Final
Environmental Impact Statement/Overseas Environmental Impact Statement
Hawaii-Southern California Training and Testing

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4 CUMULATIVE IMPACTS

4.1 PRINCIPLES OF CUMULATIVE IMPACTS ANALYSIS

The approach taken herein to analyze cumulative effects meets the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality regulations, and Council on Environmental Quality guidance. Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] 1500-1508) provide the implementing procedures for NEPA. The regulations define "cumulative effects" as:

> *…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time* (40 CFR 1508.7).

The Council on Environmental Quality provides guidance on cumulative impacts analysis in Considering Cumulative Effects Under the NEPA (Council on Environmental Quality, 1997). This guidance further identifies cumulative effects as those environmental effects resulting "from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation." Noting that environmental impacts result from a diversity of sources and processes, this Council on Environmental Quality guidance observes that "no universally accepted framework for cumulative effects analysis exists," while also noting that certain general principles have gained acceptance. One such principle provides that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, cumulative effects analysis normally will encompass a region of influence or geographic boundaries beyond the immediate area of the proposed action, and a time frame including past actions and foreseeable future actions, to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, Council on Environmental Quality guidelines observe that it "is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful."

4.1.1 DETERMINATION OF SIGNIFICANCE

Per the *Council on Environmental Quality's Considering Cumulative Effects Under the NEPA* (Council on Environmental Quality, 1997), the "levels of acceptable change used to determine the significance of effects will vary depending on the type of resource being analyzed, the condition of the resource, and the importance of the resource as an issue." Furthermore, "this change is evaluated in terms of both the total threshold beyond which the resource degrades to unacceptable levels and the incremental contribution of the proposed action to reaching that threshold." In practice, "the analyst must determine the realistic potential for the resource to sustain itself in the future and whether the proposed action will affect this potential." In other words, for a proposed action to have a cumulatively significant impact to an environmental resource, two conditions must be met. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource, including the effects of the proposed action, must be significant. Second, the proposed action must make a measurable or meaningful contribution to that significant cumulative impact.

4.1.2 Identifying Region of Influence or Geographical Boundaries for Cumulative Impacts Analysis

The region of influence or geographic boundaries for analyses of cumulative impacts can vary for different resources and environmental media. Council on Environmental Quality guidance (Council on Environmental Quality, 1997) indicates that geographic boundaries for cumulative impacts almost always should be expanded beyond those for the project-specific analyses. This guidance continues, indicating that one way to evaluate geographic boundaries is to consider the distance an effect can travel, and it identifies potential cumulative assessment boundaries accordingly. For air quality, the potentially affected air quality regions are generally the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere; however, greenhouse gases impact the entire atmosphere. For water resources and land-based effects, watershed boundaries may be the appropriate regional boundary. For wide-ranging or migratory wildlife, specifically marine mammals, fish, sea turtles, and sea birds, any impacts of the Proposed Action might combine with the impacts of other activities or processes within the range of the population.

A region of influence for evaluating the cumulative impacts of the Proposed Action is defined for each resource in Section 4.4 (Resource-Specific Cumulative Impacts). The basic region of influence or geographic boundary for the majority of resources analyzed for cumulative impacts in this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) is the entire Hawaii-Southern California Training and Testing (HSTT) Study Area (Figure 2.1-1). The Study Area includes two large marine ecosystems, the California Current and the Insular Pacific-Hawaiian, and one open ocean area, the North Pacific Subtropical Gyre (Figure 3.0-1 and Figure 3.0-2), although the geographic boundaries for cumulative impacts analysis for some resources are expanded to include activities outside the Study Area that might impact migratory or wide-ranging animals. Other activities potentially originating from outside the Study Area that are considered in this analysis include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

4.2 Projects and Other Activities Analyzed for Cumulative Impacts

Cumulative analysis includes consideration of past, present, and reasonably foreseeable future actions. For past actions, the cumulative impacts analysis only considers those actions or activities that have had ongoing impacts that may be additive to impacts of the Proposed Action. Likewise, present and reasonably foreseeable future actions selected for inclusion in the analysis are those that may have effects additive to the effects of the Proposed Action as experienced by specific environmental receptors.

The cumulative impacts analysis makes use of the best available data, quantifying impacts where possible and relying on qualitative description and best professional judgement where detailed measurement is unavailable. Because specific information and data on past projects and actions are typically scarce, the analysis of past effects is often qualitative (Council on Environmental Quality, 1997). Likewise, analysis for ongoing actions is often inconsistent or unavailable. All likely future development or use of the region is considered to the greatest extent possible, even when foreseeable future action is not planned in sufficient detail to permit complete analysis (Council on Environmental Quality, 1997).

