NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL OPINION

Title:	Biological Opinion on Operational Evaluations of Live Long Range Strike Weapon Systems and Other Munitions Conducted by the U.S. Air Force off of the western shores of the island of Kauai
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce
Action Agencies:	U.S. Air Force
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Action Agencies:	United States Air Force
Activity Considered:	Operational evaluations of live long range strike weapons and other munitions 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 in October 2016
Consultation Conducted By:	Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service

Approved:

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Director, Office of Protected Resources

Date: SEP 28 2016

Public Consultation Tracking System number: FPR-2016-9160

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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 (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 Air Force during pre-consultation and in the June 16, 2016, request for ESA formal consultation, which included a biological assessment and two appendices, one containing acoustic modelling methodology and the other containing marine species depth distribution data. The 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 in October 2016. The Air Force has not previously conducted these activities in the PMRF, but similar activities (i.e., use of explosive ordnance) are conducted on a regular basis in the PMRF by the United States 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 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 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 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 of the proposed action.

On July 1, 2016, following initial review of the 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 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 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. This consultation was to be completed on or before August 29, 2016. For activities proposed from 2017 through 2021, we indicated that we would conclude consultation on or before July 1, 2017, pending issuance of the Marine Mammal Protection Act (MMPA) letters of authorization.

On August 24, 2016, the 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 Air Force that we would not complete our biological opinion until the end of September 2016.

On August 30, 2016, the Air Force submitted an amendment to the Long Range Strike Weapon Systems Evaluation Program mission Biological Assessment (originally submitted June 16,

2016) requesting that if the rule to revise the listing status of humpback whales was finalized as proposed (80 FR 22304), that NMFS remove humpback whales from consideration in both of the consultations.

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 will not be considered in this consultation or the future consultation on the Long Range Strike Weapon Systems Evaluation Program mission.

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 Air Force proposes to conduct air-to-surface operational evaluations of live, long-range strike weapons off of the western coast of Kauai, Hawaii in October 2016. This operational program uses long-range strike weapons systems, along with other munitions (bombs and missiles) and would be carried out by the 86th Fighter Weapons Squadron (86 FWS). The Air Force will conduct the mission in the BSURE area of the PMRF. The PMRF is part of the Navy's Hawaii Range Complex (HRC) and was chosen because it supports the full range of tasks for the proposed action. The impact area will be approximately 44 nm (81 km) offshore of Kauai, Hawaii in a water depth of approximately 4,645 m (15,240 ft). There will not be any ground-based or nearshore activities requiring the use of any shoreline in Kauai. The purpose of the activities performed by the Air Force in the BSURE area is to conduct daytime operational evaluations of long-range strike weapons and other munitions in order to properly train and score units of the Air Force in their ability to effectively execute scenarios that resemble realistic operations in a time of war. The ordnance may be delivered by bombers and fighter aircraft and will detonate and be scored at the surface of the water in the BSURE area.

2.1 Aircraft Operations

The aircraft used 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 aircrafts associated with releasing weapons would originate from an out base (i.e., Ellsworth 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 the 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 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 operational evaluations of live long-range strike weapons and other munitions mission would release eight live (explosive) Small Diameter Bomb-Is (SDB-I) and one Joint Air-to-Surface Stand-off Missile/Joint Air-to-Surface Stand-off Missile-Extended Range (JASSM/ER). All releases will occur in one day within the PMRF. A description of the two munitions used in the 2016 Long Range Strike Weapon Systems Evaluation Program mission is including in the following subsections.

2.2.1 Small Diameter Bomb-I

The Small Diameter Bomb-I is a 250-pound air-launched guided weapon with Global Positioning System (GPS) technology and an Internal Navigation System (INS). The weapon has a range of up to 60 nm (111 km), and they each contain 37 pounds of 2,4,6-trinitrotoluene (TNT) equivalent net explosive weight, using AFX-757, a type of plastic-bonded explosive, as the specific type of explosive.

2.2.2 Joint Air-to-Surface Stand-off Missile/Joint Air-to-Surface Stand-Off Missile-Extended Range (JASSM/JASSM-ER)

The Joint Air-to-Surface Stand-off Missile is a precision cruise missile with a range of more than 200 nm (370 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. Like the SMD-I, the type of explosive used for the JASSM is AFX-757. The 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.

2.3 Schedule and Mission Procedures

The evaluation of live long-range strike weapons and other munitions is scheduled for October 20, 2016, with a back-up day scheduled for October 21, 2016. This mission will consist of releasing one live JASSM/JASSM-ER and eight SDB-I, and every release is expected to result in a surface detonation.

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 (MSL) and terminate at a specified location. The cruise time for a SDB-I is approximately 10 minutes whereas the JASSM/JASSM-ER takes about 45 minutes. 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. Weapon release parameters for the mission would involve a B-1 bomber releasing one live JASSM and fighter aircraft, such as F-15, F-16, or F-22, releasing eight live SDB-I. Up to four SDB-I munitions would be released simultaneously, similar to a ripple effect, each hitting the water surface within a few seconds of each other. The release of the eight SDB-I munitions would occur separately from the JASSM release, but all releases would occur on the same mission day. The final impact point on the water surface would be programmed into the munitions for weapons scoring and evaluations.

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 12 nm from the Kauai coastline). This information is 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 Mitigation Measures, Monitoring, and Reporting

In order to minimize the risk to protected marine species associated with explosive ordnance detonation, pre-mission aerial surveys will be conducted of the impact area for the presence of marine mammals and sea turtles. To complete the aerial survey for this mission, Navy test range personnel will inspect the area from mission aircraft (typically jet aircraft such as F-15E, F-16, or F-22) or a U.S. Coast Guard C-130 aircraft. The aircrew tasked with observing protected species will be trained and will have experience conducting aerial marine mammal surveys. The aircrew will have provided similar support for other missions at PMRF.

Protected species surveys will begin as close to the impact time as feasible (usually within one hour of weapon release), taking into account human safety requirements. Personnel will conduct aerial surveys within an area defined by an approximately 2 nm (3,704 m) radius around the impact point, with aerial surveys typically following a star pattern. This survey distance encompasses all mortality, physical injury (e.g., slight lung injury), and permanent threshold shift (PTS) impact areas for ESA-listed marine mammals and sea turtles. All temporary threshold shift (TTS) impact areas for ESA-listed marine mammals are covered in this area, but the survey distance only covers approximately 50 percent of the TTS impact area for sea turtles. Given operational constraints, surveying larger areas would not be feasible (Department of the Air Force 2016). If daytime weather and/or sea conditions preclude adequate monitoring for detecting marine mammals and sea turtles, operations will be delayed until adequate sea conditions exist for monitoring to be undertaken. Aerial surveys are typically conducted at an altitude of approximately 200 feet but may vary depending on sea state and atmospheric conditions. Pre-mission surveys usually last approximately 30 minutes once the aircraft reaches the impact area, though the time may vary slightly based on the survey pattern. If adverse weather conditions prevent the aircraft from operating safely, the mission would either be delayed until the weather clears or the mission would be cancelled for the day and the mission would occur on the back-up weather day (October 21, 2016). If a protected species is observed in the impact area, weapon release would be delayed until one of the following conditions is met: (1) the animal is observed exiting the impact area, (2) the animal is thought to have exited the impact area based on its course and speed, or (3) the impact area has been clear of any additional sightings for 30 minutes.

Post-mission surveys would begin immediately after the mission is complete and the Range Safety Officer declares the human safety area is reopened. The same aircraft and aircrew that conducted the pre-mission surveys would conduct the post-mission surveys and would follow the same patterns as pre-mission surveys, focusing instead on the area down current of the weapon area impact (as opposed to within the impact area) to determine if protected species were affected by the mission (i.e., observation of dead or injured animals). NMFS would be notified if post-mission surveys reveal any injured or otherwise adversely affected ESA-listed animals, and all records would be sealed and held for investigation should injury or mortality occur to a protected species.

In the event that activities clearly cause the take of an ESA-listed marine mammal or sea turtle in a manner not authorized by NMFS, the Air Force will immediately cease activities and report the incident to the NMFS Office of Protected Resources and the Regional Stranding Coordinator. Activities will not resume until NMFS reviews the circumstances of the take and determines what further measures are necessary to minimize the likelihood of further prohibited take. Additionally, if an injured or dead marine mammal or sea turtle is discovered and the cause of injury or death is unknown and occurred relatively recently (i.e., with respect to the proposed action), the Air Force will immediately report the incident to the NMFS Office of Protected Resources and the Regional Stranding Coordinator. Lastly, if an injured or dead marine mammal or sea turtle is discovered, and the observer determines that the injury or death is not related to operational evaluations of live long-range strike weapons and other munitions activities, the Air Force will report the incident to NMFS Office of Protected Resources and the Regional Stranding Coordinator within 24 hours, and may provide photographs, video footage, or other documentation of the affected animal.

2.5 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 (Figure 1). 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 m (1,800 ft) and 4,572 m (15,000 ft), 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 about 4,645 m (15,240 ft). All aspects of the operational evaluations of live long-range strike weapons and other munitions mission will take place over open ocean areas. There will be no ground or nearshore activities requiring the use of any shoreline areas of Kauai.

