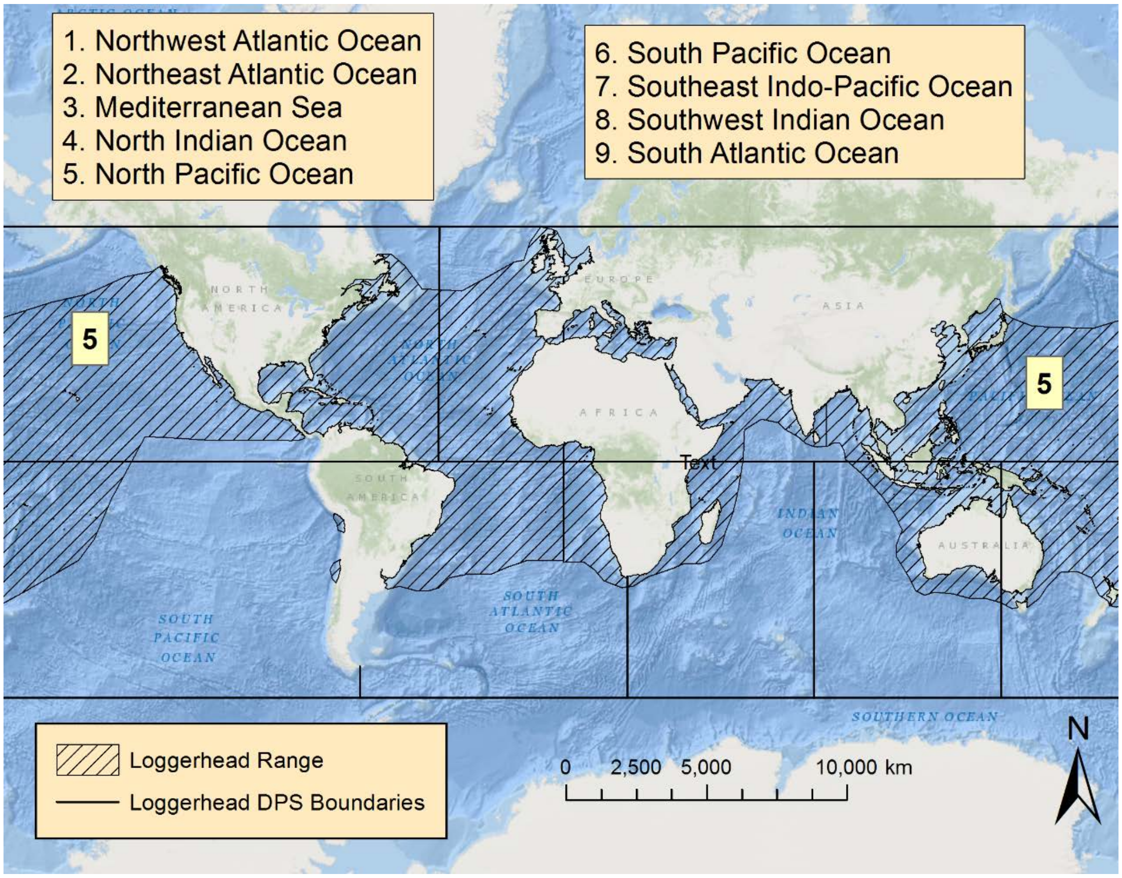

Figure 7. Map identifying the range of the North Pacific Ocean distinct population segment loggerhead sea turtle.

Within the North Pacific Ocean, loggerhead nesting has only been documented in Japan(Kamezaki et al. 2003). Hatchlings from Japanese nesting beaches use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to foraging grounds. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off of Mexico's Baja California Peninsula. Both of these feeding grounds are frequented by individuals from Japanese nesting beaches (Abecassis et al. 2013; Seminoff et al. 2014).

Population Dynamics

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size. Adult nesting females often account for less than one percent of total population numbers (Bjorndal et al. 2005). Overall, Gilman (2009) estimated that the number of loggerheads nesting in the Pacific has declined by eighty percent in the past twenty years. There was a steep (fifty to ninety percent) decline in the annual nesting population in Japan during the last half of the twentieth century (Kamezaki et al. 2003) Since then, nesting

has gradually increased, but is still considered to be depressed compared to historical numbers, and the population growth rate is negative (-0.032) (Conant et al. 2009).

The North Pacific Ocean DPS has a nesting population of about 2,300 nesting females (Matsuzawa 2011). Loggerhead abundance on foraging grounds off the Pacific Coast of the Baja California Peninsula, Mexico, was estimated to be 43,226 individuals (Seminoff et al. 2014). Our understanding of the genetic diversity and population structure of the different loggerhead DPSs is being refined as more studies examine samples from a broader range of specimens using longer mitochondrial DNA sequences. Recent mitochondrial DNA analysis using longer sequences has revealed a more complex population sub-structure for the North Pacific Ocean DPS. Previously, five haplotypes were present, and now, nine haplotypes have been identified in the North Pacific Ocean DPS. This evidence supports the designation of three management units in the North Pacific Ocean DPS: 1) the Ryukyu management unit (Okinawa, Okinoerabu, and Amami), 2) Yakushima Island management unit and 3) Mainland management unit (Bousou, Enshu-nada, Shikoku, Kii and Eastern Kyushu) (Matsuzawa et al. 2016). Genetic analysis of loggerheads captured on the feeding grounds of Sanriku, Japan, found only haplotypes present in Japanese rookeries (Nishizawa et al. 2014).

Nest count data for the last two decades suggests that the North Pacific population is "small" and lacks a robust gene pool when compared to the larger northwest Atlantic and north Indian Ocean loggerhead populations. Small populations are more susceptible to demographic variability which increases their probability of extinction. Available evidence indicates that due to loss of adult and juvenile mortalities from fishery bycatch and, to a lesser degree the loss of nesting habitat, the North Pacific loggerhead population is declining.

Snover (2008) combined nesting data from the Sea Turtle Association of Japan and data from Kamezaki et al. (2003) to analyze an 18-year time series of nesting data from 1990 through 2007. Nesting declined from an initial peak of approximately 6,638 nests in 1990 and 1991, followed by a steep decline to a low of 2,064 nests in 1997. During the past decade, nesting increased gradually to 5,167 nests in 2005, declined and then rose again to a high of just under 11,000 nests in 2008. Estimated nest numbers for 2009 were on the order of 7,000 to 8,000 nests. While nesting numbers have gradually increased in recent years and the number for 2009 was similar to the start of the time series in 1990, historical evidence from Kamouda Beach (census data dates back to the 1950s) indicates that there has been a substantial decline over the last half of the 20th century (Kamezaki et al. 2003) and that current nesting represents a fraction of historical nesting levels.

There are very few records of loggerheads nesting on any of the many islands of the central Pacific, and the species were considered rare or vagrant in this region (USFWS 1998). Data for the years between 1982 -1999 also indicated there were no documented strandings of

loggerheads on the Hawaiian Islands. Overall, Gilman (2009) estimated that the number of loggerheads nesting the Pacific has declined by 80 percent in the past 20 years. However, more recent data provided by the Navy (2017) utilizing stranding and fishery bycatch information indicates loggerheads make up a higher percentage of Pacific Guild sea turtle species present in the oceanic zone surrounding the Hawaiian Islands than previously thought (see section 3.1.1).

Status

Once abundant in tropical and subtropical waters, loggerhead sea turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation. Globally, egg harvest, the harvest of females on nesting beaches and directed hunting of turtles in foraging areas remain the greatest threats to their recovery. In addition, bycatch in drift-net, long-line, set-net, pound-net and trawl fisheries kill thousands of loggerhead sea turtles annually. Increasing coastal development (including beach erosion and re-nourishment, construction and artificial lighting) threatens nesting success and hatchling survival. On a regional scale, the different DPSs experience these threats as well, to varying degrees. Differing levels of abundance combined with different intensities of threats and effectiveness of regional regulatory mechanisms make each DPS uniquely susceptible to future perturbations.

Neritic juveniles and adults in the North Pacific Ocean DPS are at risk of mortality from coastal fisheries in Japan and Baja California, Mexico. Habitat degradation in the form of coastal development and armoring pose a threat to nesting females. Based on these threats and the relatively small population size, the Biological Review Team concluded that the North Pacific Ocean DPS is currently at risk of extinction (Conant et al. 2009)

Critical Habitat

No critical habitat has been designated for the North Pacific Ocean DPS loggerhead sea turtle.

4.2.4 Olive Ridley Sea Turtles

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution (Figure 4).

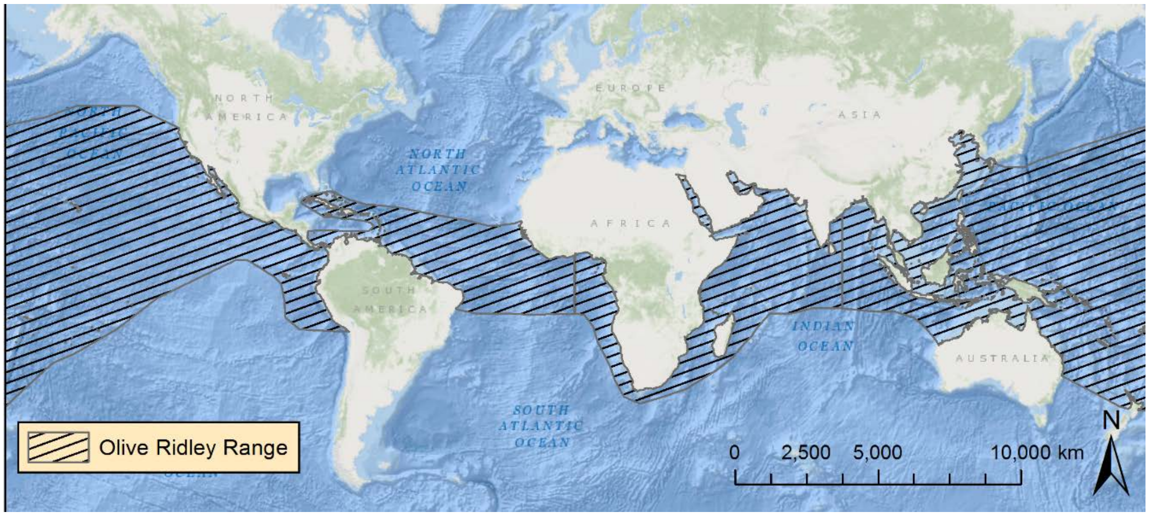

Figure 8. Map identifying the range of the olive ridley sea turtle.

The olive ridley turtle (*Lepidochelys olivacea*) is a small to medium-sized sea turtle with a heart-shaped carapace (Figure 5). Adults typically range between 55 and 80 cm (22 to 31 in) in carapace length and weigh around 45 kg (100 lb). The species was listed under the ESA on July 28, 1978. The species was separated into two listing designations: endangered for breeding populations on the Pacific coast of Mexico, and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range).

Figure 9. Olive ridley turtle. Photo: Reuven Walder

Life History

Olive ridley females mature at ten to eighteen years of age. Olive ridley turtles nest along continental margins and oceanic islands. They lay an average of two clutches per season (three to six months in duration). The annual average clutch size is one hundred to 110 eggs per nest. Olive ridley sea turtles commonly nest in successive years. Females nest in solitary or in arribadas, large aggregations coming ashore at the same time and location. As adults, olive ridleys forage on crustaceans, fish, mollusks, and tunicates, primarily in pelagic habitats. The post-nesting olive ridleys are known to traverse thousands of kilometers in deep oceanic waters, ranging from Mexico to Peru, and more than 3,000 kilometers out into the central Pacific (Plotkin 2007).

Diving and Social Behavior

Although olive ridley turtles are probably surface feeders, they have been caught in trawls at depths of 80 to 110 m (NMFS and USFWS 1998f), and a post-nesting female reportedly dove to

a maximum depth of 290 m. The average dive length for an adult female and adult male is reported to be 54.3 and 28.5 minutes, respectively (Plotkin 1994, in Lutcavage and Lutz 1997).

Vocalizations and Hearing

As stated previously, little is known about sea turtle sound production and use. There are no published recordings of olive ridley sea turtle vocalizations, and no information on olive ridley turtle hearing.

Distribution

Olive ridley sea turtles are thought to be the most abundant species of sea turtle, and can be found in the Atlantic, Indian and Pacific Oceans. Olive ridley sea turtles occur in tropical and subtropical seas in the Pacific, Atlantic, and Indian Oceans and occasionally seen in the Caribbean Sea. While Pacific ridley turtles have a generally tropical to subtropical range, individual turtles have been reported as far as the Gulf of Alaska (Hodge and Wing 2000).

The eastern Pacific Ocean population is the population that overlaps with the BSURE action area. This species are nomadic migrants and know to swim hundreds to thousands of kilometers over vast oceanic areas (Armstrong et al. 1996; Parker et al. 2003). In the eastern Pacific Ocean, this nomadic behavior may be unique to this species, as studies in other ocean basins indicate olive ridleys occupy neritic waters and do not make the extensive migrations observed in the eastern Pacific (Armstrong et al. 1996).

Population Dynamics

Population growth rate and trend information for the threatened population of olive ridely sea turtles is difficult to discern, owing to its range over a large geographic area, and a lack of consistent monitoring data in all nesting areas. Below, we present the any known population trend information for olive ridley sea turtles by ocean basin (NMFS and USFWS 2014).

Genetic studies have identified four main lineages for the olive ridley: east India, Indo-Western Pacific, Atlantic, and the eastern Pacific. In the eastern Pacific, rookeries on the Pacific Coasts of Costa Rica and Mexico were not genetically distinct, and fine-scale population structure was not found when solitary and arribada nesting beaches were examined. There was no population subdivision among olive ridleys along the east India coastline. Low levels of genetic diversity among Atlantic French New Guinea and eastern Pacific Baja California nesting sites are attributed to a population collapse caused by past overharvest (NMFS and USFWS 2014).

Nesting at arribada beaches in French Guiana appears to be increasing, while in Suriname, nesting has declined by more than ninety percent since 1968. Solitary nesting also occurs

elsewhere in Suriname, Guyana and French Guiana; no trend data are available. Solitary nesting in Brazil appears to be increasing, with one hundred nests recorded in 1989 to 1990, to 2,606 in 2002 to 2003. In the Eastern Atlantic, trend data is not available for most solitary nesting beaches. Nest counts in the Republic of Congo decreased from 600 nests in 2003 and 2004 to less than 300 in 2009 and 2010. The three arribada nesting beaches in India—Gahirmatha, Rushikulya, and Devi River—are considered stable over three generations. There is no trend data available for several solitary nesting beaches in the Indian Ocean. However, even for the few beaches with short-term monitoring, the nest counts are believed to represent a decline from earlier years. There are no known arribada nesting beaches in the western Pacific Ocean. Data are lacking or inconsistent for many solitary nesting beaches in the western Pacific, so it is not possible to assess population trends for these sites. However, some solitary nesting occurs in Australia, Brunei, Malaysia, Indonesia and Vietnam. Data are lacking for many sites. Terengganu, Malaysia had ten nests in 1998 and 1999. Alas Purwo, Indonesia, had 230 nests annually from 1993 to 1998. Nest counts at Alas Purwo, Indonesia, appear to be increasing, the nest count at Terengganu, Malaysia, is thought to be a decline from previous years. Population trends at Nicaraguan arribaba nesting beaches are unknown or stable (La Flor). Ostional, Costa Rica arribada nesting beach is increasing, while trends Nancite, Costa Rica, and Isla Cañas, Panama, nesting beaches are declining. For most solitary nesting beaches in the East Pacific Ocean, population trends are unknown, except for Hawaii Beach, Guatemala, which is decreasing.

In the eastern Pacific Ocean (excluding breeding populations in Mexico), there are arribada nesting beaches in Nicaragua, Costa Rica and Panama. La Flor, Nicaragua had 521,440 effective nesting females in 2008 and 2009; Chacocente, Nicaragua had 27,947 nesting females over the same period (Gago et al. 2012). Two other arribada nesting beaches are in Nicaragua, Masachapa and Pochomil, but there are no abundance estimates available. Costa Rica hosts two major arribada nesting beaches; Ostional has between 3,564 and 476,550 turtles per arribada, and Nancite has between 256 and 41,149 turtles per arribada. Panama has one arribada nesting beach, with 8,768 turtles annually. On Hawaii Beach in Guatemala, 1,004 females were recorded in 2005 (NMFS and USFWS 2014). The eastern Pacific Ocean population is the population that overlaps with the BSURE action area offshore of Hawaii.

Status

It is likely that solitary nesting locations once hosted large arribadas; since the 1960s, populations have experienced declines in abundance of fifty to eighty percent. Many populations continue to decline. Threats to olive ridley sea turtles are primarily from egg harvest, adult harvest, and fisheries bycatch. Olive ridley sea turtles continue to be harvested as eggs and adults, legally in some areas, and illegally in others. Incidental capture in fisheries is also a major threat. The olive ridley sea turtle is the most abundant sea turtle in the world; however, several populations are declining as a result of continued harvest and fisheries bycatch. Incidental take of olive ridley sea turtles is known to occur within longline fisheries operating in Hawaii and in the

central Pacific (Polovina et al. 2003, 2004; NMFS 2009). The large population size of the range-wide population, however, allows some resilience to future perturbation.

Critical Habitat

No critical habitat has been designated for the range-wide, threatened population of olive ridley turtles.

5 ENVIRONMENTAL BASELINE

By regulation, environmental baselines for biological opinions include the past and present impacts of all state, Federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process (50 CFR § 402.02). The environmental baseline for this opinion includes the effects of several activities that affect the survival and recovery of sei whales, leatherback, loggerhead and olive ridley sea turtles in the action area.

5.1 Climate Change

The latest Assessment Synthesis Report from the Working Groups on the Intergovernmental Panel on Climate Change (IPCC) concluded climate change is unequivocal (IPCC 2014). The Report concludes oceans have warmed, with ocean warming the greatest near the surface (e.g., the upper 75 m have warmed by 0.11^{o}C per decade over the period between 1971 to 2010) (IPCC 2014). Global mean sea level rose by 0.19 m between 1901 and 2010, and the rate of sea-level rise since the mid-19th century has been greater than the mean rate during the previous two millennia (IPCC 2014). Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014), and this rise has been linked to climate change.

Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine, coastal, and terrestrial ecosystems in the reasonably foreseeable future (Houghton 2001; IPCC 2001; Parry et al. 2007) (IPCC 2001; IPCC 2002). The direct effects of climate change will result in increases in atmospheric temperatures, changes in sea surface temperatures, patterns of precipitation, and sea level and the frequency of extreme weather and climate events including, but not limited to, cyclones, heat waves, and droughts (IPCC 2014). Oceanographic models project a weakening of the thermohaline circulation resulting in a reduction of heat transport into high latitudes of Europe, an increase in the mass of the Antarctic ice sheet, and a decrease in the Greenland ice sheet, although the magnitude of these changes remain unknown. Curran (2003) analyzed ice-core samples from 1841 to 1995 and concluded Antarctic sea ice cover had declined by about 20 percent since the 1950s. The most recent report by the Intergovernmental Panel on Climate

Change has found that over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and Arctic sea ice and Northern Hemisphere spring snow cover have continued to decrease in extent (www.climatechange2013.org/images/uploads/WGIAR5-SPM_Approved27Sep2013.pdf).

Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined distribution and diversity of top predators in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. The researcher predicted up to 35 percent change in core habitat for some key Pacific species based on climate change scenarios predicated on the rise in average sea surface temperature by 2100. Some species were predicted to experience gains in available core habitat while others would experience losses. For example, leatherback sea turtles were predicted to gain core habitat area, whereas loggerhead sea turtles and blue whales were predicted to experience losses. McMahon and Hays (2006) predicted increased ocean temperatures would expand the distribution of leatherback sea turtles into more northern latitudes.

Effects of climate change could also result in changes in the distribution of temperatures suitable for marine mammal calving and rearing calves, the distribution and abundance of prey, and the distribution and abundance of competitors or predators. Primary production is estimated to have declined by six percent between the early 1980s and 2010, making foraging more difficult for marine species (Hoegh-Guldberg and Bruno 2010). For example, variations in the recruitment of krill (*Euphausia superba*) and the reproductive success of krill predators have been linked to variations in sea-surface temperatures and the extent of sea-ice cover during the winter months. Climate-mediated changes in the distribution and abundance of krill , and climate-mediated changes in the distribution of cephalopod populations worldwide is likely to affect marine mammal populations as they re-distribute throughout the world's oceans in search of prey. Baleen whales that specialize in eating krill seem likely to change their distribution in response to changes in the distribution of krill (for example, see Payne et al. 1990; Payne 1986); if they did not change their distribution or could not find the biomass of krill necessary to sustain their population numbers, their populations seem likely to experience declines similar to those observed in other krill predators, which would cause dramatic declines in their population sizes or would increase the year-to-year variation in population size; either of these outcomes would dramatically increase the extinction probabilities of these whales. Moreover, for species that undergo long migrations, individual movements are usually associated with prey availability or habitat suitability. If either is disrupted by changing ocean temperature regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott. 2009).

In general, species that are shorter-lived, of larger body size, or generalist in nature are liable to be better able to adapt to climate change over the long term versus those that are longer-lived,

smaller-sized, or rely upon specialized habitats (Brashares 2003; Cardillo 2003; Cardillo et al. 2005; Issac 2009; Purvis et al. 2000). Although, Acevedo-Whitehouse and Duffus (2009) proposed that the rapidity of environmental changes, such as those resulting from global warming, can harm immunocompetence and reproductive parameters in wildlife to the detriment of population viability and persistence. An example of this is the altered sex ratios observed in sea turtle populations worldwide (Fuentes et al. 2009a; Mazaris et al. 2008; Reina et al. 2008; Robinson et al. 2008). This does not appear to have yet affected population viabilities through reduced reproductive success, although nesting and emergence dates of days to weeks in some locations have changed over the past several decades (Poloczanska et al. 2009). Altered ranges can also result in the spread of novel diseases to new areas via shifts in host ranges (Simmonds and Eliott. 2009). It has also been suggested that increases in harmful algal blooms could be a result from increases in sea surface temperature (Simmonds and Eliott. 2009).

Changes in global climatic patterns will likely have profound effects on the coastlines of every continent by increasing sea levels and the intensity, if not the frequency, of hurricanes and tropical storms (Wilkinson and Souter 2008). A half degree Celsius increase in temperatures during hurricane season from 1965-2005 correlated with a 40 percent increase in cyclone activity in the Atlantic. Sea levels have risen an average of 1.7 mm/year over the 20th century due to glacial melting and thermal expansion of ocean water; this rate will likely increase. Based on computer models, these phenomena would inundate nesting beaches of sea turtles, change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and would increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). The loss of nesting beaches, by itself, would have catastrophic effects on sea turtle populations globally if they are unable to colonize new beaches that form or if the beaches do not provide the habitat attributes (sand depth, temperature regimes, refuge) necessary for egg survival. In some areas, increases in sea level alone may be sufficient to inundate sea turtle nests and reduce hatching success (Caut et al. 2009). It remains unclear however, how nesting habitat loss will impact future nesting in the Hawaiian Islands. Storms may also cause direct harm to sea turtles, causing "mass" strandings and mortality (Poloczanska et al. 2009).

For sea turtles, changes in air temperature could also decrease the success of egg clutches, as an increase of 3°C is likely to exceed the thermal threshold of most clutches, leading to death (Hawkes et al. 2007). In other cases, as demonstrated with green sea turtle hatchling size, smaller hatchlings were produced at higher incubation temperatures (Glen et al. 2003). Smaller individuals likely experience increased predation (Fuentes et al. 2009b).

Changes in global temperatures could also affect juvenile and adult distribution patterns. Warming ocean temperatures may extend poleward the habitat which they can utilize (Poloczanska et al. 2009). Seagrass habitats have declined by 29 percent in the last 130 years and 19 percent of coral reefs have been lost due to human degradation, reducing lower latitude habitat for some sea turtle species. Although, Poloczanska et al. (2009) noted that extant marine turtle species have survived past climatic shifts, including glacial periods and warm events, and

therefore, may have the ability to adapt to ongoing climate change (e.g., by finding new nesting beaches). However, the authors also suggested since the current rate of warming is very rapid, expected changes may outpace sea turtles' ability to adapt. Hawkes et al. (2009) stated that if turtles cannot adapt quickly, they may face local to widespread extirpations (cited in 80 FR 15271). All of these temperature related impacts have the potential to significantly impact sea turtle reproductive success and ultimately, long-term species viability.

Although it is challenging to predict the precise consequences of climate change on highly mobile marine species (Simmonds and Isaac 2007), such as many of those considered in this opinion, recent research has identified a range of consequences already occurring. Climate change is most likely to have its most pronounced effects on species whose populations are already in tenuous positions (Issac 2009). As such, NMFS expects the risk of extinction to ESA-listed species to rise with the degree of climate shift associated with global warming.

5.2 Vessel Interactions

Collisions with commercial ships are an increasing threat to many large whale species, particularly as shipping lanes cross important large whale breeding and feeding habitats or migratory routes. The number of observed physical injuries to humpback whales as a result of ship collisions has increased in Hawaiian waters (Glockner-Ferrari et al. 1987; Lammers et al. 2007), possibly partly stemming from rapid humpback whale population growth. On the Pacific coast, a humpback whale is probably killed about every other year by ship strikes (Barlow et al. 1997). Through 2008, 82 instances of humpback whale ship strike have been found (Gabriele et al. 2011).