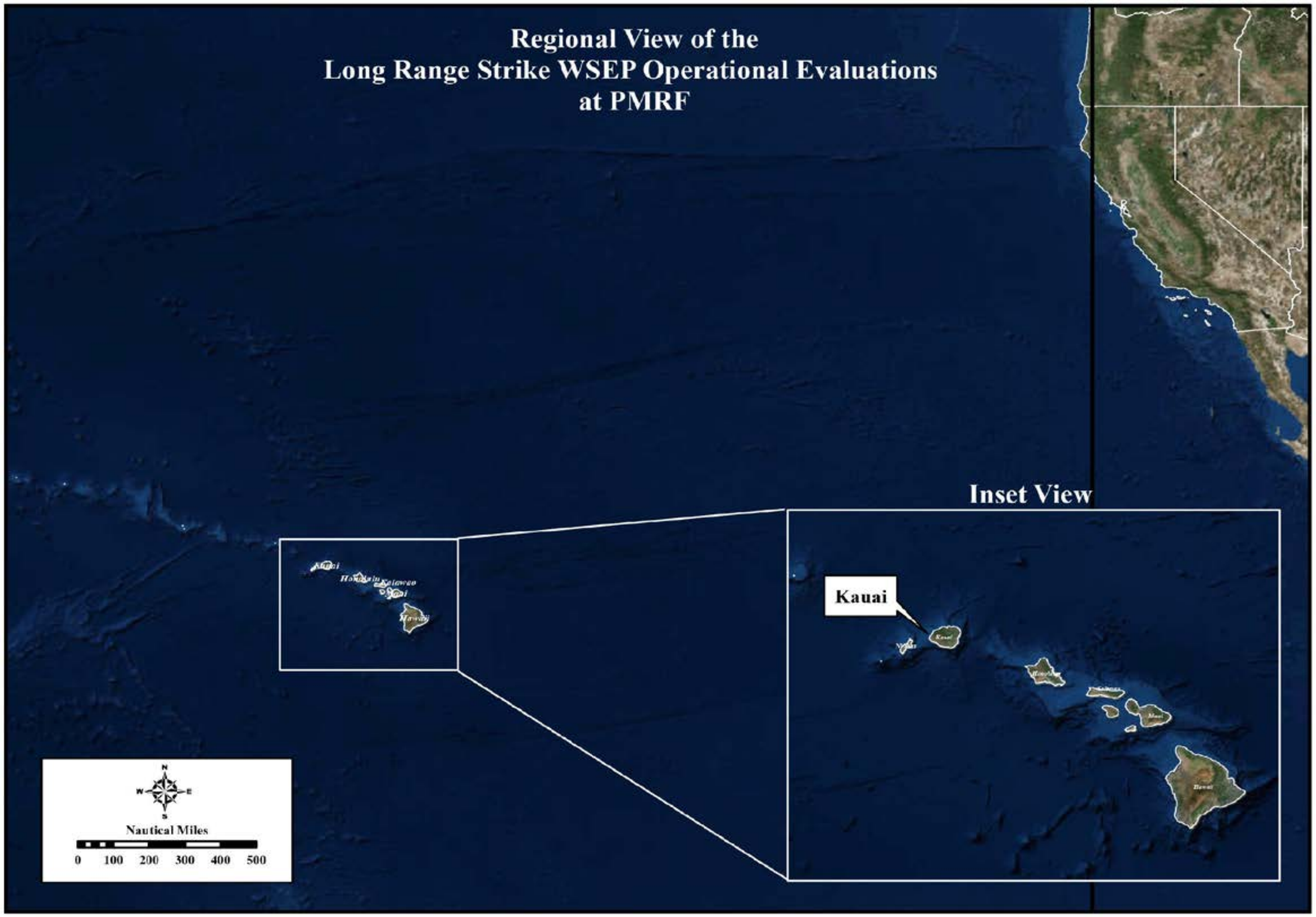

Figure 1. A regional view of the Hawaiian Islands with a close up of the location of the island of Kauai. All Long Range Strike Long Range Strike Weapon Systems Evaluation Program mission operations in 2016 will take place off of the west coast of Kauai (Department of the Air Force 2016).

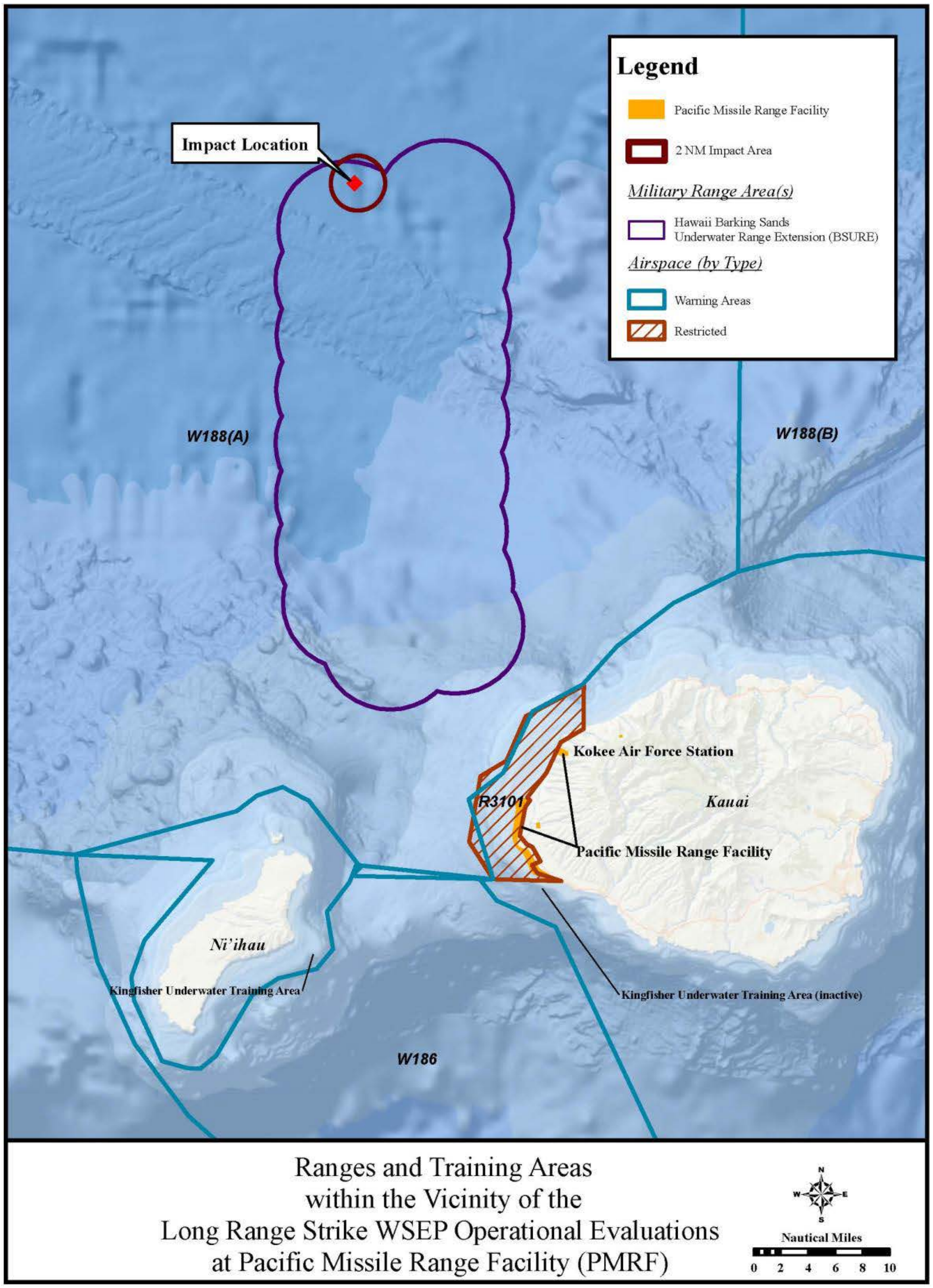

Figure 2. Map of the Pacific Missile Range Facility off of the coast of Kauai, including the Hawaii Barking Sounds Underwater Range Expansion area, the 2 nm (3.7 km) area of impact, and the impact location (Department of the Air Force 2016).

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 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 Listed Resources*, *Environmental Baseline*, and *Risk Analyses* 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 Air Force, including the Biological Assessment and acoustic modelling methodology and marine species depth distribution appendices.

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 Air Force's Exposure Analysis

To estimate potential exposure of marine mammals and sea turtles to sounds from detonations, the Air Force used acoustic modeling and marine mammal and sea turtle density information. We summarize the Air Force's exposure analysis below. A comprehensive description of this analysis is included in the Air Force's Long Range Strike Weapons System Evaluation Program Biological Assessment and appendices (Department of the Air Force 2016). We verified the methodology and data used by the 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 (see below for species density estimates); 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 Air Force used acoustic modeling (thoroughly described in Appendix A of (Department of the Air Force 2016), which incorporated the criteria and thresholds presented in Finneran and Jenkins (2012). Criteria are the types of possible effects and include mortality, injury (e.g., PTS, slight lung injury), and harassment (i.e., TTS, behavioral harassment). Threshold is the level of pressure or noise above which impact criteria are reached.

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 2016 mission. Table 1 lists the estimated ranges for the 2016 mission. The ranges were used to 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 was then calculated as the product of the adjusted impact area (i.e., zone of influence), animal density, and the number of events per year (i.e., only one for 2016). 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 1. Threshold radii (in meters) for Long Range Strike Weapon Systems Evaluation Program mission.

Species	Mortality	Slight Lung Injury	GI Tract Injury	PTS (SEL[1])	PTS (SPL[2])	TTS (SEL)	TTS (SPL)	Behavioral (SEL)
Blue whale	28	59	165	2,161	330	6,565	597	13,163
Fin whale	28	62	165	2,161	330	6,565	597	13,163
Sei whale	38	83	165	2,161	330	6,565	597	13,163
Sperm whale	33	72	165	753	330	3,198	597	4,206
False Killer Whale (MHI[3] DPS)	72	153	165	753	330	3,198	597	4,206
Hawaiian Monk Seal	135	256	165	1,452	1,107	3,871	1,881	6,565
Pacific sea turtles[4]	153	285	165	2,328	329	6,558	597	6,129

[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 mitigation measures employed by the Air Force (described in Section 2.4) to minimize impacts to marine mammals and sea turtles. These measures would be expected to decrease the potential for explosive impacts. 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 decrease exposure levels.