The vast majority of vessel strike mortalities are never identified, and actual mortality is higher than currently documented. Jensen and Silber's (2004a) review of the NMFS' ship strike database revealed fin whales as the most frequently confirmed victims of ship strikes (26 percent of the recorded ship strikes [n = 75/292 records]), with most collisions occurring off the east coast, followed by the west coast of the U.S. and Alaska/Hawaii. Five of seven fin whales stranded along Washington State and Oregon showed evidence of vessel strike with incidence increasing since 2002 (Douglas et al. 2008a). From 1994-1998, two fin whales were presumed killed by vessel strikes. More recently, in 2002, three fin whales were struck and killed by vessels in the eastern North Pacific (Jensen and Silber 2003). From 1991-2010, 11 fin whales were involved in vessel strikes off California. From 1994 – 1998, two fin whales were presumed to have been killed in ship strikes. In 2006-2007, the stranding network in Hawaii reported eight ship strikes, three of which were reported to have injured the whale involved. In 1996, a humpback whale calf was found stranded on Oahu with evidence of vessel collision (propeller cuts; NMFS unpublished data). From 1991-2010, eight ship strikes of humpback whales in California waters were documented. As described in the *Status of ESA-listed Species Section, s*ei whales are also occasionally killed in collisions with vessels, although no information of this occurrence is available for this species within the action area.

Despite these reports, the magnitude of the risks commercial ship traffic poses to large whales in the action area is difficult to quantify or estimate. It is difficult to estimate the number of whales that are killed or seriously injured in vessel strikes within the U.S. EEZ and have virtually no information on interactions between ships and commercial vessels outside of U.S. waters. With the information available, we know those interactions occur but we cannot estimate their significance to the different species of whales in the action area.

Vessel strike of sea turtles is poorly studied, but has the potential to be highly significant (Work et al. 2010). Sea turtles must surface to breath and several species are known to bask at the surface for long periods. Research found that sea turtles likely cannot move out of the way of vessels moving at more than 4 km/hr; most vessels move far faster than this in open water (Hazel et al. 2007; Work et al. 2010). Chaloupka et al. (2008c) report that of the 3,745 green turtle strandings in the Hawaiian Archipelago from 1982 to 2003, 2.5 percent were caused by boat strike. However, it should be noted that not all struck sea turtles are likely to strand (NMFS 2008b). Based on an observed annual average of eight green sea turtles stranded in the Main Hawaiian Islands between 1982 and 2007 (as compiled from the Hawaii Sea Turtle Stranding Database), and after applying a correction factor for those that do not strand, NMFS estimates 25 to 50 green sea turtles are killed by vessel strike annually in the Main Hawaiian Islands (NMFS 2008b). The majority of strandings are likely the result of strikes with relatively small, but high-speed fishing boats making thousands of trips through Hawaiian nearshore waters annually. The frequency of vessel strike in open ocean waters surrounding Hawaii is much less clear. It is assumed that if an animal is struck in waters further from shore, it is less likely to strand and be documented. Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. We assume that other sea turtle species with similar sensory structures and abilities could be at similar risk of vessel strike as the species that have been documented.

5.3 Anthropogenic Noise

The marine mammals and sea turtles that occur in the action area are regularly exposed to several sources of natural and anthropogenic sounds. Anthropogenic noises that could affect ambient noise arise from the following general types of activities in and near the sea, any combination of which can contribute to the total noise at any one place and time. These noises include transportation, dredging, construction; geophysical (seismic) surveys; sonars; explosions; and ocean research activities (Richardson et al. 1995b).

Noise in the marine environment has received a lot of attention in recent years and is likely to continue to receive attention in the reasonably foreseeable future. Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (Jasny et al. 2005; NRC 1994; NRC 2000; NRC 2003b; NRC 2005; Richardson et al. 1995b). Commercial fishing vessels, cruise ships, transport boats, airplanes, helicopters and recreational boats all contribute sound into the ocean (NRC 2003b). The military uses sound to test the construction of new vessels as well as for naval operations.

Many researchers have described behavioral responses of marine mammals to the sounds produced by helicopters and fixed-wing aircraft, boats and ships, as well as dredging, construction, geological explorations, etc. (Richardson et al. 1995b). Most observations have been limited to short-term behavioral responses, which included cessation of feeding, resting, or social interactions. Several studies have demonstrated short-term effects of disturbance on humpback whale behavior (Baker et al. 1983; Bauer and Herman 1986; Hall 1982; Krieger and Wing 1984), but the long-term effects, if any, are unclear or not detectable.

Anthropogenic noise may also interfere with communication and the ability to interpret or hear biological relevant cues in the environment. Researchers have found that either lower levels of anthropogenic noise presented for long time periods of time or intense impulsive sounds or sonar pings for short time periods (Mooney et al. 2009b) can produce a temporary reduction in hearing sensitivity and TTS in marine mammals (Nachtigall et al. 2013). Carretta et al. (2001) and Jasny et al. (2005) identified the increasing levels of anthropogenic noise as a habitat concern for whales and other cetaceans because of its potential effect on their ability to communicate.

Much of the increase in noise in the ocean environment is due to increased shipping as ships become more numerous and of larger tonnage (Hildebrand 2009; McKenna et al. 2012; NRC 2003). Shipping constitutes a major source of low-frequency noise in the ocean, particularly in the Northern Hemisphere where the majority of ship traffic occurs. At frequencies below 300 Hz, ambient noise levels are elevated by 15 to 20 dB when exposed to sounds from ships at a distance (McKenna et al. 2013). Surface shipping is the most widespread source of anthropogenic, low frequency (0 to 1,000 Hz) noise in the oceans (Simmonds and Hutchinson 1996). The radiated noise spectrum of merchant ships ranges from 20 to 500 Hz and peaks at approximately 60 Hz. Analysis of noise from ships revealed that their propulsion systems are a dominant source of radiated underwater noise at frequencies less than 200 Hz (Ross 1976). Additional sources of ship noise include rotational and reciprocating machinery that produces tones and pulses at a constant rate. Individual vessels produce unique acoustic signatures that may change with ship speed, vessel load, and activities that may be taking place on the vessel. Peak spectral levels for individual commercial ships are in the frequency band of 10 Hz to 50 Hz and range from 195 dB re μPa^2/Hz at 1 m for fast-moving (greater than 20 knots) supertankers to 140 dB re μPa^2/Hz at 1 m for small fishing vessels (NRC 2003). Small boats with outboard or inboard engines produce sound that is generally highest in the mid-frequency (1 kHz to 5 kHz) range and at moderate (150 to 180 dB re 1 μPa at 1 m) source levels (Erbe 2002; Gabriele et al. 2003; Kipple and Gabriele 2004). On average, noise levels are higher for the larger vessels and increased vessel speeds resulted in higher noise levels.

The Navy estimated that the 60,000 vessels of the world's merchant fleet annually emit low frequency sound into the world's oceans for the equivalent of 21.9 million days, assuming that 80 percent of the merchant ships are at sea at any one time (Navy 2001). Ross (1976) has estimated that between 1950 and 1975 shipping had caused a rise in ambient ocean noise levels of 10 decibels (dB). The researcher predicted that this would increase by another 5 dB by the

beginning of the 21st century. The National Research Council (NRC 2000) estimated that the background ocean noise level at 100 Hz has been increasing by about 1.5 dB per decade since the advent of propeller-driven ships. At lower frequencies, the dominant source of this noise is the cumulative effect of ships that are too far away to be heard individually, but because of their great number, contribute substantially to the average noise background.

Several major ports occur along the U.S. west coast, including Portland, San Francisco, Los Angeles, Long Beach, and San Diego (DoT 2005). These ports service a wide variety of vessels, including cargo, tug and barges, small ships, liquid bulk, dry bulk, break bulk, intermodal (container, roll-on/roll-off, lighter aboard ship), ferry, tourist passenger vessels (sailboats, ferry, party-boat fishing, whale watching) and cruise ships. Ocean shipping is a significant component of Hawaii's economy. Several shipping ports exist in Hawaii, including Nawailiwili on the southeast coast of Kauai (outside of the action area). Data from the U.S. Army Corps of Engineers U.S. Waterway Network indicate that major shipping routes around Hawaii are generally outside of the action area (Figure 10), though military and non-military vessels (e.g., recreational, tourist, fishing) do occur in the PMRF.

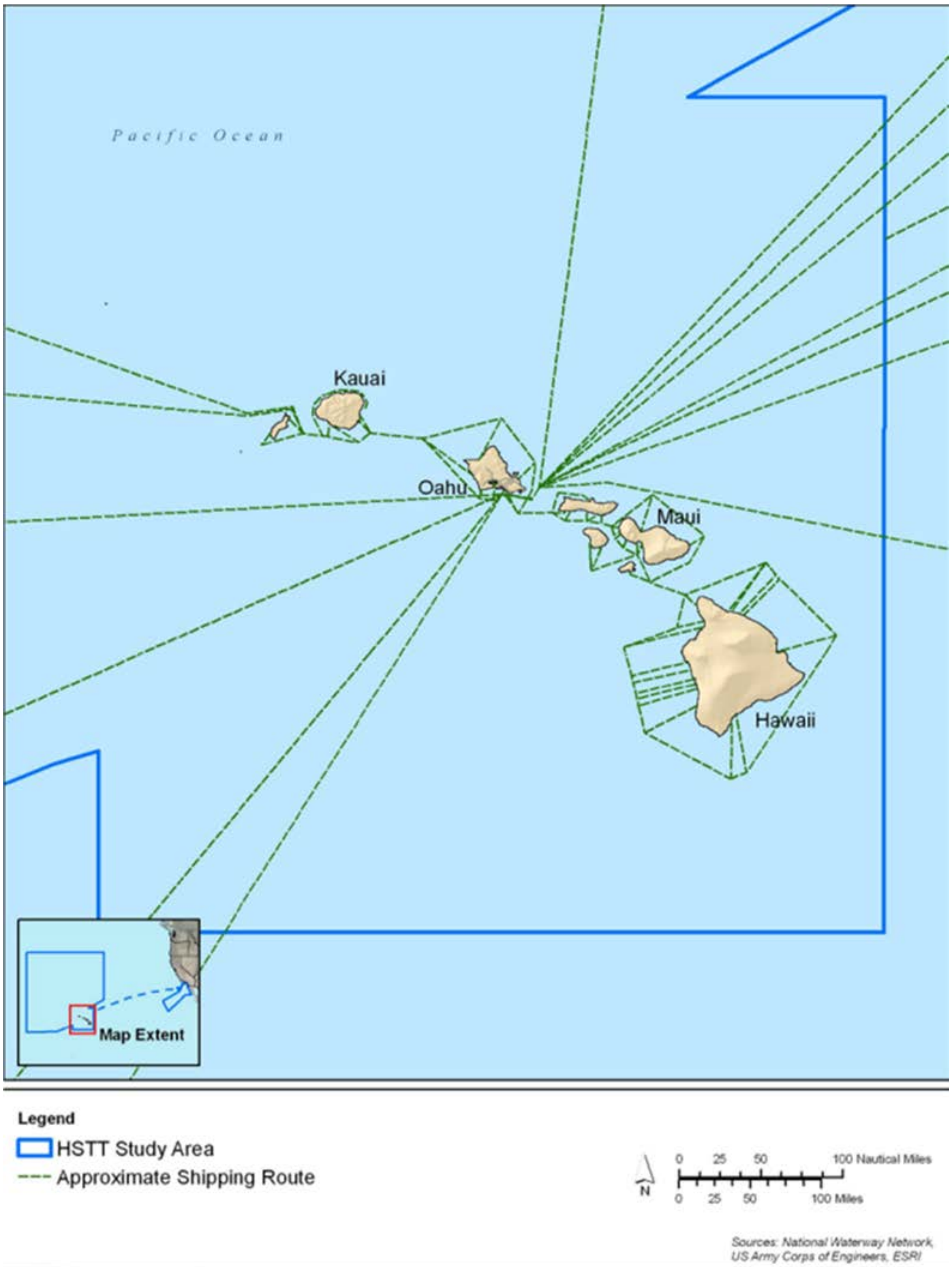

Figure 10. Approximate shipping routes around the Main Hawaiian Islands. Source: Navy 2013.

5.3.1 Ongoing Military Activities

The U.S. Navy conducts military readiness activities in the HRC, which includes the action area. Since 1971, the U.S. Navy has conducted the biennial Rim of the Pacific exercises. These exercises, which historically have lasted for about a month, have involved forces from various nations on the Pacific Rim including Australia, Canada, Chile, Japan, and the Republic of Korea. We have limited information on the particular components of those exercises since their

inception, but we assume that most of those exercises involved many of the components that are part of current exercises. Currently, the PMRF supports military training operations from small, single-unit exercises up to largescale, multiple-unit battle group scenarios using a variety of aircraft, surface combatant vessels and submarines. These activities are a source of anthropogenic noise in the action area. Specific activities that occur in the PMRF include, but are not limited to, anti-submarine warfare and missile testing. Potential noise-related stressors associated with these activities include vessel and aircraft noise, sonar, and noise from explosive ordnance detonations. A more comprehensive description of these activities is available in several consultations NMFS has concluded for the Navy since 2006. More recently, NMFS issued a biological opinion on the effects of these activities of the Navy's Hawaii-Southern California Training and Testing on marine animals. For sei whales, the 2015 biological opinion estimated a total of one sei whale could be killed over the course of the 5-year actions, and up to 630 per year (not to exceed 2,996 total in five years) would experience TTS or other behavioral harassment. No sei whales were expected to experience any other physical injury or PTS. The effects analysis in the biological opinion estimated four Pacific sea turtles[1] could be killed, 13 could be harmed by GI tract, slight lung or other physical injury, 21 could experience PTS, and 327 could experience TTS annually as a result of exposure to Navy acoustic stressors occurring in the HRC. The 2015 biological opinion concluded that the Navy's military readiness activities were likely to adversely affect, but would not jeopardize the survival or recovery of these marine species.

The U.S. Air Force conducted one mission under this same program in October 2016. These activities are discussed in the 2016 biological opinion for the project. Weapons testing and training activities occurred in the action area of the PMRF on one day only. The total NEW of the munitions were 250 lbs. (JASSM) and 37 lbs. (SDB) with detonations occurring at the water surface. The 2016 biological opinion exempted take for one sea turtle in the Pacific sea turtle guild in the form of TTS. No additional sea turtle or marine mammal exposures were estimated to occur at sound pressure thresholds expected to require incidental take under the ESA. Based on relative abundance information for sea turtles in the action area at the time, NMFS assumed that the one instance of TTS from the Pacific sea turtle guild was of a green sea turtle from the Central North Pacific DPS.

Mitigation and monitoring procedures were implemented by the U.S. Air Force as required by NMFS' 2016 biological opinion. The U.S. Air Force determined no marine animals were sighted during pre and post surveys. Based on these results, NMFS assumes no take occurred for ESA-listed species in the action area during 2016 operations beyond what was expected and described in the 2016 biological opinion.

[1] The 2015 biological opinion did not separate the sea turtles according to species. So the estimates include any turtle in the Pacific sea turtle guild, comprised of green, hawksbill, loggerhead, olive ridley, and leatherback turtles. Although, the majority of turtles were expected to be green sea turtles.

5.4 Natural and Human-induced Mortality

For marine mammals, natural mortality rates in cetaceans, especially large whale species, are largely unknown. Although factors contributing to natural mortality cannot be quantified at this time, there are a number of suspected causes, including parasites, predation, red tide toxins and ice entrapment. For example, the giant spirurid nematode (*Crassicauda boopis*) has been attributed to congestive kidney failure and death in some large whale species (Lambertsen 1986). Predation on some species of marine mammals by others has also been documented. A well-known observation of killer whales attacking a blue whale off Baja, California, demonstrates that blue whales are at least occasionally vulnerable to these predators (Tarpy 1979). Other stochastic events, such as fluctuations in weather and ocean temperature affecting prey availability, may also contribute to large whale natural mortality.

Whales also appear to strand from natural (as compared with anthropogenic) causes. Nitta (1991) reported that between 1936 and 1988, eight humpback whales, one fin whale, and five sperm whales stranded in the Hawaiian Archipelago. In a partial update of that earlier report, Maldini et al. (2005) identified 202 toothed cetaceans that had stranded between 1950 and 2002. Sperm whales represented ten percent of that total. Although these two studies did not specify the cause or causes of death in these cases, we include these strandings in this discussion of sources of natural mortality because the causes of death remain unknown. Most of these stranding events consisted of individual animals and many of the multiple stranding events identified in these reports occurred prior to the mid-1960s (four of the eight multiple stranding events identified by Maldini et al. occurred between 1957 and 1959, 3 of 8 occurred in 1976, and 1 occurred in 1981).

Sea turtles are also exposed to a wide variety of natural threats. The beaches on which sea turtles nest and the nests themselves are threatened by hurricanes and tropical storms as well as the storm surges, sand accretion, and rainfall that are associated with hurricanes. Hatchlings are hunted by predators like herons, gulls, dogfish, and sharks. Larger individuals, including adults, are also killed by sharks and other large, marine predators.

Sources of human-induced mortality on marine mammals and sea turtles include commercial whaling, subsistence hunting, commercial fishing, ship strikes, and habitat degradation. These sources of mortality are discussed below.

5.4.1 Commercial Whaling and Subsistence Hunting

Large whale population numbers in the proposed action areas (sei whales in particular) have historically been impacted by commercial exploitation, mainly in the form of whaling. Prior to current prohibitions on whaling, such as the International Whaling Commission's 1966 moratorium, most large whale species had been depleted to the extent it was necessary to list them as endangered under the ESA of 1966. For example, from 1900 to 1965 nearly 30,000 humpback whales were taken in the Pacific Ocean with an unknown number of additional animals taken prior to 1900 (Perry et al. 1999a). Sei whales are estimated to have been reduced

to 20 percent (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific (Tillman 1977). In addition, 9,500 blue whales were reported killed by commercial whalers in the North Pacific between 1910-1965 (Ohsumi and Wada 1972) and 25,800 sperm whales (Barlow et al. 1997). These numbers likely represent the minimum harvested, as illegal or underreported harvests are not included. Although commercial whaling no longer targets the large, endangered whales in the proposed action area, historical whaling may have altered the age structure and social cohesion of these species in ways that continue to influence them.

5.4.2 Fisheries Interactions

Entrapment and entanglement in commercial fishing gear is one of the most frequently documented sources of human-caused mortality in large whale and sea turtle species. For example, an estimated 78 rorquals were killed annually in the offshore southern California drift gillnet fishery during the 1980s (Heyning and Lewis 1990). From 1996-2000, 22 humpback whales of the Central North Pacific population were found entangled in fishing gear (Angliss et al. 2002). From 1998 to 2005, five fin whales, twelve humpback whales, and six sperm whales were either seriously injured or killed in fisheries off the mainland west coast of the U.S. (California Marine Mammal Stranding Network Database 2006). Many of the entangled humpback whales observed in Hawaiian waters brought the gear with them from higher latitude feeding grounds; for example, the whale the U.S. Navy rescued in 1996 had been entangled in gear that was traced to a recreational fisherman in southeast Alaska. Thus far, six of the entangled humpback whales observed in the Hawaiian Islands have been confirmed to have been entangled in gear from Alaska. Nevertheless, humpback whales are also entangled in fishing gear in the Hawaiian Islands. Since 2001, there have been five observed interactions between humpback whales and gear associated with the Hawaii-based longline fisheries (NMFS 2008a). In each instance, however, all of the whales were disentangled and released or they were able to break free from the gear without reports of impairment of the animal's ability to swim or feed. A photography study of humpback whales in southeastern Alaska in 2003 and 2004 found at least 53 percent of individuals showed some kind of scarring from fishing gear entanglement (Neilson et al. 2005).

False killer whales in Hawaiian waters have been seen to take catches from longline and trolling lines (Nitta and Henderson 1993; Shallenberger et al. 1981). Interactions with longline and troll fishery operations appear to result in disfigurement to dorsal fins, with roughly 4 percent of the population showing this injury, as well as entanglement and hooking (Baird and Gorgone 2005; Forney and Kobayashi. 2007; McCracken and Forney 2010; Nitta and Henderson 1993; Shallenberger et al. 1981; Zimmerman 1983). Carretta et al. (2013) estimated that less than one (0.5, CV=1.7) individuals per year from the MHI insular false killer whale stock are killed or seriously injured during the course of fishing operations in the Hawaiian exclusive economic zone. Sperm whale interactions with the longline fisheries in the Gulf of Alaska are also increasing in frequency with the first documented entanglement occurring in June of 1997 (Hill et al. 1999; Sigler et al. 2008). To date, no sei whales have been killed in interactions with any

eastern North Pacific fisheries, but the true mortality rate must be considered unknown because of unobserved mortality. Therefore, we consider it possible for sei whales to also be vulnerable to interactions with longline and trolling lines.

Sea turtles may be impacted by fisheries through entrapment or entanglement in actively fished gear, or may be impacted through entanglement in derelict fishing gear. A large number of sea turtles are killed or injured in fisheries worldwide each year (e.g., (Finkbeiner et al. 2011)). Incidental capture in fisheries is identified as a threat to sea turtle species. However, assessing the impact of fisheries on such species is difficult, due to the large number of fisheries that may interact with the animals, and the inadequate protected species monitoring that occurs in many of those fisheries. The primary fisheries that are known to affect the action area for sea turtles are commercial longline and gillnet as well as other hook and line fisheries (primarily recreational). U.S. longline fisheries are required to use circle hooks, dehookers, line clippers, and crewmember training in order to minimize impacts to sea turtles. These measures have reduced some sea turtle interactions to negligible levels (80 FR 15271).

Gillnet fisheries in the Main Hawaiian Islands have documented instances where green sea turtles are incidentally entangled in net gear, sometimes resulting in mortality (80 FR 15271; (Francke 2013). Hook and line fishing from shore and boats in the Hawaiian Islands also hooks and entangles sea turtles (Francke 2013; NMFS 2012; 80 FR 15271), though the chance of survival is higher than if caught in a gillnet (Chaloupka et al. 2008b). Loggerhead sea turtles have also been and are expected to continue to be captured and killed in the deep-set based longline fisheries based out of Hawaii and American Samoa.

Spotila (2000) concluded that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific Ocean during the 1990s is 1,500 animals. The researcher estimated this represented about a 23 percent mortality rate (or 33 percent if most mortality was focused on the East Pacific population). Between 1,000 and 1,300 leatherback turtles are estimated to have been captured and killed in longline fisheries in 2000 (Lewison et al. 2004). Shallow-set longline fisheries based out of Hawaii are estimated to have captured and killed several hundred leatherback turtles before they were closed in 2001. When they were re-opened in 2004, with substantial modifications to protect sea turtles, these fisheries were estimated to have captured and killed about one or two leatherback turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawaii are estimated to have captured about 19 leatherback turtles, killing about five of these sea turtles. Leatherback sea turtles have also been and are expected to continue to be captured and killed in the deep-set based longline fisheries based out of Hawaii and American Samoa.

Loggerhead sea turtles are also captured and killed in commercial fisheries. In the Pacific Ocean, between 2,600 and 6,000 loggerhead turtles were estimated to have been captured and killed in longline fisheries in 2000 (Lewison et al. 2004). Shallow-set Hawaii based longline fisheries are estimated to have captured and killed several hundred loggerhead turtles before they were closed in 2001. When they were re-opened in 2004, with substantial modifications to protect sea turtles,

these fisheries were estimated to have captured and killed about fewer than five loggerhead turtles each year. Between 2004 and 2008, shallow-set fisheries based out of Hawaii are estimated to have captured about 45 loggerhead turtles, killing about ten of these sea turtles. This fishery has interacted with three loggerhead and nine leatherback turtles in 2009 and seven loggerhead and eight leatherback turtles in 2010 (NMFS 2011). These fisheries are expected to continue at similar rates of interaction and deaths into the reasonably foreseeable future.

5.5 Habitat Degradation

Chronic exposure to the neurotoxins associated with paralytic shellfish poisoning from zooplankton prey has been shown to have detrimental effects on marine mammals. Estimated ingestion rates are sufficiently high to suggest that the paralytic shellfish poisoning toxins are affecting marine mammals, possibly resulting in lower respiratory function, changes in feeding behavior and a lower reproduction fitness (Durbin et al. 2002). There are four types of “shellfish” poisoning including; paralytic shellfish poisoning from dinoflagellates (*Alexandrium spp*) and amnesic shellfish poisoning from domoic acid from diatoms (*Pseudonitzschia spp*). Domoic acid poisoning also impairs nervous and respiratoiry function, sometimes to point of death (Bargu et al. 2002; Fire et al. 2010; Lefebvre et al. 2002; Lewitus et al. 2012; Scholin et al. 2000; Silvagni et al. 2005).

Other human activities, including discharges from wastewater systems, dredging, ocean dumping and disposal, aquaculture and additional impacts from coastal development are also known to impact marine mammals and their habitat. Point-source pollutants from coastal runoff, at-sea disposal of dredged materials and sewage effluent, oil spills, as well as substantial commercial vessel traffic, and the impact of trawling and other fishing gear on the ocean floor are continued threats to marine mammals and sea turtles in the proposed action area.

The impacts from these activities are difficult to measure. However, some researchers have correlated contaminant exposure to possible adverse health effects in marine mammals. Studies of captive harbor seals have demonstrated a link between exposure to organochlorines (e.g., DDT, PCBs, and polyaromatic hydrocarbons) and immunosuppression (De Swart et al. 1996; Harder et al. 1992; Ross et al. 1995). Organochlorines are chemicals that tend to bioaccumulate through the food chain, thereby increasing the potential of indirect exposure to a marine mammal via its food source. During pregnancy and nursing, some of these contaminants can be passed from the mother to developing offspring. Contaminants like organochlorines do not tend to accumulate in significant amounts in invertebrates, thus contaminant levels in planktivorous mysticetes have been reported to be one to two orders of magnitude lower compared to other marine mammal species such as piscivorous odontocetes (O'Hara and Rice 1996; O'Shea and Brownell 1994).