Density estimates

The 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 (U.S. Department of the Navy 2016). The 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. 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 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 mammals

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 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 Department of the Air Force (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 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 2. The operational evaluations of live long-range strike weapons and other munitions 2016 mission is scheduled to occur on October 20, 2016, so fall density estimates were used.

Table 2. Marine mammal and sea turtle density estimates in the action area (U.S. Department of the Navy 2016).

Species	Fall Density Estimate (animals per km^2)
Blue whale	0.00005
Fin whale	0.00006
Sei whale	0.00016
Sperm whale	0.00156
False killer whale (MHI insular DPS)	0.00050
Hawaiian monk seal	0.00003
Pacific sea turtles[1]	0.00429

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

Sea turtles

In-water occurrence data for sea turtles are severely limited (U.S. Department of the 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, density estimates for the HRC are derived entirely from 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 Air Force assessed the impacts of the 2016 Long Range Strike Weapon Systems Evaluation Program mission using a single guild (Pacific Sea Turtles), which combines all sea turtle species. This group theoretically encompasses all five species with potential occurrence in the action area, although only green and hawksbill sea turtles are known to have been observed in the HRC by Navy divers and contractors. Loggerhead, leatherback, and olive ridley turtles could pass through the area during migration, but their likelihoods of occurrence are extremely low.

Turtles have primarily been observed by Navy divers and contractors within the 100-m isobath (and usually much shallower than 100-m) around the islands of Kauai, Lanai, Molokai, and Oahu, and density values have been directly calculated only within this depth contour. Densities beyond this depth in the open ocean are expected to be substantially less. For areas of the HRC outside the 100-m isobath, the Navy used the mean density around the islands reduced by two orders of magnitude. The resulting density estimate used for the Air Force impacts analysis is 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) in all seasons.

Available information suggests that the majority of the sea turtles within the PMRF (and the majority of the sea turtles within the Pacific sea turtle guild) would be green sea turtles from the Central North Pacific DPS. As mentioned above, loggerhead, leatherback, and olive ridley sea turtles were not observed during Navy surveys used to derive sea turtle density data. While these species still could occur in the action area, occurrences would be rare, and these species would only likely be temporarily migrating through the area. Chaloupka et al. (2008c) found that while hawksbills are the second-most abundant species in the offshore waters of the Hawaiian Islands, they are far less abundant than green turtles. This is further supported by stranding data, which indicate that the majority of stranded sea turtles on the Hawaiian Islands are green sea turtles. Ninety-seven percent of sea turtles that strand in the Main Hawaiian Islands are green turtles. Three percent of sea turtles that strand in the Main Hawaiian Islands are hawksbills and olive ridleys, and loggerheads and leatherbacks rarely strand in the Main Hawaiian Islands (Balazs and Chaloupka 2006b).

On April 6, 2016, NMFS published a final rule to list 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The action area is entirely contained within the DPS delineation of the Central North Pacific DPS. While some green turtles from other DPSs in the Pacific Ocean could occur within the action area during for foraging and migration (i.e., 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), we would expect the vast majority of green turtles within the action area to be from the Central North Pacific DPS.

3.2 Consideration of the National Oceanic and Atmospheric Administration's Marine Mammal Acoustic Technical Guidance

In August 2016, NOAA released its *Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing*, which established new thresholds for predicting auditory injury (i.e., permanent threshold shift). The criteria and thresholds for marine mammals used in the acoustic modeling for this consultation are from Finneran and Jenkins (2012), as opposed to the recently released technical guidance. In the Federal Register Notice of the Technical Guidance, NMFS explained the approach it would take during a transition period, wherein we balance the need to consider this new best available science with the fact that some applicants have already committed time and resources to the development of acoustic analyses based on our previous guidance and have constraints that preclude the recalculation of take estimates, as well where the agency is in the decision-making pipeline. In that Notice, we included a non-exhaustive list of factors that would inform the most appropriate approach for considering the new guidance, including how far in the MMPA authorization process the applicant has progressed, the scope of the effects, when the MMPA authorization is needed, the cost and complexity of the analysis, and the degree to which the guidance is expected to affect our analysis. In this case, the Air Force has requested MMPA authorization (for take of non-ESA listed marine mammal species) and consultation for a one-day activity in October 2016 that would include one explosive release and two explosive bursts of four munitions timed a few seconds apart. The extremely short duration of the activity (essentially three instantaneous events within a day) and the robust monitoring and mitigation measures minimize the likelihood that auditory injury would occur. In short, although the new thresholds were not used in the calculation of take, we believe that the existing analysis adequately addresses the likely effects of the proposed action on ESA-listed marine mammals.

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 3). It then summarizes the biology and ecology of those species and what is known about their life histories in the action area.

Table 3. Species listed under the Endangered Species Act under NMFS jurisdiction that may occur in the action area during the Air Force's 2016 proposed operational evaluations of live long-range strike weapons and other munitions mission.

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 ESA-listed Species Not Likely to be Adversely Affected

As described in the *Approach to the Assessment*, 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 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 1, 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 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), although 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. (In Review) 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

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 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 (i.e., fall). Therefore, the Air Force's acoustic analysis resulted in zero blue whale exposures to acoustic stressors from live explosive munitions during 2016 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.

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 (Barlow 2006; Carretta et al. 2010; Mobley Jr. et al. 2000). 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. (In Review) 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 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 (i.e., fall). Therefore, the Air Force’s acoustic analysis resulted in zero fin whale exposures to acoustic stressors from live explosive munitions during 2016 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.

4.1.3 Sei Whale

Sei whales (pronounced "say" or "sigh"; *Balaenoptera borealis*) are members of the baleen whale family and are considered one of the "great whales" or rorquals. These large animals can reach lengths of about 12 to 18 m (40 to 60 ft) and weigh 45,000 kg (100,000 lbs). Sei whales have a long, sleek body that is dark bluish-gray to black in color and pale underneath. 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 1985b).

In the North 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° to 23°N (Gambell 1985b; Masaki 1977). Saski et al. (2013) demonstrated that sei whale in the North Pacific are strongly correlated with sea surface temperatures between 13.1 to 16.8°C. Sei whales are infrequently observed near the HRC and are more abundant during the cool seasons (Barlow 2006). Bradford et al. (In Review) report a uniform density value for sei whales of 0.00016 animals/km^2 (CV = 0.90) 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 Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. For sei whales, a density of 0.00016 was used for the period of time during which the action will occur (i.e., fall). Therefore, the Air Force's acoustic analysis resulted in zero sei whale exposures to acoustic stressors from live explosive munitions during 2016 activities. For this reason, we determined that the likelihood of a sei whale being exposed to acoustic stressors from the proposed action is discountable, and sei whales are not likely to be adversely affected by the proposed action.

4.1.4 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 feet) and weigh 13, 607 kg (15 tons). Adult males, however, reach about 16 m (52 feet) 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 (largely 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 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 Air Force's acoustic analysis resulted in zero sperm whale exposures to acoustic stressors from live explosive munitions during 2016 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.

4.1.5 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 feet), while males are almost 6 m (20 feet). 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 Molokaʻi, and (3) southwest of Lanaʻi (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 Niʻihau 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 Niʻihau 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 (Department of the Air Force 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 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 0.00050 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The Air Force's acoustic analysis resulted in zero MHI insular false killer whale exposures to acoustic stressors from live explosive munitions during 2016 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.

4.1.6 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 16 kg (35 lbs) at birth. Monk seals grow to 2.1 to 2.3 m (7.0 to 7.5 ft) in length with females being slightly larger than males; pups are 1 m (3 feet) at birth. The lifespan is estimated at 25 to 30 years.

Hawaiian monk seals are found primarily on the Northwestern Hawaiian Islands, especially 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 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, Ka‘ula, Ni‘ihau, Oahu, and Moloka‘I (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 Ni‘ihau. 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).

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 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 Air Force's acoustic analysis resulted in zero Hawaiian monk seal exposures to acoustic stressors from live explosive munitions during 2016 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.

4.1.7 Hawksbill Sea Turtle

The hawksbill turtle (*Eretmochelys imbricata*) is a small to medium-sized sea turtle; adults typically range between 65 and 90 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. Stranded or injured hawksbills are occasionally found in the Northwestern Hawaiian Islands (Parker et al. 2009). Hawksbills are the second-most-common species in the offshore waters of the Hawaiian Islands, yet they are far less abundant than green turtles (Chaloupka et al. 2008c). 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 5 and 18 days to complete the trip from nesting to foraging areas (Parker et al. 2009).

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 Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. As documented further in section 3.1 of this opinion, 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 Air Force assessed the impacts of the 2016 Long Range Strike Weapon Systems Evaluation Program mission using a single guild (Pacific Sea Turtles), which combines all sea turtle species. For Pacific sea turtles, a density of 0.00429 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The Air Force's acoustic analysis resulted in one Pacific sea turtle exposure to acoustic stressors from live explosive munitions during 2016 activities that would be expected to result in TTS (see section 6.4.1). However, as also documented in section 3.1 of this opinion, available information suggests that the majority of the sea turtles within the PMRF (and the majority of the sea turtles within the Pacific sea turtle guild) would be green sea turtles from the Central North Pacific DPS. Therefore, we assume that the one instance of TTS would likely happen to a Central North Pacific DPS green sea turtle. For this reason, 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, permanent threshold shift, slight lung injury, behavioral harassment) is discountable, and hawksbill sea turtles are not likely to be adversely affected by the proposed action.

4.1.8 Loggerhead Sea Turtle – North Pacific Ocean DPS

Loggerhead turtles (*Caretta caretta*) were named for their relatively large heads, which support powerful jaws and enable them to feed on hard-shelled prey, such as whelks and conch. The carapace (top shell) is slightly heart-shaped and reddish-brown in adults and sub-adults, while the plastron (bottom shell) is generally a pale yellowish color. The neck and flippers are usually dull brown to reddish brown on top and medium to pale yellow on the sides and bottom. Flippers are dark gray to brown above with white to white-gray margins. The coloration of the plastron is generally yellowish to tan. At emergence, hatchlings average 45 mm (1.8 in) in length and weigh approximately 20 g (0.04 lbs).

Loggerheads are circumglobal, inhabiting continental shelves, bays, estuaries, and lagoons in temperate, subtropical, and tropical waters. Major nesting grounds are generally located in temperate and subtropical regions, with scattered nesting in the tropics (NMFS and USFWS 1998d). Within the North Pacific Ocean, loggerhead nesting has only been documented in Japan (Kamezaki et al. 2003). 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. 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).

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 Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. As documented previously in section 3.1 of this opinion, 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 Air Force assessed the impacts of the 2016 Long Range Strike Weapon Systems Evaluation Program mission using a single guild (Pacific Sea Turtles), which combines all sea turtle species. For Pacific sea turtles, a density of 0.00429 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The Air Force's acoustic analysis resulted in one Pacific sea turtle exposure to acoustic stressors from live explosive munitions during 2016 activities that would be expected to result in TTS (see section 6.4.1). However, as also documented in section 3.1 of this opinion, available information suggests that the majority of the sea turtles within the PMRF (and the majority of the sea turtles within the Pacific sea turtle guild) would be green sea turtles from the Central North Pacific DPS. Therefore, we assume that the one instance of TTS would likely occur to a Central North Pacific DPS green sea turtle. For this reason, we determined that the likelihood of a loggerhead 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, permanent threshold shift, slight lung injury, behavioral harassment) is discountable, and loggerhead sea turtles from the North Pacific Ocean DPS are not likely to be adversely affected by the proposed action.

4.1.9 Olive Ridley Sea Turtle

The olive ridley turtle (*Lepidochelys olivacea*) is a small to medium-sized sea turtle; adults typically range between 55 and 80 cm (22 to 31 in) in carapace length and weigh around 45 kg

(100 lb). They are olive/grayish-green (darker in the Atlantic than in the Pacific) with a heart-shaped top shell (carapace) with 5 to 9 pairs of costal "scutes" with 1 to 2 claws on their flippers; hatchlings emerge mostly black with a greenish hue on the sides.

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). Olive ridley turtles nest along continental margins and oceanic islands. 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). Although they are the most abundant north Pacific sea turtle, surprisingly little is known of the oceanic distribution and critical foraging areas of Pacific ridley turtles. Most records of olive ridley turtles are from protected, shallow marine waters. Nevertheless, olive ridley turtles have also been observed in the open ocean. Since olive ridley turtles throughout the eastern Pacific Ocean depend on rich upwelling areas off South America for food, Pacific ridley turtles sighted offshore may have been foraging. Genetic information from the Hawaii-based longline fishery indicates that Olive Ridley sea turtles from breeding populations in the eastern (endangered populations) and western Pacific (threatened populations) mix in waters around Hawaii (NMFS 2005).

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 Air Force’s exposure analysis relied on density estimates from the NMSDD for the Pacific region. As documented previously in section 3.1 of this opinion, 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 Air Force assessed the impacts of the 2016 Long Range Strike Weapon Systems Evaluation Program mission using a single guild (Pacific Sea Turtles), which combines all sea turtle species. For Pacific sea turtles, a density of 0.00429 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The Air Force’s acoustic analysis resulted in one Pacific sea turtle exposure to acoustic stressors from live explosive munitions during 2016 activities that would be expected to result in TTS (see section 6.4.1). However, as also documented in section 3.1 of this opinion, available information suggests that the majority of the sea turtles within the PMRF (and the majority of the sea turtles within the Pacific sea turtle guild) would be green sea turtles from the Central North Pacific DPS. Therefore, we assume that the one instance of TTS would likely occur to a Central North Pacific DPS green sea turtle. For this reason, we determined that the likelihood of an olive ridley sea turtle (from the endangered populations that nest in the eastern Pacific or the threatened populations that nest in the western Pacific) 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 olive ridley sea turtles are not likely to be adversely affected by the proposed action.

4.1.10 Leatherback Sea Turtle

The leatherback turtle (*Dermochelys coriacea*) is the largest turtle and the largest living reptile in the world. Mature males and females can be as long as 2 m (6.5 feet) and weigh almost 900 kg (2000 lbs). The leatherback is the only sea turtle that lacks a hard, bony shell. Leatherbacks lack the crushing chewing plates characteristic of sea turtles that feed on hard-bodied prey (Pritchard 1971). Instead, they have pointed tooth-like cusps and sharp edged jaws that are perfectly adapted for a diet of soft-bodied pelagic (open ocean) prey, such as jellyfish and salps.

Leatherback turtles are widely distributed throughout the oceans of the world. The species is found in four main regions of the world: the Pacific, Atlantic, and Indian Oceans, and the Caribbean Sea. 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). 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.

Few quantitative data are available concerning the seasonality, abundance, or distribution of leatherbacks in the central northern 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 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.

Leatherback turtles are regularly sighted by fishermen in offshore waters surrounding the Hawaiian Islands, generally beyond the 1,158 m (3,800 ft) contour, and especially at the southeastern end of the island chain and off the northern coast of Oahu (Balazs 1995). 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).

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). 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). Leatherbacks were not sighted during any of the aerial surveys, all of which took place over waters lying close to the Hawaiian shoreline. Leatherbacks were also not sighted during any of the NMFS shipboard surveys; their deep diving capabilities and long submergence times reduce the probability that observers could spot them during marine surveys. One leatherback turtle was observed along the Hawaiian shoreline during monitoring surveys in 2006 (Rivers 2011).

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 Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. As documented previously in section 3.1 of this opinion, 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 Air Force assessed the impacts of the 2016 Long Range Strike Weapon Systems Evaluation Program mission using a single guild (Pacific Sea Turtles), which combines all sea turtle species. For Pacific sea turtles, a density of 0.00429 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The Air Force's acoustic analysis resulted in one Pacific sea turtle exposure to acoustic stressors from live explosive munitions during 2016 activities that would be expected to result in TTS (see section 6.4.1). However, as also documented in section 3.1 of this opinion, available information suggests that the majority of the sea turtles within the PMRF (and the majority of the sea turtles within the Pacific sea turtle guild) would be green sea turtles from the Central North Pacific DPS. Therefore, we assume that the one instance of TTS would likely occur to a Central North Pacific DPS green sea turtle. For this reason, we determined that the likelihood of a leatherback 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, permanent threshold shift, slight lung injury, behavioral harassment) is discountable, and leatherback sea turtles are not likely to be adversely affected by the proposed action.

4.1.11 Green sea turtle – East Indian-West Pacific, Central West Pacific, Southwest Pacific, Central South Pacific, Southwest Pacific, Central South Pacific, and East Pacific DPSs

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).

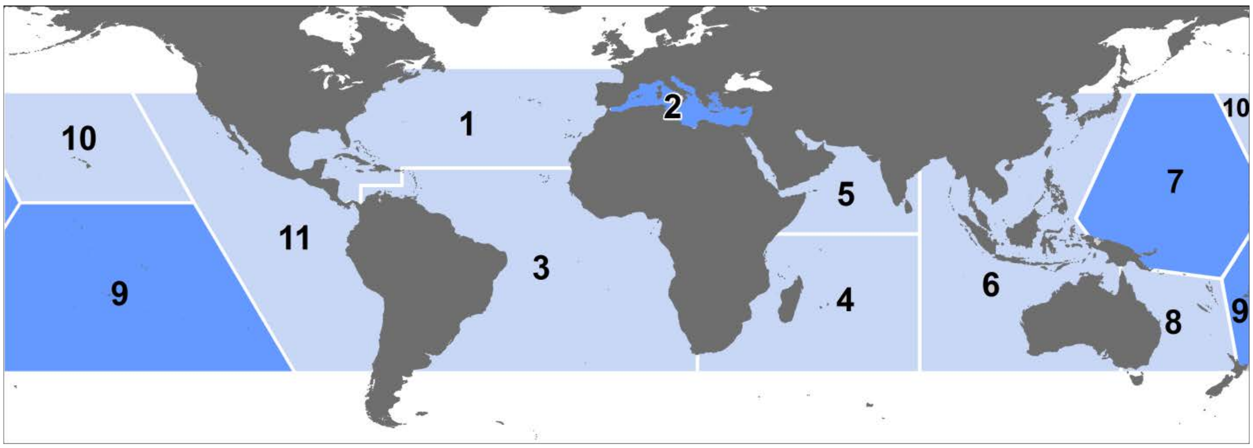

Figure 3. Threatened (light blue) and endangered (dark blue) green turtle Distinct Population Segments : 1) North Atlantic, 2) Mediterranean, 3) South Atlantic, 4) Southwest Indian, 5) North Indian, 6) East Indian-West Pacific, 7) Central West Pacific, 8) Southwest Pacific, 9) Central South Pacific,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

For general green sea turtle distribution and life history information, see section 4.2.1 of this opinion. As documented in Section 3.1, the action area is entirely contained within the DPS delineation of the Central North Pacific DPS. 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 within the action area to be from the Central North Pacific DPS. Green sea turtles from DPSs within the Pacific Ocean other than the Central North Pacific DPS (i.e., 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) could rarely occur in the action area.