Very little is known about baseline levels and physiological effects of environmental contaminants on marine turtle populations (Bishop et al. 1991; Witkowski and Frazier 1982). There are a few isolated studies on organic contaminants and trace metal accumulation in green and leatherback turtles (Aguirre et al. 1994; Davenport et al. 1990). Mckenzie et al. (McKenzie

et al. 1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in marine turtle tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles. It is thought that dietary preferences were likely to be the main differentiating factor among species (Storelli et al. 2008). Keller et al. (2005) found that chronic exposure of sea turtles to organochlorine contaminants (such as PCBs and pesticides) may modulate the immune response in these animals by suppressing innate immunity and enhancing certain lymphocyte activity. More research is needed on the short- and long-term health and fecundity effects of chlorobiphenyl, organochlorine, and heavy metal accumulation in sea turtles. Domoic acid can also impact sea turtles of the action area (Jacobson et al. 2006).

5.6 Marine Debris

Marine debris is another significant concern for ESA-listed species and their habitats. Marine debris has been discovered to be accumulating in gyres throughout the oceans. Marine debris is prevalent throughout the action area, originating from a variety of oceanic and land-based sources. Marine debris is also known to accumulate in large numbers along the beaches of the Northwestern Hawaiian island atolls due to oceanic currents.

Debris can be introduced into the marine environment by its improper disposal, accidental loss, or natural disasters (Watters et al. 2010), and can include plastics, glass, derelict fishing gear, derelict vessels, or military expendable materials. Though debris abundance is well understood in shallow-water, shoreline, and surface-water habitats, debris can also settle into deep water benthic habitats (Watters et al. 2010). Marine debris affects marine habitats and marine life worldwide, primarily by entangling or choking individuals that encounter it. Despite debris removal and outreach to heighten public awareness, marine debris in the environment has not been reduced (Academies 2008). Stranding information shows that entanglement in lost or discarded fishing line is one of the causes of green turtle strandings and mortality in the main Hawaiian Islands (81 FR 20057).

Marine debris can also be accidentally consumed while foraging. Ingestion of marine debris can have fatal consequences even for large whales as well as sea turtles. In 1989, a stranded sperm whale along the Mediterranean was found to have died from ingesting plastic that blocked its digestive tract (Viale et al. 1992). A sperm whale examined in Iceland had a lethal disease thought to have been caused by the complete obstruction of the gut with plastic marine debris (Lambertsen 1990). The stomach contents of two sperm whales that stranded separately in California included extensive amounts of discarded fishing netting (NMFS 2009). A fifth individual from the Pacific was found to contain nylon netting in its stomach when it washed ashore in 2004 (NMFS 2009). Further incidents may occur but remain undocumented when carcasses do not strand.

For turtles, juveniles investigating multiple types of prey items, may be particularly vulnerable to ingesting non-food items (Baird and Hooker 2000; Schuyler et al. 2013). This can have

significant implications for an animal's survival, potentially leading to starvation, malnutrition, or internal injuries from consumption. Parker et al. (2005) conducted a diet analysis of 52 loggerhead sea turtles collected as bycatch from 1990 to 1992 in the high seas drift gillnet fishery in the central north Pacific. The authors found that 34.6 percent of the individuals sampled had anthropogenic debris in their stomachs (e.g., plastic, Styrofoam, paper, rubber, etc.). Similarly, a study of green sea turtles found that 61 percent of those observed stranded had ingested some form of marine debris, including rope or string, which may have originated from fishing gear (Bugoni et al. 2001).

5.7 Scientific Research

Scientific research permits issued by NMFS currently authorize studies on marine mammals and sea turtles in and around Hawaii, some of which extend into portions of the action area. The issuance of these research permits was considered in section 7 consultations by NMFS. Authorized research on ESA-listed marine mammals includes close vessel and aerial approaches, biopsy sampling, tagging, ultrasound, and exposure to acoustic activities, and breathe sampling. Research activities involve non-lethal "takes" of these whales by harassment, with none resulting in mortality. Sea turtle research includes capture, handling, restraint, tagging, biopsy, blood sampling, lavage, ultrasound, and tetracycline injection.

5.8 Summary of the Factors Affecting the Environmental Baseline

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on ESA-listed species considered in the biological opinion. These stressors include, but are not limited to, climate change, vessel interactions, fisheries interactions, habitat degradation, marine debris, scientific research, and military readiness activities. These factors are ongoing and are expected to occur contemporaneously with the proposed action. Assessing the aggregate impacts of these stressors on sei whales, leatherback, loggerhead, and olive ridley sea turtles is difficult and, to our knowledge, no such analysis exists. This becomes even more difficult considering that these species are wide ranging and subject to stressors in locations well beyond the action area.

We consider the best indicator of the aggregate impact of the *Environmental Baseline* on these species in the action area to be the status of these species. Because these vary for each species, this indicates that the *Environmental Baseline* is impacting species in different ways. For the species that are more resilient to perturbations because of their wide distribution worldwide (e.g., olive ridley sea turtle), they remain so despite the potential negative impacts of the *Environmental Baseline*. Therefore, while the *Environmental Baseline* described previously may slow their recovery, recovery is not being prevented. For the species that may be declining in abundance (sei whales, leatherback and loggerhead sea turtles), it is possible that the suite of conditions described in the *Environmental Baseline* is preventing their recovery. However, it is also possible that their populations are at such low levels (e.g., due to historic and current threats) that even when the species' primary threats are removed, the species may not be able to

achieve recovery. At small population sizes, they may experience phenomena such as demographic stochasticity, inbreeding depression, and Allele effects, among others, that cause their population size to become less resilient to continued perturbation and a threat in and of itself.

6 Effects of the Action on ESA-Listed Species and Critical Habitat

Section 7 regulations define "effects of the action" as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but are reasonably certain to occur. This effects analyses section is organized following the stressor, exposure, response, risk assessment framework.

As was stated in Section 3, this opinion includes both a jeopardy analysis and an adverse modification analysis.

The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

6.1 Stressors Associated with the Proposed Action

The potential stressors (risks) to ESA-listed species that we analyzed based on the activities that the U.S. Air Force proposes to conduct in the PMRF action area are summarized in Table 6 below.

Table 6. U.S. Air Force Stressor Categories and Descriptions for 2017-2021 operations (USAF 2016)	
Stressor	**Description of Stressor**
Acoustic (launch and detonation noise from explosives, aircraft noise)	Effects on species from acoustic sources (e.g., explosives) are dependent on a number of factors, including the proximity of the animal to the sound source, and the duration, frequency, and intensity of the sound. Underwater sound propagation is highly dependent upon environmental characteristics such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location will be different than near the source due to the interaction of many factors, including propagation loss; how the sound is reflected, refracted, or scattered; the potential for reverberation; and interference due to multi-path propagation. Explosives used during this mission include bombs and missiles. Detonations would occur near the water's surface over waters deeper than 4,645 m (15,240 ft), and approximately 44 nm from shore. Noise associated with munitions firing and explosives at the surface could occur anywhere within the impact area. Sound could be generated by the launch or dropping of the munitions, the munition flying through the air, the detonation at the surface of the water, or through vibrations from detonations that propagate through the water. Aircraft are used for firing the munitions throughout the action area, contributing airborne sound via motor/propeller noise to the ocean environment. Aircraft sounds have more energy at lower frequencies. Since the aircrafts will be taking off and landing at out bases, most sound from the aircraft would be during pre and post-mission surveys and refueling in the action area should a fighter jet need fuel.
Physical disturbance and strike (military expended materials)	Physical disturbances, including direct strikes on ESA-listed animals, may occur in association with munitions deployment and materials expended from detonations at the water surface. Military expended materials include all pieces and fragments from explosive munitions, which have the potential to contribute to the physical disturbance and strike stressor either in-air or in-water or both.
Ingestion of munition fragments	Marine mammals or sea turtles could ingest fragments of exploded bombs and missiles. Fragments would result from fractures in the munitions casing and would vary in size depending on the size of the net explosive weight and munition type. These solid metal materials would quickly sink through the water column and settle to the seafloor.

Secondary (explosion byproducts, metals, and chemicals)	Secondary stressors associated with explosive ordnance activities could pose indirect impacts to ESA-listed marine species through habitat degradation or alteration or an effect on prey availability. Effects to habitat and prey availability may result from: (1) explosives, (2) explosion byproducts and unexploded ordnance, (3) metals, and (4) chemicals. In addition to directly impacting marine species, explosions could impact other species in the food web, including prey species that ESA-listed marine species feed upon. The impacts of explosions would differ depending upon the type of prey species in the detonation area. Explosion byproducts are not toxic to marine organisms at realistic exposure levels (Rosen and Lotufo 2010). Relatively low solubility of most explosives and their degradation products means that concentrations of these contaminants in the marine environment are relatively low and readily diluted. Metals are introduced into seawater and sediments as a result of explosive ordnance activities. Missiles may also release potentially harmful chemicals into the marine environment, though properly functioning missiles combust most of their propellants, leaving benign or readily diluted soluble combustion byproducts (e.g., hydrogen cyanide). Operational failures allow propellants and their degradation products to be released into the marine environment. The greatest risk to marine species would be from perchlorate released from missiles that operationally fail. Perchlorate is highly soluble in water, persistent, and impacts metabolic processes in many plants and animals.

6.1.1 Summary of Effect Determinations by Stressor

Table 7 below summarizes our final effects determinations by stressor category.

Table 7. Stressors associated with the Long Range Strike Weapon Systems Evaluation Program activities for 2017-2021 in the PMRF area and the effects determination for ESA-listed species. The species in bold are those that are likely to be adversely affected by the U.S. Air Force Long Range Strike Weapon Systems Evaluation Program activities.

Common Name	Overall ESA Determination	Effect Determinations by Stressor						
		Acoustic			Physical		Ingestion	Secondary
		Detonation Noise	Launch Noise	Aircraft Noise	Military expended materials	Munition strike	Munitions	Explosion byproducts, metals, chemicals, and food web effects
Blue whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Fin whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sei whale	**LAA**	**LAA**	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Sperm whale	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
False killer whale (Main Hawaiian Islands Insular DPS)	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Hawaiian monk seal	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Green sea turtle (Central North Pacific DPS**)**	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Green sea turtle (East Indian-West Pacific, Central West Pacific, Southwest Pacific, Central South Pacific, Southwest Pacific, Central South Pacific, and East Pacific DPSs)	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Hawksbill sea turtle	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Loggerhead sea turtle (North Pacific Ocean) DPS)	**LAA**	**LAA**	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Olive Ridley sea turtle	**LAA**	**LAA**	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Leatherback sea turtle	**LAA**	**LAA**	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

6.2 Stressors Not Likely to Adversely Affect ESA-listed Species

The following section discusses stressors that are not likely to adversely affect ESA-listed species. If a stressor is likely to adversely affect any of the ESA-listed species in the action area, it is carried forward in our effects analysis.

6.2.1 Effects of Aircraft Noise

Many of the activities the U.S. Air Force conducts in the action area involve some level of activity from aircraft that include helicopters, bombers, and fighter jets. Low-flying aircraft produce sounds that marine mammals and sea turtles can hear when they occur at or near the ocean's surface. Underwater sounds from aircraft are strongest just below the surface and directly under the aircraft. Sounds from aircraft would not have physical effects on marine mammals or sea turtles, but represent acoustic stimuli (primarily low-frequency sounds from engines and rotors) that have been reported to affect the behavior of some marine mammals and sea turtles. It should also be noted that the air-sea interface constitutes a substantial sound barrier, with sound waves in the water being reduced by a factor of more than a thousand when they cross this boundary (Hildebrand 2005).

We did not estimate the number of ESA-listed marine mammals or sea turtles that are likely to be exposed to noise from aircraft overflight or other fixed or rotary-wing aircraft operations at altitudes low enough for the sounds to be prominent at, or immediately below, the ocean's surface. We assume any ESA-listed species that occur in the action area during activities that involve aircraft are likely to be exposed to minor acoustic stimuli associated with aircraft traffic. Furthermore, the altitude at which most of the flights will occur is likely beyond the range of detection for marine animals in the action area.

Studies have shown that aircraft presence and operation can result in changes in behavior of cetaceans (Arcangeli and Crosti 2009; Holt et al. 2009; Luksenburg and Parsons 2009b; Noren et al. 2009; Patenaude et al. 2002; Richter et al. 2006; Richter et al. 2003b; Smultea et al. 2008). In a review of aircraft noise effects on marine mammals, Luksenburg and Parsons (2009a) determined that the sensitivity of whales and dolphins to aircraft noise may depend on the animals' behavioral state at the time of exposure (e.g. resting, socializing, foraging or travelling) as well as the altitude and lateral distance of the aircraft to the animals. While resting animals seemed to be disturbed the most, low flying aircraft with close lateral distances over shallow water elicited stronger disturbance responses than higher flying aircraft with greater lateral distances over deeper water (Patenaude et al. 2002; Smultea et al. 2008) in Luksenburg and Parsons (2009a).