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 Air Force's exposure analysis relied on density estimates from the NMSDD for the Pacific region. As documented previously in section 3.1 of this opinion, 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 Air Force assessed the impacts of the 2016 Long Range Strike Weapon Systems Evaluation Program mission using a single guild (Pacific Sea Turtles), which combines all sea turtle species. For Pacific sea turtles, a density of 0.00429 animals per km^2 was used for the period of time during which the action will occur (i.e., fall). The Air Force's acoustic analysis resulted in one Pacific sea turtle exposure to acoustic stressors from live explosive munitions during 2016 activities that would be expected to result in TTS (see section 6.4.1). However, as also documented in section 3.1 of this opinion, available information suggests that the majority of the sea turtles within the PMRF (and the majority of the sea turtles within the Pacific sea turtle guild) would be green sea turtles from the Central North Pacific DPS. Therefore, we assume that the one instance of TTS would likely occur to a Central North Pacific DPS green sea turtle. For this reason, we determined that the likelihood of a 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) 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 green sea turtles from these DPSs are not likely to be adversely affected by the proposed action.

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 Green sea turtle – Central North Pacific DPS

Green turtles are distinguished by their smooth carapace with four pairs of costal scutes, a single pair of elongated prefrontal scales between the eyes, and a serrated upper and lower jaw (Figure 4) (Carr 1952; Hirth 1971; Pritchard and Trebbau 1984). Green turtles are the largest of all the hard-shelled sea turtles, but have a comparatively small head. Adults have a light to dark brown carapace with shades of olive, grey, green and black in starburst or irregular patterns (Lagueux 2001), and their plastron (bottom shell) is yellowish white. They can exceed one meter in length and 100 kg in body mass (NMFS and USFWS 1998c). Eastern Pacific green turtles are conspicuously smaller and lighter than their counterparts in the central and western Pacific. Nesting females at French Frigate Shoals in the Northwestern Hawaii Islands average 92 cm in straight carapace length (Balazs 1980), while at the Olimarao Atoll in Yap (western Pacific), females average 104 cm in curved carapace length (Kolinski 1991). Hatchlings average about 4.7 to 5.4 cm in carapace length and 22 to 31 g in weight (Márquez 1990).

Figure 4. Green sea turtle (*Chelonia mydas*). Credit: Andy Bruckner, NOAA.

Nesting in the Hawaiian Islands occurs from May to September, peaking in early June. Females lay an average of two, but up to six nests per season with a mean of 104 eggs per clutch (Balazs 1979). 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). In the spring of 2010, two green turtles nested at the Pacific Missile Range Facility for the first time in more than a decade, with successful hatching in August 2010 (DON 2010).

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). After hatchlings depart the beach for pelagic areas, green turtles reside in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), but they spend the majority of their lives in coastal foraging grounds. When juveniles reach about 20 to 25 cm in carapace length, they leave pelagic habitats and enter coastal foraging grounds (Bjorndal 1997). Adult females return to the same beach from which they hatched to lay eggs (Carr et al. 1978; Meylan et al. 1990). Hawaiian green turtles monitored through satellite transmitters were found to travel more than 1,100 km from their nesting beach in the French Frigate Shoals, south and southwest against prevailing currents to numerous distant foraging grounds within the 2,400-km span of the archipelago (Balazs et al. 1994; Balazs and Ellis 1996). Tag returns of eastern Pacific green turtles establish these turtles travel more than 1,000 km between their foraging and nesting grounds. In 1990, observers documented green turtles 1600 to 3200 km from the shore (Eckert 1993a).

4.2.1.1 Distribution

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.

The green turtle is the most 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 inshore waters 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. They are also common in an oceanic zone surrounding the Hawaiian Islands. 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.

As documented in Section 3.1, 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. 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 North-western 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.

4.2.1.2 Habitat

Green sea turtles occur preferentially in drift lines or surface current convergences, probably because of the prevalence of cover and higher prey densities that associate with flotsam. For example, in the western Atlantic Ocean, drift lines commonly containing floating *Sargassum* spp. are capable of providing juveniles with shelter (NMFS and USFWS 1998c). Underwater resting sites include coral recesses, the underside of ledges, and sand bottom areas that are relatively free of strong currents and disturbance. Available information indicates that green turtle resting areas are near feeding areas (Bjorndal and Bolten 2000). Strong site fidelity appears to be a characteristic of juveniles green sea turtles along the Pacific Baja coast (Senko et al. 2010). Recent tagging data from off the northwestern coast of Saipan and the western coast of Tinian also indicate strong site fidelity (Jones and Houtan 2014).

4.2.1.3 Feeding

Adult green turtles are unique among sea turtles in that they are herbivorous, feeding primarily on sea grasses and algae. This diet is thought to give them greenish-colored fat, from which they take their name. While offshore and sometimes in coastal areas, green sea turtles are not obligate herbivores but consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey (Hatase et al. 2006b; Heithaus and Dill 2002; Seminoff et al. 2002). A shift to a more herbivorous diet occurs when individuals move into neritic habitats. This transition occurs rapidly starting at 30 cm carapace length, but animal prey continues to be an important nutritional component until individuals reach about 62 cm (Cardona et al. 2010). Localized movement in foraging areas can be strongly influenced by tidal movement (Berkson 1967).

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation. Therefore, direct destruction of foraging areas due to dredging, boat anchorage, deposition of spoil, and siltation may have considerable effects on the distribution of foraging green turtles (Coston-Clements and Hoss 1983; Williams 1988). Eutrophication, heavy metals, radioactive elements, and hydrocarbons all may reduce the extent, quality, and productivity of foraging grounds as well (Frazier 1980; McKenzie et al. 1999; Storelli and Marcotrigiano 2003). Various types of marine debris such as plastics, oil, and tar tend to collect on pelagic drift lines that young green turtles inhabit (Carr 1987; Moore et al. 2001) and can lead to death through ingestion (Balazs 1985; Bjorndal et al. 1994a).

4.2.1.4 Migration and movement

Green sea turtles are highly mobile and undertake complex movements through geographically disparate habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). After hatchlings depart the beach for pelagic areas, green turtles reside in a variety of marine habitats for 40 or more years (Limpus and Chaloupka 1997), but they spend the majority of their lives in coastal foraging grounds. These areas include open coastline and protected bays and lagoons. When juveniles reach about 20 to 25 cm in carapace length, they leave pelagic habitats and enter coastal foraging grounds (Bjorndal 1997).

Adult females return to the same beach from which they hatched to lay their eggs (Carr et al. 1978; Meylan et al. 1990). Hawaiian green turtles monitored through satellite transmitters were found to travel more than 1,100 km from their nesting beach in the French Frigate Shoals, south and southwest against prevailing currents to distant foraging grounds around the 2,400-km span of the archipelago (Balazs et al. 1994; Balazs and Ellis 1996). Tag returns of eastern Pacific green turtles establish that these turtles travel more than 1,000 km between foraging and nesting grounds. In 1990, observers documented green turtles 1600 to 3200 km from shore (Eckert 1993a).

4.2.1.5 Hearing

Little information exists regarding the impacts of underwater explosives on sea turtles. The effects of explosions on turtles are 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. Potential impacts include non-injurious and injurious effects. Non-injurious effects include acoustic annoyance, tactile detection, or physical discomfort. Injurious effects include non-lethal and lethal injury (Viada et al. 2008).

The ear anatomy of sea turtles has been thoroughly discussed (Bartol et al. 1999a; Lenhardt et al. 1985; Moein Bartol and Musick 2003; Moein 1994; Wever 1978). Most reptiles demonstrate three principal divisions of the ear: the outer, middle, and inner ear. The external ear for sea turtles is absent (Wever 1978). The middle ear is well-developed and is sound-receptive and sound-conductive and is the most important to evaluate because of the air-filled chamber called the tympanic cavity. The basilar papilla serves as the auditory sense organ within the inner ear (Wever 1978).

The organ most sensitive to the primary effects of a blast wave is the auditory apparatus. A few studies have been conducted to measure green turtle hearing sensitivity, each using a slightly different methodology. Ridgeway et al. (1969) studied the auditory evoked potentials of three green turtles (in air and through direct mechanical stimulation of the inner ear) and tested a range of 30 to 2000 Hz. Results revealed that green sea turtles detected limited sound frequencies (200 to 700 Hz) with maximum sensitivity of about 400 Hz and rapid declines for tones at lower and higher frequencies. They reported an upper limit for cochlear potentials without injury of 2000 Hz and a practical limit of about 1000 Hz. Bartol and Ketten (2006) measured auditory brainstem responses (short latency auditory evoked potentials) to aerial tones in partially submerged green turtles and documented hearing between 100 and 800 Hz, with maximum sensitivity between 600 and 700 Hz in Atlantic juvenile greens, and100 and 500 Hz with maximum sensitivity between 200 and 400 Hz in Pacific sub-adult greens (Moein Bartol and Ketten 2006). Dow Piniak et al. (2012) recorded auditory evoked potential in response to both aerial and underwater acoustic stimuli. Green turtles detected acoustic stimuli in both media, responding to underwater signals between 50 and 1,600 Hz (turtles completely submerged) and aerial signals between 50 and 800 Hz, with maximum sensitivity between 200 and 400 Hz underwater and 300 and 400 Hz in air (Piniak et al. 2012).

These studies provide the reasonable assumption that the sea turtle auditory apparatus is sensitive to sounds produced by underwater explosions. A momentary startle response or temporary disorientation could result from detonations of low intensity or of sufficient distance to be detected, but not injurious (Viada et al. 2008). 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).