Thorough reviews on the behavioral reactions of marine mammals to aircraft and missile overflight are presented in Richardson et al. (1995), Efroymson et al. (2000), Luksenburg and Parsons (2009b), and Holst et al. (2011). The most common responses of cetaceans to aircraft overflights were short surfacing durations, abrupt dives, and percussive behavior (breaching and tail slapping) (Nowacek et al. 2007). Other behavioral responses such as flushing and fleeing the area of the source of the noise have also been observed (Holst et al. 2011; Manci et al. 1988). Richardson et al. (1995) noted that marine mammal reactions to aircraft overflight largely consisted of opportunistic and anecdotal observations. These observations lack a clear distinction between reactions potentially caused by the noise of the aircraft and the visual cue an aircraft presents. In addition, it was suggested that variations in the responses noted were due to other

undocumented factors associated with overflight (Richardson et al. 1995). These factors could include aircraft type (single engine, multi-engine, jet turbine), flight path (centered on the animal, off to one side, circling, level and slow), environmental factors such as wind speed, sea state, cloud cover, and locations where native subsistence hunting continues.

Mysticetes either ignore or occasionally dive in response to aircraft overflights (Efroymson et al. 2000; Koski et al. 1998). Richardson et al. (1995) reported that while data on the reactions of mysticetes is meager and largely anecdotal, there is no evidence that single or occasional aircraft flying above mysticetes causes long-term displacement of these mammals. In general, overflights above 305 m (1,000 ft) do not cause a reaction.

Bowhead whales in the Beaufort Sea exhibited a transient behavioral response to fixed-wing aircraft and vessels. Reactions were frequently observed at less than 305 m (1,000 ft) above sea level, infrequently observed at 457 m (1,500 ft), and not observed at 610 m (2,000 ft) above sea level (Richardson et al. 1995). Bowhead whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns. Behavioral reactions decreased in frequency as the altitude of the helicopter increased to 150 m (492 ft) or higher. It should be noted that bowhead whales may have more acute responses to anthropogenic activity than many other marine mammals since these animals are often presented with limited egress due to limited open water between ice floes. Additionally, many of these animals may be hunted by Alaska Natives, which could lead to animals developing additional sensitivity to human noise and presence.

Variable responses to aircraft have been observed in toothed whales, though overall little change in behavior has been observed during flyovers. Toothed whale responses to aircrafts include diving, slapping the water with their flukes or flippers, swimming away from the direction of the aircraft, or not visibly reacting (Richardson et al. 1995). Several authors have reported that sperm whales did not react to fixed-wing aircraft or helicopters in some circumstances (Au and Perryman 1982; Clarke 1956; Gambell 1968; Green et al. 1992a) and reacted in others (Clarke 1956; Fritts et al. 1983; Mullin et al. 1991; Patenaude et al. 2002; Richter et al. 2006; Richter et al. 2003a; Smultea et al. 2008; Wursig et al. 1998). Smultea et al. (2008) studied the response of sperm whales to low-altitude (233 to 269 m) flights by a small fixed-wing airplane near Kauai and reviewed data available from other studies. They concluded that sperm whales responded behaviorally to aircraft passes in about 12 percent of encounters. All of the reactions consisted of sudden dives and occurred when the aircraft was less than 360 m from the whales (lateral distance). They concluded that the sperm whales had perceived the aircraft as a predatory stimulus and responded with defensive behavior. In at least one case, Smultea et al. (2008) reported that the sperm whales formed a semi-circular "fan" formation that was similar to defensive formations reported by other investigators.

Other authors have corroborated the variability in sperm whales' reactions to fixed-wing aircraft or helicopters (Green et al. 1992b; Richter et al. 2006; Richter et al. 2003b; Smultea et al. 2008; Wursig et al. 1998). In one study, sperm whales showed no reaction to a helicopter until they

encountered the downdrafts from the rotors (Richardson et al. 1995). A group of sperm whales responded to a circling aircraft (altitude of 244 to 335 m [800 to 1,100 ft]) by moving closer together and forming a defensive fan-shaped semicircle, with their heads facing outward. Several individuals in the group turned on their sides, apparently to look up toward the aircraft (Smultea et al. 2008). Whale-watching aircraft apparently caused sperm whales to turn more sharply but did not affect blow interval, surface time, time to first click, or the frequency of aerial behavior (Richter et al. 2003b).U.S. Air Force aircraft do not fly at low altitude, hover over, or follow whales and so are not expected to evoke this type of response.

Smaller delphinids generally react to overflights either neutrally or with a startle response (Wursig et al. 1998). The same species that show strong avoidance behavior to vessel traffic (*Kogia* species and beaked whales) also react to aircraft (Wursig et al. 1998). Beluga whales reacted to helicopter overflights by diving, breaching, changing direction or behavior, and altering breathing patterns to a greater extent than mysticetes in the same area (Patenaude et al. 2002). These reactions increased in frequency as the altitude of the helicopter dropped below 150 m (492 ft).

Based on sea turtle sensory biology (Bartol et al. 1999b; Ketten and Bartol 2005; Ketten and Bartol 2006; Lenhardt et al. 1994; Ridgway et al. 1969), sound from low flying aircraft could be heard by a sea turtle that is at or near the surface. Turtles might also detect low flying aircraft via visual cues such as the aircraft's shadow. Hazel et al. (2007) suggested that green turtles rely more on visual cues than auditory cues when reacting to approaching water vessels. This suggests that sea turtles might not respond to aircraft overflights based on noise alone.

In conclusion, the low number of aircraft flights (i.e., just pre- and post-survey flights), typical altitudes of flights, sporadic occurrence of flights, limited duration of flights, deep water depths in the action area, and the lack of substantial sound propagation into the water column from aircraft indicate there is a low probability of exposing ESA-listed marine mammals and sea turtles to aircraft noise at perceivable levels. In the event an ESA-listed species was exposed to aircraft noise, it would likely result in temporary behavioral responses. These behavioral responses would not increase the likelihood of injury from significantly disrupting breeding, feeding, or sheltering and would not rise to the level of take. Therefore, the effects of aircraft noise on ESA-listed species are insignificant and not likely to adversely affect them.

6.2.2 Effects of Weapons Launch Noise

Aircraft fired munitions are not expected to have sound waves emanating from the firing source that would be of sufficient intensity to propagate a sound wave into the water that could adversely affect ESA-listed species. This is partially due to the height above the surface of the water that the munition would be released from (i.e., between 3,000 and 18,000 ft.), but also due to minimal transmission of sound from air to water (Hildebrand 2005). Further, these activities are of limited duration (i.e., nine explosions in 2016 all occurring on the same day) and the increased noise from each launch event would be brief. This limits the likelihood that ESA-listed species would be exposed to noise from weapons launch. Even if an animal were exposed to

noise from a weapons launch, at most we would expect a temporary behavioral response, similar to how an animal may respond to aircraft noise. Due to the short duration and sporadic nature of munition firing, the low likelihood that an ESA-listed animal would be in close enough proximity to detect sound from munition firing above water, and the high likelihood that any ESA-listed animal able to detect noise from weapons firing would only react very briefly, an increase in the likelihood of injury from significant disruption of breeding, feeding, or sheltering for ESA-listed marine mammals or fish is not likely. Therefore, the effects of weapons launch noise on ESA-listed marine mammals and sea turtles are insignificant and not likely to adversely affect them.

6.2.3 Effects of Munitions from Ingestion

The only materials small enough to be ingested by ESA-listed marine mammals and sea turtles are fragments from explosive ordnance. The detonations will occur over deep water (approximately 4,600 m depth) and fragments will likely sink quickly and settle on the sea floor below the diving and foraging depths of most animals considered in this opinion. Given the limited time most items will spend in the water column, it is not expected these items will be accidentally ingested by ESA-listed species not accustomed to foraging on the sea floor. The ESA-listed species potentially exposed to expended munitions while foraging on the sea floor is limited to sperm whales (monk seals and sea turtles forage on the sea floor, but do not forage on the sea floor in deep-water habitat where the detonations will occur; benthic feeding occurs in relatively more shallow, near-shore areas). Sperm whales are capable of foraging along the sea floor in deep water. However, the relatively low density of both sperm whales and explosive fragments on the sea floor suggests ingestion would be rare. Further, an animal would not likely ingest every fragment it encounters. Animals may attempt to ingest a projectile and then reject it, after realizing it is not a food item. Additionally, ingestion of items does not necessarily result in injury or mortality to the individual if the item does not become embedded in tissue (Wells et al. 2008). It is likely that most ingested material would pass through the digestive tract of the animal. Therefore impacts of fragment ingestion would be limited to the unlikely event where a marine mammal or sea turtle might suffer a negative response from ingesting an item that becomes embedded in tissue or is too large to be passed through the digestive system.

In conclusion, ESA-listed species are so unlikely to ingest expended material as to be discountable, or in the case of sperm whales, any ingested materials are likely to pass through the digestive tract without causing injury or any effects rising to the level of take. Therefore, the effects of ingested expended materials on ESA-listed species are either discountable, or insignificant, and not likely to adversely affect them.

6.2.4 Effects of Secondary Stressors

The use of explosive ordnance could pose indirect impacts to marine mammals or sea turtles through impacts to their habitat or prey.

Underwater explosions may reduce available prey items for ESA-listed species by either directly killing prey or by scaring them from the area. Behavioral avoidance of explosive ordnance by prey species may facilitate behavioral avoidance of additional explosives by ESA-listed species as they follow their food source as it flees. This benefit would remove ESA-listed species from blast locations while not interrupting feeding behavior. Due to the infrequent use of explosives and the limited area where explosives are used, it is not expected their use will have a persistent effect on prey availability or the health of the aquatic food web.

Metals used to construct the bombs and missile used by the U.S. Air Force include aluminum, steel, and lead. Aluminum is also present in some explosive materials such as tritonal and AFX-757. Metals would be expected to settle to the seafloor after munitions are detonated. Metal ions would slowly leach into the substrate and the water column, causing elevated concentrations in a small localized area around munition fragments. Some of the metals, such as aluminum, occur naturally in the ocean at varying concentrations and would not necessarily impact the substrate or water column. Other metals, such as lead, could cause toxicity in microbial communities in the substrate (USAF 2016). However, such effects would be localized and would not significantly affect the overall habitat quality of sediments in the action area. In addition, metal fragments would corrode, degrade, and become encrusted over time. It is extremely unlikely that marine mammals and sea turtles would be indirectly impacted by metals via the water column or sediment because of the small area that could be affected, dilution of any potentially harmful elements leached into the water column, and the low density of ESA-listed species in the area where metals may occur.

Chemical materials include explosive byproducts. Explosive byproducts would be introduced into the water column through detonation of live munitions. Explosive materials associated with long range strike Long Range Strike WSEP munitions include tritonal and research department explosive, among others. Tritonal is primarily composed of TNT. RDX is sometimes referred to as cyclotrimethylenetrinitramine. Various byproducts are produced during and immediately after detonation of RDX. During the very brief time that a detonation is in progress, intermediate products may include carbon ions, nitrogen ions, oxygen ions, water, hydrogen cyanide, carbon monoxide, nitrogen gas, nitrous oxide, cyanic acid, and carbon dioxide (Becker 1995). However, reactions quickly occur between the intermediates, and the final products consist mainly of water, carbon monoxide, carbon dioxide, and nitrogen gas, although small amounts of other compounds may be produced as well. Chemicals introduced to the water column would be quickly dispersed by waves, currents, and tidal action and eventually be distributed throughout the surrounding open ocean waters. A portion of the carbon compounds, such as carbon monoxide and carbon dioxide, would likely become integrated into the carbonate system (alkalinity and pH buffering capacity of seawater). Some of the nitrogen and carbon compounds, including petroleum products, would be metabolized or assimilated during protein synthesis by phytoplankton and bacteria. Most of the gas products that do not react with the water or become assimilated by organisms would be released to the atmosphere. Due to dilution, mixing, and

transformation, none of these chemicals are expected to have significant impacts on ESA-listed species or the marine environment.

Explosive material that is not consumed in a detonation could sink to the substrate and bind to sediments. However, the quantity of such materials is expected to be inconsequential. When munitions function properly, nearly full combustion of the explosive materials occurs, and only extremely small amounts of raw material remain. Additionally, TNT decomposes when exposed to sunlight/ultraviolet radiation and is also degraded by microbial activity (Becker 1995). Several types of microorganisms have been shown to metabolize TNT. Similarly, RDX is decomposed by hydrolysis, ultraviolet radiation exposure, and biodegradation (USAF 2016).

The use of 20-mm gunnery rounds for targeting sinkable aluminum or retrievable inflatable boats is not expected to cause any disturbance or result in adverse effects on animals. Most of the boats will be retrieved and are not expected to pose a risk for marine species after they have been used as part of the testing program. If any boat does sink, the water depths in the area are deep enough that the final settling location would be out of the diving range for most of the species. This area has been in regular use by the U.S. Navy and U.S. Air Force for years, so this type activity is common and has not been shown to have adverse effects on the water quality or substrate in the action area. These gunnery rounds are inert and would be fired against a target boat after the area has been cleared of marine species during pre-mission surveys. Therefore no acoustic impacts on species are expected from the use of targets or gunnery rounds.

Given the information provided above regarding the potential for explosives and byproducts, metals, and chemicals to indirectly affect marine ESA-listed marine mammal and sea turtle species through habitat and prey availability impacts, the likelihood of ESA-listed species being exposed to toxic levels of explosives, explosive byproducts, metals, other chemicals from Long Range Strike WSEP activities are so unlikely as to be considered discountable. Therefore, secondary stressors from Long Range Strike WSEP activities are not likely to adversely affect ESA-listed species.