4.2.1.6 Diving

The behavior of post-hatchlings and juvenile green turtles raised in captivity indicate that turtles in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters (Hazel et al. 2009; NMFS and USFWS 1998b). Data from Australia indicate green sea turtles rarely dive deep, staying in upper 8 m of the water column (Hazel et al. 2009). Daytime dives were shorter and shallower than those at night (Ballorain et al. 2013; Hazel et al. 2009).

In their coastal habitat, green turtles typically make dives shallower than 100 feet (30.5 m) (Hatase et al. 2006a; Hays et al. 2000; Hochscheid et al. 2005; Houghton et al. 2002) and often do not exceed 16.8 m (55 feet) (Hays et al. 2000; Rice and Balazs 2008a), although they are known to feed and rest at depths of 19.8 to 50.3 m (65 to 165 ft) (Balazs 1980; Brill et al. 1995). Green turtles migrating between the northwestern and main Hawaiian Islands reached a maximum depth greater than 135.6 m (445 feet) at night (the deepest dives ever recorded for a green turtle). The mean maximum night dive depth was 35 to 50 m (115 to 164 feet) but only 4.3 m (14.1 feet) during the day (Rice and Balazs 2008b).

Time spent resting and dive duration increased significantly with decreases in seasonal water temperatures. Subadults routinely dive to 20 m for 9 to 23 minutes, with a maximum recorded dive of 66 minutes (Brill et al. 1995; I-Jiunn 2009). Green sea turtles along Taiwan may rest during long, shallow dives (I-Jiunn 2009). Dives by females may be shorter in the period leading up to nesting (I-Jiunn 2009).

4.2.1.7 Natural threats

Natural threats include predation, environmental factors, and disease. Herons, gulls, dogfish, and sharks prey upon hatchlings. Adults face predation primarily by sharks and to a lesser extent by killer whales. Predators (primarily of eggs and hatchlings) also include dogs, pigs, rats, crabs, sea birds, reef fishes, and groupers (Bell et al. 1994; Witzell 1981). All sea turtles except leatherbacks can undergo "cold stunning" if water temperatures drop below a threshold level, which can be lethal.

Fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body, has been found to infect green turtles, most commonly juveniles (Williams Jr. et al. 1994). For unknown reasons, the frequency of a disease called fibropapillomatosis is much higher in green sea turtles than in other species and threatens a large number of existing subpopulations. Extremely high incidence has been reported in Hawaii, where affliction rates peaked at 47 to 69 percent in some foraging areas (Murakawa et al. 2000). A to-date unidentified virus may aid in the development of fibropapillomatosis (Work et al. 2009). Green sea turtles with an abundance of barnacles have been found to have a much greater probability of having health issues (Flint et al. 2009). The fungal pathogens *Fusarium falciforme* and *F. keratoplasticum* kill in excess of 90 percent of sea turtle embryos they infect and may constitute a major threat to nesting productivity under some conditions (Sarmiento-Ramırez et al. 2014).

4.2.1.8 Anthropogenic threats

Historically, the main cause of the worldwide decline of the green sea turtle was long-term harvest of eggs and adults on nesting beaches and juveniles and adults on feeding grounds. Green turtles were traditionally prized for their flesh, fat, eggs, and shell, and fisheries in the United States and throughout the Caribbean contributed to the decline of the species. Egg removal and poaching of nesting females continues to be a problem for the greater threatened populations nesting throughout the south Pacific Ocean, Eastern Atlantic Ocean, Indian Ocean and some areas in the Caribbean (as summarized in (Seminoff 2004). Removal of eggs each nesting season can severely impact juvenile cohorts that would have recruited from the post-hatchling phase while poaching of nesting females reduces the abundance of reproductive adults as well as potential for annual egg production. Both these impacts lead to declines in overall survival and reproduction for these respective populations. Despite substantial declines in the population of green sea turtles in these respective regions, intentional harvest remains legal in many countries and remains a threat to populations worldwide.

Green turtles depend on shallow foraging grounds with sufficient benthic vegetation and normal beach temperatures (Ackerman 1997). Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). Direct destruction of foraging areas due to dredging, boat anchorage, deposition of soil, and siltation (Coston-Clements and Hoss 1983; Williams 1988) may have considerable effects on the distribution of foraging green turtles. These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). Eutrophication, heavy metals, radioactive elements, and hydrocarbons all may reduce the extent, quality, and productivity of foraging grounds (Frazier 1980; McKenzie et al. 1999; Storelli and Marcotrigiano 2003).

On the Pacific coast of Mexico in the mid-1970s, more than 70,000 green turtle eggs were harvested every night. Hundreds of mostly immature green sea turtles were killed between 2006 and 2008 due to bycatch and direct harvest along Baja California Sur (Senko et al. 2014). Very few green sea turtles are caught via bycatch in U.S. fisheries (Finkbeiner et al. 2011). However, a legal fishery operates in Madagascar that harvested about 10,000 green turtles annually in the mid-1990s. Green sea turtles are killed because they are seen as competitors for fishery resources in parts of India (Arthur et al. 2013). Between 1991 and 2011, an average of 8,169 green sea turtles were harvested annually along the Caribbean coast of Nicaragua (over 171,000 over this period); this rate that has been in decline potentially due to population depletion (Lagueux et al. 2014).

The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Witherington and Bjorndal 1991).

Pollution also threatens the pelagic habitat of young green turtles. The pelagic drift lines that young green turtles inhabit tend to collect floating debris such as plastics, oil, and tar (Carr 1987; Moore et al. 2001). Ingestion of plastic and other marine debris is another source of morbidity and mortality (Stamper et al. 2009). Green sea turtles stranded in Brazil were all found to have ingested plastics or fishing debris (n = 34), although mortality appears to have resulted in three cases (Tourinho et al. 2009). Contact with oil and the ingestion of plastics and tar are known to kill sea turtles (Carr 1987; Lutcavage et al. 1995). Older juvenile green turtles have been found dead after ingesting seaborne plastics (Balazs 1985; Bjorndal et al. 1994b). Further, the introduction of alien algae species threatens the stability of some coastal ecosystems and may lead to the elimination of preferred dietary species of green sea turtles (De Weede 1996).

Sea level rise may have significant impacts upon green turtle nesting on Pacific atolls. These low-lying, isolated locations could be inundated by rising water levels associated with global warming, eliminating nesting habitat (Baker et al. 2006; Fuentes et al. 2010a). Fuentes et al. (2010a) predicted that rising temperatures would be a much greater threat in the long term to the hatching success of sea turtle turtles in general and green sea turtles along northeastern Australia particularly. Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). Predicted temperature rises may approach or exceed the upper thermal tolerance limit of sea turtle incubation, causing widespread failure of nests (Fuentes et al. 2010a). Although the timing of loggerhead nesting depends upon sea-surface temperature, green sea turtles do not appear to be affected (Pike 2009).

4.2.1.9 Status and trends

The principal nesting site for green turtles in the Central North Pacific DPS is French Frigate Shoals, where 96 percent of the population (3,710 of 3,846 nesting females) currently nests (Balazs 1980; Lipman and Balazs 1983). Current nesting by green turtles occurs in low numbers (3 to 36 nesting females at any one site) throughout the northwest Hawaiian Islands at Laysan, Lisianski, Pearl and Hermes Reef, and very uncommonly at Midway. Since 2000, green turtle nesting on the main Hawaiian Islands has been identified in low numbers (1 to 24) on seven islands (Frey et al. 2013; Kittinger et al. 2013). Green turtles in the Central North Pacific DPS bask on beaches throughout the northwest Hawaiian Islands and in the main Hawaiian Islands.

Since nesting surveys were initiated in 1973, there has been a marked increase in annual green turtle nesting at East Island, French Frigate Shoals, where approximately 50 percent of the nesting on French Frigate Shoals occurs (Balazs and Chaloupka 2006a; Balazs and Chaloupka 2004). During the first 5 years of monitoring (1973 to 1977), the mean annual nesting abundance was 83 females, and during the most recent 5 years of monitoring (2009 to 2012), the mean annual nesting abundance was 464 females (Balazs and Chaloupka 2006a). This increase over the last 40 years corresponds to an annual increase of 4.8 percent.

Information on in-water abundance trends is consistent with the increase in nesting (Balazs 2000; Balazs et al. 1996; Balazs et al. 2005). The number of immature green turtles residing in foraging areas of the eight main Hawaiian Islands has increased (Balazs et al. 1996). In addition, although the causes are not totally clear, there has been a dramatic increase in the number of basking turtles in the Hawaiian Islands over the last two decades, both in the southern foraging areas of the main islands (Balazs et al. 1996) as well as at northern foraging areas at Midway Atoll (Balazs et al. 2005).

With regard to diversity and resilience, because nesting in the Central North Pacific DPS is unusually concentrated at one site, there is little diversity in nesting areas. Balazs (1980) reported that the distribution of green turtles in the Hawaiian Archipelago has been reduced within historical times, and Kittinger et al. (2013) suggest that a significant constriction in the spatial distribution of important reproduction sites presents a challenge to the population's future and makes this DPS highly vulnerable. Further, the primary nesting site, the French Frigate Shoals, is a low-lying coral atoll that is susceptible to erosion, geomorphological changes and sea level rise, and has already lost significant nesting area (Baker et al. 2006).

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 green 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°C per decade over the period 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 also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, heat waves, and droughts (IPCC 2014). Climate change has the potential to impact species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. 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.

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. He predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback sea turtles were predicted to gain core habitat area, whereas loggerhead sea turtles and blue whales were predicted to experience losses in available core habitat. McMahon and Hays (2006) predicted increased ocean temperatures would expand the distribution of leatherback sea turtles into more northern latitudes.