6.2.5 Potential for Direct Physical Strike

This section evaluates the potential for the explosive ordnances used by the U.S. Air Force in 2017-2021 to physically strike an ESA-listed species. The potential for acoustic stressors associated with explosive detonations to affect ESA-listed species is evaluated in Section 6.4.1. A total of nine explosive ordnances (one JASSM and eight SDBs) will be released during the 2016 mission. The velocity of bombs and the missile will decrease quickly after the initial impact with the water, thereby decreasing the risk of direct physical strike to animals swimming in the water column at a depth below a few meters. Therefore, the potential for being struck by a bomb or munition would most likely be limited to marine mammals (e.g., sei whales) or sea turtles located at the water surface or in the water column close to the surface. In order to be struck, an animal would have to be at the water surface at the same time and location where the weapon would impact the surface of the water. While this is possible, the low densities (see Section 3.1 of this opinion) and dispersed distribution of marine mammals and sea turtles in the action area,

as well as the low number of bombs and missiles used in the proposed action, suggest this is highly unlikely. Pre-mission surveys of the impact area (see section 2.4) would reduce this likelihood even further as a bomb or missile launch would not occur if a marine mammal or sea turtle is observed in proximity to the impact area until the animal has left the area. The potential for direct strike from inert gunnery rounds is very low and not expected to occur since animals will have been cleared form the area. For these reasons, the likelihood of explosive (or inert) ordnance physically striking an ESA-listed marine mammal or sea turtle during the 2017 – 2021 U.S. Air Force Long Range Strike WSEP mission is so unlikely as to be considered discountable.

6.3 Minimization Measures to Avoid or Minimize Exposure

The U.S. Air Force will implement visual aerial surveys within the impact area prior to the release of munitions in order to minimize effects to ESA-listed marine mammals and sea turtles (described in section 2.4). These surveys are routinely implemented in the PMRF prior to similar military readiness exercises being conducted by the United States Navy. To date, there have been no documented instances of protected marine species serious injury or mortality in the PMRF from similar activities when the same range clearance procedures were followed. Personnel conducting these surveys are trained and experienced at conducting aerial marine animal surveys, which helps to ensure the surveys are as effective as possible. Surveys are conducted before, during and after each weapon deployment and training exercise, reducing the likelihood that protected species could enter the impact area during the time of detonation.

The surveys span a vast area, and will cover an 8 mile (13 km) radius around the planned detonation point, with a smaller marine mammal exclusion zone of 2.3 miles. This will encompass the entire zone of effects which correlate with injury, sub-injury and behavioral effects for marine mammals and sea turtles. Lastly, due to the speed and altitude of aircraft during protected species surveys, these aircraft may fly the survey pattern multiple times within a survey period to help ensure that protected species are not missed in the impact zone. We assume that aerial surveys would be more effective at identifying larger individuals (e.g., large whales) than smaller individuals (e.g., juvenile sea turtles); but the addition of the SNIPER technology will help to identify smaller sized species presence. Should any marine animal be observed during any of the surveys, the U.S. Air Force will implement measures (.i.e., delayed launches or ceasing activities) intended to avoid or minimize the potential adverse effects on ESA-listed species of sei whales, leatherback, loggerhead, and olive ridley sea turtles.

6.4 Stressors Likely to Adversely Affect ESA-listed Species

The only stressor we determined was likely to adversely affect ESA-listed species during the Air Force's proposed 2017-2021 mission was acoustic stressors from explosive detonations.

6.4.1 Exposure and Response Analysis

Our exposure analyses are designed to determine whether ESA-listed resources are likely to co-occur with the direct and indirect effects of actions and the nature of that co-occurrence. In this

step of our analyses, we try to identify the number of the individuals that are likely to be exposed to one or more of the stressors produced by, or associated with, an action and the populations or subpopulations those individuals represent.

The response analyses are designed to identify how endangered or threatened species (or designated critical habitat, when it is applicable) are likely to respond given their exposure to one or more of the stressors produced by an action. These analyses consider and weigh all of the evidence available, including the best scientific and commercial data available, to identify the probable responses of endangered and threatened species upon being exposed to stressors associated with actions.

The U.S. Air Force's analysis to estimate potential exposure of marine mammals and sea turtles to sounds from detonations is summarized in Section 3.1 and fully described in the U.S. Air Force's BA and associated appendices (USAF 2016). We verified the methodology and data used by the U.S. Air Force for their exposure analysis and accept the modeling conclusions on exposure of marine mammals and sea turtles. The density numbers that were derived per square kilometers of ocean area were then used to determine number of individuals likely to be affected by each injury or behavioral threshold criteria daily and annually to estimate potential incidental take numbers. In instances where the calculated number resulted in a decimal value, this was rounded up to the nearest whole number for a more conservative and realistic estimate of individual animals likely to experience acoustic exposure risks from the program.

6.4.1.1 Marine mammals (sei whales)

The criteria and thresholds used to estimate potential pressure and acoustic impacts from explosive detonations on marine mammals were obtained from Finneran and Jenkins (2012), and NMFS' 2016 *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* to include mortality, gastrointestinal tract injury, slight lung injury, PTS, TTS, and behavioral harassment.

For all ESA-listed marine mammal species considered in this opinion, exposure calculations from model output resulted in decimal values. The highest unrounded ESA-listed marine mammal exposure for any year was 0.6 instances of behavioral harassment for sei whales annually. These estimates were rounded to the nearest whole number to obtain exposure estimates for the 2017-2021. For activities occurring in 2017-2021, the U.S. Air Force's analysis indicated there would be no exposures of ESA-listed marine mammals to acoustic stressors from bombing and missile activities at thresholds that would rise to the level of take under the ESA in the form of mortality, gastrointestinal tract injury, slight lung injury, PTS, or TTS. No disturbance for any marine mammal is expected to occur in 2017. However, during 2018-2021, density estimates indicate one sei whale could potentially be affected annually and experience adverse behavioral effects. However, these modeled take numbers show that the probability of some of these species being impacted by the U.S. Air Force's activities is low (e.g., one modeled take for behavioral harassment of 4 of the 16 species). Realistically, these species are seen in larger groups (rather than on an individual basis); therefore, we took into consideration average

group sizes to determine our actual number of authorized takes. Given the life history and ecology of sei whales, they tend to occur in small groups with an average group size of 3.1 (Bradford et al., 2017). Thus, it is unlikely for a single sei whale to be present but at least a group of three. Because of this, NMFS assumes that three sei whales could be affected annually and experience harassment from adverse behavioral effects. Therefore, a total of twelve sei whales is expected to be affected over the 5-year duration of the program. No other sei whale exposures were estimated to occur at thresholds that would result in physical injuries, PTS, TTS, or mortality.

6.4.1.2 Sea turtles (leatherback, loggerhead, and olive ridley)

The criteria and thresholds used to estimate potential pressure and acoustic impacts from explosive detonations on sea turtles were also obtained from Finneran and Jenkins (2012). The criteria and thresholds include onset of mortality, onset of slight lung injury, onset of gastrointestinal tract injury, PTS, TTS, and behavioral harassment. The U.S. Air Force's exposure analysis (section 3.1) indicated there would be one exposure to explosives in 2017, two or three exposures daily in 2018-2021, for a maximum total of nine (eight in some years) annual exposures of ESA-listed sea turtles from the Pacific sea turtle guild. Based on species percentages for each species in the Pacific sea turtle guild, this will result in TTS and behavioral effects occurring for a maximum of four leatherback sea turtles, three loggerhead sea turtles, and two olive ridley sea turtles annually; for a total 16 leatherback sea turtles, 12 loggerhead sea turtles and eight olive ridley sea turtles experiencing TTS or behavioral effects over the 5-Year duration of the project. No other sea turtle exposures were estimated to occur at thresholds that would result in other physical injuries, PTS, or mortality.

6.4.2 Risk Analysis

As described previously, the only stressor we determined likely to adversely affect ESA-listed sei whales or sea turtles during the U.S. Air Force's proposed 2017- 2021 missions is acoustic stressors from exposure to explosive detonations. For sei whales, this stressor is expected to result in some type of behavioral response, but not expected to result in any injury. For sea turtles, a temporary threshold shift in hearing or behavioral response is expected. These effects are discussed below.

Behavioral Effects on Sei Whales

We have no specific information on the sound use or production by sei whales, or their sensitivity to sounds in their environment. Based on their anatomical and physiological similarities to both blue and fin whales, we assume that the hearing thresholds of sei whales will be similar as well and will be centered on low-frequencies in the 10-200 Hz. Moreover, there is no specific data regarding the behavioral responses of sei whales to underwater explosives. Thus we will discuss the general behaviors sei whales are likely to exhibit based on what is known about marine mammal behavior in relation to sound overall. Behavioral impacts can occur for marine mammals as a result of exposure to underwater detonations. These effects are considered

disturbances to an animal that may occur when an animal receives a sound level from and acoustic source that are below those considered to cause TTS or more severe physical injuries.

Behavioral studies on marine mammals indicate that reactions to sounds, if any, are highly contextual and vary between species and individuals within a species (Moretti et al., 2010; Southall et al., 2011; Thompson et al., 2010; Tyack, 2009a; Tyack et al., 2011). Because the few available studies show wide variation in response to underwater sound, it is difficult to quantify exactly how sound from the U.S. Air Force Long Range Strike WSEP operational testing would affect marine mammals. It is likely that the onset of surface detonations could result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include changing durations of surfacing and dives, number of blows per surfacing, moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); or avoidance of areas where sound sources are located (Richardson *et al*., 1995):.

The severity of the response may depend on the animal's location or proximity to the sound source, as well as how high the sound level is. An animal may also react to the received sound based upon its previous experience with the same or a similar sound, the context of the exposure, and the presence of other stimuli. The type and severity of the behavioral response will determine the energetic cost to the animal, which could result in a fitness consequence to an individual or ultimately the population. The biological significance of any of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. This would depend on the magnitude and type of effect, as well as the speed and completeness of recovery, affect the long-term consequences to individual animals and populations. Animals that recover quickly and completely from explosive effects will not likely suffer reductions in their health or reproductive success, or experience changes in their habitat utilization. In such cases, no population-level effects would be expected. Animals that do not recover quickly and fully could suffer reductions in their health and reproductive success; they could be permanently displaced or change how they utilize the environment; or they could die. Frequent disruptions to natural behavior patterns may not allow an animal to fully recover between exposures, which increases the probability of causing long-term consequences to individuals.

Effects on Sea Turtles – Pacific Leatherback, Loggerhead and Olive Ridley

As described previously, the proposed activities are expected to affect sea turtle hearing and behavior. Little information is known about sea turtle hearing and their use of sound in the marine environment. Based on knowledge of their sensory biology (Bartol and Ketten 2006; Moein Bartol and Musick 2003), sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues (Hazel 2007). Similarly, while sea turtles may rely on acoustic cues to identify nesting beaches, they appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann and Lohmann 1996a; Lohmann and Lohmann 1996b) and light (Avens and Lohmann 2003).

Studies on sea turtle hearing have been conducted on a few sea and freshwater species such as juvenile green, loggerhead, Kemp's Ridley and the red-ear slider (Ridgway et al. 1969; Bartol et al. 1999; Bartol and Ketten 2006; Christiansen-Dalsgaard et al. 2012; Lavender et al. 2012; Martin et al. 2012; Piniak et al. 2012). In general, these studies indicate turtles seem capable of detecting and responding to low-frequency vibrations, and thus able to detect underwater sound pressure. Their typical hearing is within frequencies from 30 Hz to 2,000 Hz, with a range of maximum sensitivity between 100 Hz and 800 Hz (Bartol et al. 1999c; Lenhardt 1994a; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). A few other studies have been conducted regarding responses of sea turtles to impulsive sounds emitted by airguns (McCauley et al., 2000; Moein Bartol et al., 1995; O'Hara and Wilcox, 1990). Overall, these studies indicate that perception and a behavioral reaction to a repeated sound may occur with sound pressure levels greater than 166 dB re 1 μPa root mean square (rms), and that more erratic behavior and avoidance may occur at higher thresholds around 175 to 179 dB re 1 μPa root mean square (McCauley et al., 2000; Moein Bartol et al., 1995; O'Hara and Wilcox, 1990). Based on this limited information, a received level of 175 dB re 1 μPa rms is more likely to be the threshold for which a sea turtle may exhibit an avoidance response from exposure to an impulsive sound source (McCauley et al., 2000). Thus, this is the threshold used to assess potential behavioral effects on sea turtles for the U.S. Air Force Long Range Strike WSEP mission.

The effects from impacts of underwater explosives on sea turtle hearing is largely unknown, and usually inferred from documented effects to other vertebrates including humans, marine mammals, and fishes. However, extrapolating these effects to sea turtles may not be reliable. The organ most sensitive to the primary effects of a sound wave produce by a blast is the auditory apparatus. The studies listed above enable a reasonable assumption that the sea turtle auditory apparatus is sensitive to sounds produced by underwater explosions. Rupture of the tympanic membrane, or the tympanum in the case of sea turtles, while not necessarily a serious or life-threatening injury, may lead to permanent hearing loss (Ketten 1995; Ketten 1998). No data exist that correlate the sensitivity of the sea turtle tympanum and middle and inner ear trauma associated with shock waves from underwater explosions (Viada et al. 2008).