The final rule to list 11 DPSs of green sea turtles under the Endangered Species Act (81 FR 20057) listed climate change as a threat for green sea turtles from the Central North Pacific DPS. For example, in some locations, rising sea levels are projected to inundate some sea turtle nesting beaches (Caut et al. 2009; Wilkinson and Souter 2008), change patterns of coastal erosion and sand accretion that are necessary to maintain those beaches, and increase the number of turtle nests destroyed by tropical storms and hurricanes (Wilkinson and Souter 2008). The loss of nesting beaches may have catastrophic effects on sea turtle populations if they are unable to colonize new beaches, or if new beaches do not provide the habitat attributes (e.g., sand depth, temperature regimes, and refuge) necessary for egg survival. As stated in the proposed rule (80 FR 15271), it remains unclear how nesting habitat loss will impact future nesting in the Hawaiian Islands. Additionally, increasing temperatures in sea turtle nests, as is expected with climate change, alters sex ratios, reduces incubation times (producing smaller hatchlings), and reduces nesting success due to exceeded thermal tolerances (Fuentes et al. 2009a; Fuentes et al. 2010b; Fuentes et al. 2009b; Glen et al. 2003). Changes in global temperatures could also affect juvenile and adult distribution patterns. Possible changes to ocean currents and dynamics may result in negative effects to natural dispersal during a complex life cycle (Houtan and Halley 2011), and possible nest mortality linked to erosion may result from increased storm frequency (Van Houtan and Bass 2007) and intensity (Keller et al. 2009). All of these temperature related impacts have the potential to significantly impact sea turtle reproductive success and ultimately, long-term species viability.

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).

5.2 Vessel Interactions

Vessel interactions were identified as a threat to sea turtles around the Hawaiian Islands in the final rule to list 11 DPSs of green sea turtles under the Endangered Species Act (81 FR 20057). 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 2008). Based on an observed annual average of 8 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 2008). 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.

5.3 Ambient and Anthropogenic Noise

Noise in the ocean is the result of both natural and anthropogenic sources. Natural sources of noise include processes such as earthquakes, wind-driven waves, rainfall, bio-acoustic sound generation, and thermal agitation of the seawater. Anthropogenic noise is generated by a variety of activities including shipping, oil and gas exploration, development, military operations (e.g., sonars and explosions), fishing (e.g., commercial/civilian sonars, acoustic deterrent, and harassment devices), research (e.g., air-guns, sonars, telemetry, communication, and navigation), construction, and recreational boating. Sources of anthropogenic noise in some areas of the world are becoming more pervasive, leading to increased oceanic background noise levels at some frequencies as well as peak sound intensity levels. Many anthropogenic sources of noise are located along shipping routes and encompass coastal and continental shelf waters, which are areas that are important marine habitats.

The scientific community recognizes the addition of anthropogenic sound to the marine environment as a stressor that could possibly harm marine animals or significantly interfere with their normal activities (NRC 2005). Once detected, some sounds may produce a behavioral response, including but not limited to, changes in habitat to avoid areas of higher noise levels, changes in diving behavior, or changes in vocalization (MMC 2007). Little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory (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. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 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). Additionally, they are not known to produce sounds underwater for communication.

5.3.1 Shipping and vessel traffic

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). Analysis of noise from ships revealed that their propulsion systems are a dominant source of radiated underwater noise at frequencies less than200 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.

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 5), though military and non-military vessels (e.g., recreational, tourist, fishing) do occur in the PMRF.

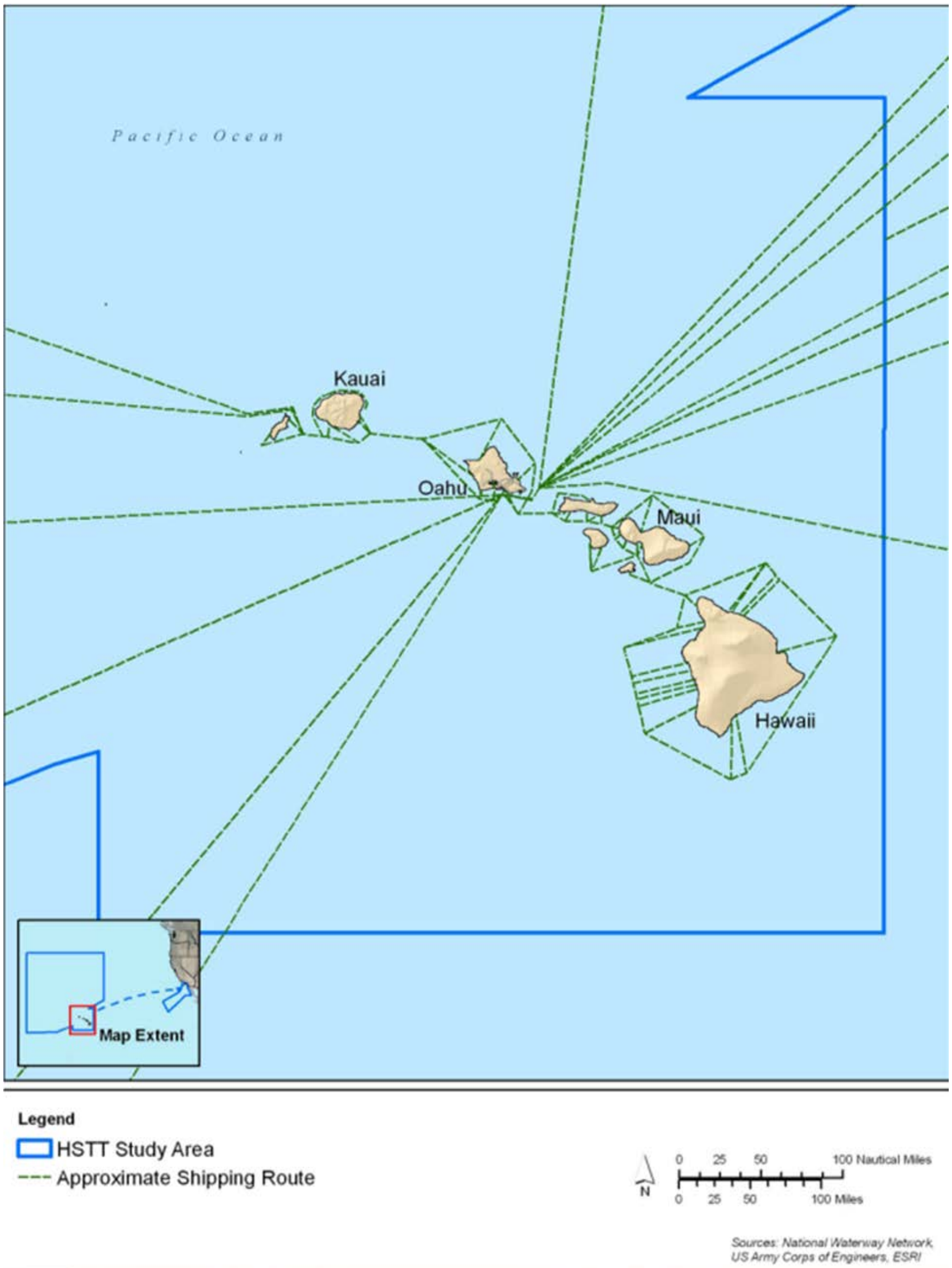

Figure 5. Approximate shipping routes around the Main Hawaiian Islands. Source: Navy (2013).

5.3.2 Ongoing military activities

The U.S. Navy conducts military readiness activities in the HRC, which includes the action area (i.e., PMRF). 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 in the Hawaii-Southern California Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement (Navy 2013). NMFS issued a biological opinion on the effects of these activities in April 2015. The effects analysis in the opinion estimated three green sea turtles would die annually as a result of Navy acoustic stressors in the HRC. Additionally, the effects analysis in the opinion estimated that there would be 7,273 instances of behavioral harassment, 405 instances of temporary threshold shift, 26 instances of permanent threshold shift, and 17 instances of slight lung injury to Pacific sea turtles[1] in the HRC on an annual basis from the acoustic effects of Navy military readiness activities. The majority of Pacific sea turtles in the Hawaii Range Complex were expected to be green turtles. The opinion concluded that the Navy's military readiness activities were likely to adversely affect, but would not jeopardize the survival or recovery of green sea turtles.

5.4 Fisheries Interactions

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. Incidental capture in fisheries was identified in the proposed rule to list 11 DPSs of green sea turtles under the Endangered Species Act as a significant threat to sea turtles of the Central North Pacific DPS (80 FR 15271). 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.

A large number of sea turtles are killed or injured in fisheries worldwide each year (e.g., (Finkbeiner et al. 2011)). The primary fisheries that are known to affect the Central North Pacific DPS of green 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 green sea turtle interactions to negligible levels (80 FR 15271). Foreign longline vessels do not have the same requirements and it is estimated that 100 green sea turtles from the Central North Pacific DPS are captured and killed each year by these vessels (NMFS 2012) 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).

[1] Sea turtle species-specific density estimates were not available for the Hawaii Range Complex, so all Pacific sea turtles in the HSTT opinion were combined into one generic sea turtle group.

5.5 Marine Debris

Anthropogenic marine debris is prevalent throughout the action area, originating from a variety of oceanic and land-based sources. The final rule to list 11 DPSs of green sea turtles under the Endangered Species Act (81 FR 20057) listed marine debris as a threat to green sea turtles in the Hawaiian Islands and throughout their range.

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).

Anthropogenic marine debris can also be accidentally consumed while foraging. Recently weaned juveniles, who are 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).

5.6 Disease

Fibropapillomatosis is the most significant cause of stranding and mortality in green turtles in Hawaii, accounting for 28 percent of standings' with an 88 percent mortality rate of afflicted stranded turtles (Chaloupka et al. 2008c). While the disease appears to have regressed over time (Chaloupka et al. 2009), it persists in the population at levels of spatial variability (Van Houtan et al. 2010). Van Houtan et al. (2010) also suggest a potential relationship exists between the expression of FP and the State's land use, waste-water management practices, and invasive macroalgae.

5.7 Scientific Research

Scientific research permits issued by NMFS currently authorize studies on green sea turtles on and around Hawaii, some of which extend into portions of the action area. Currently, there are 866 authorized annual non-lethal takes of green sea turtles that could occur on or around Hawaii. The issuance of these research permits was considered in section 7 consultations by NMFS.

Authorized research on ESA-listed sea turtles includes capture, handling, restraint, tagging, biopsy, blood sampling, lavage, ultrasound, and tetracycline injection.

5.8 Conclusion on the Impact of the Environmental Baseline

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on green sea turtles in the action area. These stressors include, but are not limited to, climate change, vessel interactions, fisheries, 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 green sea turtles is difficult and, to our knowledge, no such analysis exists. This becomes even more difficult considering that green turtles 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 green sea turtles in the action area to be the status of this species. As described in the *Status of Listed Resources* section of this opinion, the Central North Pacific DPS of green sea turtles is generally experiencing increases in nesting and in-water abundance. This indicates that the species is likely increasing in abundance despite the potential negative impacts of the factors described in the *Environmental Baseline* section.

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 Air Force proposes to conduct in the PMRF action area are summarized in Table 4.

Table 4. Air Force stressor categories and description of the stressors analyzed in this opinion.

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 5 below summarizes our final effects determinations by stressor category.

Table 5. Stressors associated with the Long Range Strike Weapon Systems Evaluation Program activities for 2016 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 Air Force's 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	NLAA	NLAA	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)	**LAA**	**LAA**	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
Loggerhead sea turtle (North Pacific Ocean DPS)	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Hawksbill sea turtle	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Olive ridley sea turtle	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Leatherback sea turtle	NLAA	NLAA	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 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.

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). 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 feet), 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 seafloor. Given the limited time most items will spend in the water column, it is not reasonably 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 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 (Department of the Air Force 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 Weapon Systems Evaluation Program 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 (Department of the Air Force 2016).

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 Weapon Systems Evaluation Program activities are so unlikely as to be considered discountable. Therefore, secondary stressors from Long Range Strike Weapon Systems Evaluation Program 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 Air Force in 2016 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 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. For these reasons, the likelihood of explosive ordnance physically striking an ESA-listed marine mammal or sea turtle during the 2016 Air Force Long Range Strike Weapon Systems Evaluation Program mission is so unlikely as to be considered discountable.

6.3 Mitigation to Minimize or Avoid Exposure

The 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 mammal surveys, which helps to ensure the surveys are as effective as possible. Surveys begin as close to weapon release as possible (usually within one hour), reducing the likelihood that protected species could enter the impact area during the time between the survey and detonation. The surveys span an area of 2 nm from the impact point, encompassing the majority of PTS and TTS impact areas for marine mammals and sea turtles. Lastly, due to the speed and altitude of fixed-wing aircraft during protected species surveys, these aircraft may fly the survey pattern multiple times within a 30 minute time period to help ensure that protected species are not missed in the 2 nm 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).

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 2016 mission was acoustic stressors from explosive detonations.

6.4.1 Exposure and Response Analysis

The 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 Air Force's biological assessment and associated appendices (Department of the Air Force 2016). We verified the methodology and data used by the Air Force for their exposure analysis and accept the modeling conclusions on exposure of marine mammals and sea turtles.

6.4.1.1 Marine mammals

The criteria and thresholds used to estimate potential pressure and acoustic impacts to marine mammals were obtained from Finneran and Jenkins (2012) and include mortality, gastrointenstinal tract injury, slight lung injury, PTS, and behavioral harassment. For activities occurring in 2016, the 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 (i.e., mortality, gastrointestinal tract injury, slight lung injury, PTS, TTS, or 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 was 0.05 instances of TTS for sperm whales. These estimates were rounded to the nearest whole number to obtain exposure estimates for the 2016 mission. Following rounding, zero exposures of marine mammals at thresholds that would rise to the level of take under the ESA were estimated to occur.

6.4.1.2 Sea turtles

The criteria and thresholds used to estimate potential pressure and acoustic impacts to 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 Air Force's exposure analysis (section 3.1) indicated there would be one exposure to an individual from the Pacific sea turtle guild (which included the five ESA-listed sea turtle species within the action area) that would result in TTS. No other sea turtle exposures were estimated to occur at thresholds that would rise to the level of take under the ESA (i.e., onset of mortality, onset of slight lung injury, onset of gastrointestinal tract injury, PTS, or behavioral harassment).

As further described in Section 3.1, we would expect the majority of sea turtles within the action area to be green sea turtles based on observations by Navy divers and contractors in the HRC, distribution, abundance, and migration patterns of sea turtles, and documented nesting sites in the action area. Furthermore, based on the distribution and abundance of green sea turtle DPSs (81 FR 20057), we anticipate the majority of green sea turtles within the action area to be from the

Central North Pacific DPS. Therefore, we assume that the one instance of TTS from the Pacific sea turtle guild will be of a green sea turtle from the Central North Pacific DPS (the DPS whose nesting range encompasses the Hawaiian Islands).

6.4.2 Risk Analysis

Temporary threshold shift is a hearing loss that recovers to the original hearing threshold over a period of time. An animal may not even be aware of a TTS. It does not become deaf, but requires a louder sound stimulus (relative to the amount of TTS) to detect a sound within the affected frequencies. Temporary threshold shift may last several minutes to several days, depending on the intensity and duration of the sound exposure that induced the threshold shift (including multiple exposures).

Little is known about how sea turtles use sound in their 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. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al. 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). Additionally, they are not known to produce sounds underwater for communication. As a result, we do not expect the single instance of TTS to have fitness consequences for the individual green sea turtle affected. Because we do not anticipate fitness consequences for the individual animal exposed to sound levels that could cause TTS, we do not expect consequences for the population or the species.

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. The Air Force's acoustic exposure analysis indicated there would be one TTS exposure to an individual from the Pacific sea turtle guild, but no additional sea turtle or marine mammal exposures were estimated to occur at thresholds that would rise to the level of take under the ESA. Based on relative abundance information for sea turtles in the action area, we assume that the one instance of TTS from the Pacific sea turtle guild will be of a green sea turtle from the Central North Pacific DPS (the DPS whose nesting range encompasses the Hawaiian Islands).

As described in the *Status of ESA-listed Species* and *Environmental Baseline* sections of this opinion, the primary anthropogenic threats to the survival and recovery of the Central North Pacific DPS of green sea turtles are direct harvest, incidental bycatch in fisheries, destruction and modification of nesting habitat, disease, predation, and climate change. Despite these threats, available information (e.g., nesting surveys) indicates that Central North Pacific DPS green sea turtle abundance is increasing.

Based on our analysis in this opinion, we conclude that effects from the Air Force's operational evaluations of live long-range strike weapons and other munitions conducted off of the western shores of the island of Kauai in October 2016 would not be expected, directly or indirectly, to appreciably reduce the likelihood of the survival or recovery of the Central North Pacific DPS of green sea turtles in the wild by reducing the reproduction or distribution of the species. We do not expect the single instance of TTS to have fitness consequences for the individual green sea turtle affected because sea turtles do not rely on acoustic cues for most important life functions. Because we do not anticipate fitness consequences for the individual animal exposed to sound levels that could cause TTS, we do not expect consequences for the population or the species.

7 CONCLUSION

During the consultation, we reviewed the current status of the Central North Pacific DPS of green 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 the Air Force's activities are likely to adversely affect, but will not appreciably reduce, the ability of the Central North Pacific DPS of green sea turtles to survive and recover in the wild. Therefore, we conclude that these activities are not likely to jeopardize the continued existence of the Central North Pacific DPS of green 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. 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).

Based on the analysis in the biological opinion, NMFS anticipates that the proposed action would result in one instance of TTS to an individual from the Central North Pacific DPS of green sea turtle.

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 the 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 Air Force 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 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 Air Force shall report all observed interactions resulting in take with any ESA-listed species resulting from the proposed action that are observed.

Monitoring

As discussed in Section 6.4 of this opinion, the estimated take of ESA-listed species from acoustic stressors is based on Air Force modeling, which represents the best available means of numerically quantifying take. As the level of impulsive acoustic activities increases, the level of take is likely to increase as well. For non-lethal take from acoustic sources specified above, feasible monitoring techniques for detecting and calculating actual take of sea turtles do not exist. We are not aware of any other feasible or available means of determining when estimated take levels may be exceeded. Therefore, we must rely on Air Force modeling, and the link between explosive use and the level of take, to determine when anticipated take levels have been exceeded. Reinitiation of consultation shall be required if Air Force monitoring detects any unanticipated form of take of ESA-listed species not specified above.

8.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Air Force 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 Air Force fails 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 Air Force must implement all mitigation and monitoring measures as described in the draft Biological Assessment 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 Air Force shall immediately (within 24 hours of the discovery) contact NMFS and appropriate stranding networks.
   b. Within 120 days following the completion of the proposed action, the Air Force shall submit a report to NMFS containing the following information
      i. Date and time of the Long Range Strike Weapon Systems Evaluation Program 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 Weapon Systems Evaluation Program 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 Weapon Systems Evaluation Program 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, 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 Air Force's operational evaluations of live long-range strike weapons and other munitions in the BSURE area of the PMRF off of the western shores of the island of Kauai in October 2016. 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 Air Force must contact the ESA Interagency Cooperation Division, Office of Protected Resources immediately.

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