TTS is a temporary impairment to an animals hearing sensitivity as a result of exposure to sounds above a sea turtles hearing threshold causing fatiguing or impairment of the inner ear hair cells. This can result from a single, instantaneous exposure event, or from a sustained, prolonged exposure over some duration (e.g. multiple explosions). In some cases, an animal may not even be aware of TTS. It does not suffer permanent hearing loss, but its hearing could be temporarily impaired, requiring a louder sound stimulus (relative to the amount of TTS) to detect a sound within the affected frequencies until hearing has recovered. TTS is generally considered recoverable, however the time for recovery can vary depending on the hearing sensitivity of the species, the physical condition prior to exposure of the individual animal, as well as degree and severity of harm or fatigue sustained by the hair cells in the inner ear.

Exposure to blasts of low intensity or of sufficient distance to be detected, could also result in temporary disorientation (Viada et al. 2008) or other behavioral responses such as startling the animal. As with marine mammals, these effects could result in a decreased ability to detect biologically relevant cues in the surrounding environment such as prey or mate detection, or ability to sense and avoid predators or other threats such as vessels.

6.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

During this consultation, NMFS searched for information on future state, tribal, local, or private actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what has already been described in the *Environmental Baseline*, which we expect will continue into the future. Anthropogenic effects include commercial and recreational fishing, Navy training and testing activities, vessel traffic, ocean noise, and pollution. An increase in these activities could result in an increased effect on ESA-listed species; however, the magnitude and significance of any anticipated effects remain unknown at this time.

6.6 Integration and Synthesis

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 6) to the environmental baseline (Section 5) and the cumulative effects (Section 6.5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species (Section 4).

The following discussion summarizes the probable risks the proposed action poses to threatened and endangered species that are likely to be exposed. The summary then integrates the exposure profiles presented previously with the results of our response analyses for each of the actions considered in this opinion.

The only stressor associated with the proposed action that we determined was likely to adversely affect ESA-listed species was exposure to acoustic stressors from explosive detonations.

Sei Whale

Although sighting of sei whales are considered to be rare in the action area, the U.S. Air Force model and NMFS' Permits and Conservation Division predict there could be up to three sei whales disturbed annually, for a total of twelve over the five year duration (no sei whales will be disturbed in 2017) as a result of exposure to some of the explosives testing. Most sei whales present in the action area during weapons deployment would only be exposed periodically or episodically, if at all, to the activities the U.S. Air Force proposes to conduct in action area. Many of the weapons testing and training exercises will occur without any marine animals being exposed to acoustic stressors other than explosive detonations. And those sei whales that are exposed to explosive detonations are not likely to be injured in any way but may demonstrate behavioural responses that indicate they perceive an acoustic stimulus.

Because most of the events will occur annually over four consecutive days, this could temporarily cause sei whales to leave the area or may disrupt some other behavior such as foraging and social interactions. Those responses are likely to depend on the distance of a whale from a detonation, the number of detonations per each exercise, as well as what activity the whale is involved with at the time of exposure. Sei whales seem most likely to try to avoid being exposed to the activities and their avoidance response is likely to increase as an exercise progresses. We do not have the information necessary to determine which of the sounds associated with an activity is likely to trigger avoidance behavior in sei whales, or whether sei whales would avoid being exposed to specific received levels, the entire sound field associated with an exercise, or the general area in which an exercise would occur. Particular sei whales might not respond to the detonations at all, while in other circumstances, sei whales could change their surface times, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions. Some of these whales might experience physiological stress (but not "distress") responses if they attempt to avoid a testing area after repeated detonations. However, because of the relatively short duration of individual activities in a single day, the small number of large exercises, and the short duration of the training exercises and testing activities overall, we do not expect these temporary responses of sei whales to reduce the fitness of individual whales.

Based on the evidence available, including the environmental baseline and cumulative effects, we conclude that the U.S. Air Force Long Range Strike WSEP training exercises and testing activities on an annual basis or cumulatively over the five year period from 2017-2021; or cumulatively for the reasonably foreseeable future (assuming there are no significant changes to the status of the species or Environmental Baseline); and NMFS's promulgation of regulations and issuance of incidental take authorizations pursuant to the MMPA for these activities, are not likely to affect the population dynamics, behavioral ecology, and social dynamics of individual sei whales in ways or to a degree that would reduce their fitness. An action that is not likely to reduce the fitness of individual whales would not be likely to reduce the viability of the populations those individual whales represent (that is, we would not expect reductions in the reproduction, numbers, or distribution of those populations). As a result, the activities the U.S.

Air Force plans to conduct in the action area would not appreciably reduce the sei whales' likelihood of surviving and recovering in the wild.

Sea Turtles

As discussed previously, sea turtles present in the action area during weapons testing activities are could suffer TTS and behavioral disturbance. However, due to the number of weapons anticipated to be used, the duration of each exercise, and the expected area affected, we anticipate this will only result in TTS and behavioral effects occurring for a maximum of four leatherback sea turtles, three loggerhead sea turtles, and two olive ridley sea turtles annually; for a total 16 leatherback sea turtles, 12 loggerhead sea turtles and eight olive ridley sea turtles experiencing TTS or behavioral effects over the 5-Year duration of the project. No other sea turtle exposures were estimated to occur at thresholds that would rise to other physical injuries, PTS, or mortality.

Because TTS is considered a temporary impact on a sea turtles hearing, and the proposed activities for the project are not likely to cause permanent hearing damage or other physical harm to an individual, nor are any brief behavioral responses expected to last for a significant duration, NMFS does not expect these effects to result in an overall fitness consequence for the individual sea turtles affected. Moreover, because we do not anticipate fitness consequences for the individual animal as a result of TTS or behavioral responses, we do not expect consequences for the population or these species.

7 CONCLUSION

During the consultation, we reviewed the current status of the ESA-listed species, primarily sei whales, leatherback, loggerhead, and olive ridley sea turtles. We also assessed the *Environmental Baseline* within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects.

Our regulations require us to consider, using the best available scientific data, effects of the action that are "likely" and "reasonably certain" to occur rather than effects that are speculative or uncertain. See 50 C.F.R. § 402.02 (defining to "jeopardize the continued existence of" and "effects of the action"). For the reasons set forth above, and taking into consideration the best available scientific evidence documented throughout this opinion, we conclude that effects from the U.S. Air Force Long Range Strike Weapons Systems Evaluations Program mission conducted off of the western shores of the island of Kauai between 2017-2021 and NMFS' promulgation of regulations and issuance of incidental take authorizations pursuant to the MMPA for these activities, would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival or recovery of sei whales, leatherback, loggerhead or olive ridley sea turtles in the wild by reducing the reproduction or distribution of the species. We do not expect the incidences of behavioral disturbance to sei whales, nor the TTS or behavioral effects on sea turtles to have fitness consequences for the individual whales or turtles affected because these effects would be temporary and not result in any permanent injury. In addition, because the

action area is so vast, we would expect for any animals that leave or avoid the area to find suitable habitat elsewhere to support important life functions. Because we do not anticipate fitness consequences for the individual animals exposed to sound levels that could cause TTS, or be detectable and elicit a behavioral response, we do not expect consequences for the population or the species of sei whales, leatherback, loggerhead and olive ridley sea turtles. Therefore, we conclude that these activities are not likely to jeopardize the continued existence of sei whales, leatherback, loggerhead, or olive ridley sea turtles.

8 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. NMFS has not yet defined "harass" under the ESA in regulation. On December 21, 2016, NMFS issued interim guidance on the term "harass," defining it as an action that "creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." Under the MMPA, Level B harassment for military readiness activities, such as the activities analyzed in this opinion, is defined as "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering, to a point where such behavioral patterns are abandoned or significantly altered." 16 U.S.C. § 1362(18)(B)(ii). For purposes of this consultation, we relied on NMFS' interim definition of harassment to evaluate whether the proposed activities are likely to harass ESA-listed sei whales and turtle species. For sei whales, we relied on the MMPA definition of Level B harassment in the context of military readiness activities to estimate the number of instances of harassment.

Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

8.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 CFR § 402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions while the extent of take or "the extent of land or marine area that

may be affected by an action" may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (51 FR 19953).

Section 7(b)(4)(C) of the ESA provides that if an endangered or threatened marine mammal is involved, the taking must first be authorized by Section 101(a)(5) of the MMPA. Accordingly, the terms of this incidental take statement and the exemption from Section 9 of the ESA become effective only upon the issuance of MMPA authorization (i.e., five year regulations and LOA) to take the marine mammals identified here. Absent such authorization, this statement is inoperative for marine mammals.

Based on the analysis in the biological opinion, NMFS anticipates that the proposed action would result in adverse behavioral effects on a total of twelve sei whales over the 5-year duration of the program. No other effects are affected for sei whales. For sea turtles, NMFS expects TTS and behavioral effects to occur for a maximum of four leatherback sea turtles, three loggerhead sea turtles, and two olive ridley sea turtles annually; for a total 16 leatherback sea turtles, 12 loggerhead sea turtles and eight olive ridley sea turtles experiencing TTS or behavioral effects over the 5-Year duration of the project. No other sea turtle exposures were estimated to occur at thresholds that would cause other physical injuries, PTS, or mortality.

8.2 Effects of the Take

In this opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to sei whales, leatherback, loggerhead or olive ridley sea turtle species; or destruction or adverse modification of critical habitat.

8.3 Reasonable and Prudent Measures

The measures described below are nondiscretionary, and must be undertaken by the U.S. Air Force and NMFS' Permits and Conservation Division so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). NMFS believes the reasonable and prudent measures described below are necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

1. The U.S. Air Force shall have measures in place to limit the potential for interactions with ESA-listed species that may rise to the level of take as a result of the proposed actions described in this opinion.
2. The U.S. Air Force shall report all observed interactions resulting in take with any ESA-listed species resulting from the proposed action that are observed.
3. NMFS' Permits Division shall ensure that all mitigation and monitoring measures as prescribed in the final rule and LOAs, and as described in Section 2.4 of this opinion are implemented by the U.S. Air Force.
4. The U.S. Air Force and NMFS' Permits Division shall compile and summarize annual monitoring and exercise reports and describe interactions with ESA-listed species, as specified in the final MMPA rule and LOA.

8.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the U.S. Air Force and NMFS' Permits and Conservation Division must comply with the following terms and conditions, which implement the Reasonable and Prudent Measures described above and outlines the mitigation, monitoring and reporting measures required by the section 7 regulations (50 CFR 402.14(i)). These terms and conditions are non-discretionary. If the U.S. Air Force and NMFS' Permits and Conservation Division fail to ensure compliance with these terms and conditions and their implementation of the reasonable and prudent measures, the protective coverage of section 7(o)(2) may lapse.

1. The following term and condition implements reasonable and prudent measure 1:
    a. The U.S. Air Force must implement all mitigation and monitoring measures as described in the 2016 BA, 2017-2021 Mitigation and Monitoring Plan, and in Section 2.4 of this opinion.
2. The following terms and conditions implement reasonable and prudent measure 2:
    a. If a dead or injured marine mammal or sea turtle is observed during or following proposed activities, the U.S. Air Force shall immediately (within 24 hours of the discovery) contact NMFS and appropriate stranding networks.
    b. Within 90 days following the completion of the proposed action, the U.S. Air Force shall submit a report to NMFS containing the following information
        i. Date and time of the Long Range Strike WSEP mission;
        ii. A complete description of the pre-exercise and post-exercise activities related to mitigating and monitoring the effects of the Long Range Strike WSEP mission on marine mammals and sea turtles;
        iii. Results of the protected species monitoring including numbers (by species if possible) of any marine mammals or sea turtles noted injured or killed as a result of the Long Range Strike WSEP mission and number of marine mammals or sea turtles (by

species if possible) that may have been harassed due to presence within the zone of influence.

9 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans or develop information (50 CFR 402.02).

1. Monitor sighting, location, and stranding data for ESA-listed species in proximity to the action area.
2. Seek new information and higher quality data to validate assumptions used in acoustic modeling and risk analysis.

In order for NMFS' Office of Protected Resources ESA Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their critical habitat, the U.S. Air Force should notify the ESA Interagency Cooperation Division of any conservation recommendations they implement in their final action.

10 Reinitiation of Consultation

This concludes formal consultation for the U.S. Air Force Long Range Strike Weapons Systems Evaluations Program in the BSURE area of the PMRF off of the western shores of the island of Kauai and NMFS's promulgation of regulations and issuance of incidental take authorizations pursuant to the MMPA from August 23, 2017 through August 22, 2021. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the ESA-listed species or critical habitat that was not considered in this opinion, or (4) a new species is ESA-listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the U.S. Air Force must contact the ESA Interagency Cooperation Division, Office of Protected Resources immediately.

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