The cumulative impacts analysis is not bounded by a specific future timeframe. The Proposed Action includes general types of activities addressed by this EIS/OEIS that are expected to continue indefinitely, and the associated impacts could occur indefinitely. Likewise, some reasonably foreseeable future actions and other environmental considerations addressed in the cumulative impacts analysis are expected to continue indefinitely (e.g., oil and gas production, maritime traffic, commercial fishing). While Navy training and testing requirements change over time in response to world events, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative impacts for the reasonably foreseeable future. Navy environmental planning and compliance for training and testing activities is an ongoing process, and the Navy anticipates preparing new or supplemental environmental planning documents covering changes in training and testing activities in the Study Area as necessary. These future environmental planning documents would include cumulative impacts analysis based on information available at that time.

Table 4.2-1 describes other actions that have had, continue to have, or would be expected to have some impact upon resources also impacted by the Proposed Action within the Study Area and surrounding areas. These activities are selected based on information obtained during the scoping process and Draft EIS/OEIS public comment period (Appendix H, Public Comment Responses), communications with other agencies, a review of other military activities, literature review, previous NEPA analyses, and other available information. Table 4.2-1 focuses on identifying past and reasonably foreseeable future actions (military mission, testing, and training; offshore energy development; ocean-dependent commercial industries; and research). Table 4.2-2 focuses on other major environmental stressors or trends that tend to be widespread and arise from routine human activities and multiple past, present, and future actions. For perspective of general project locations, please refer to Figures 2.1-1 through 2.1-10, which depict the Study Area and boundaries of individual training and testing locations, and Figures 3.0-1 and 3.0-2, which depict large marine ecosystems and open ocean areas within and adjacent to the Study Area. Many of the commercial stressors are also depicted in Figure 3.11-1 through Figure 3.11-24.

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation*		
				Past	*Present*	*Future*
Military Mission, Testing, and Training Activities: California						
Boost-Back and Landing of the Falcon 9 Full Thrust First Stage	Iridium Landing Area, Vandenberg Air Force Base, California, and Offshore Landing Contingency Option	The First Stage rocket to be tested is 12 feet in diameter and 160 feet in height and includes nine engines and two tanks holding 662,250 pounds of aluminum liquid oxygen and 260,760 pounds of rocket propellant. There are three options for First Stage testing: (1) it is dropped into the Pacific Ocean, approximately 261–435 nautical miles west of the Baja California coast, and is non-recoverable; (2) it is boosted-back and lands on concrete padding at SLC-4W; (3) it is landed on a conditional landing area on an autonomous barge located at least 27 nautical miles offshore of Vandenberg Air Force Base; and (4) it is boosted-back and lands on an autonomous barge within the Iridium Landing Area, especially if carrying heavier payloads and the rocket cannot return to Vandenberg Air Force Base (may be used up to six times per year) (U.S. Air Force, 2016a). Environmental effects from potential unsuccessful autonomous barge landing include the discharge of RP-1 jet fuel and debris into the marine environment. Negligible risk to marine animals from direct strike or behavioral or physiological impacts from explosion (Level B Harassment). Vessel noise and traffic may affect, but are not likely to adversely affect: Guadalupe fur seal, blue whale, fin whale, gray whale, humpback whale, sei whale, sperm whale, and sea turtles (green, loggerhead, olive Ridley, hawksbill, and leatherback).	Recovery of all marine debris to the greatest extent practicable	O	O	O
Homeporting Littoral Combat Ships on the West Coast	Naval Base Ventura County Point Mugu and Naval Base San Diego, California	Homeport up to 16 Littoral Combat Ships and unmanned aerial systems between Fiscal Year 2013 and Fiscal Year 2020. Homebasing up to 1,700 personnel and family members. No in-water construction is proposed (U.S. Department of the Navy, 2012d). No long-term environmental impacts anticipated. Increased marine traffic increases risks of underwater noise and vessel strikes; however, Navy vessels will adhere to standard operating procedures that have resulted in minimizing risk of inadvertent marine species strike.	NA	C	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Seal Beach Ammunition Pier and Turning Basin	Naval Weapons Station Seal Beach, Anaheim Bay, California	Construction of a replacement ammunition pier, associated waterfront facilities, and a new small boat access channel for civilian boat traffic. The project would include dredging for the pier, turning basin, and small boat access channel (U.S. Department of the Navy, 2017c). Environmental impacts have not been assessed yet, but would be associated with noise, sediment suspension, and potential disturbance and mortality of individuals during dredging, pile driving and other construction activities, and ongoing operations and increased vessel traffic in the project area.	No assessment has occurred; therefore, no specific mitigation measures identified.			C/O
Joint Logistics Over-the-Shore, Maritime Prepositioning Force, and Field Exercise Training	Marine Corps Base Camp Pendleton, California, Red and Gold beaches and associated inshore training areas, and within and adjacent to the Del Mar Boat Basin	Twelve annual amphibious training activities, which consist of one Joint Logistics Over-the-Shore Training exercise every three years, one Maritime Prepositioning Force exercise every year, and up to 10 Field Exercise activities every year (U.S. Department of the Navy, 2015a). On average, approximately 2,000 to 3,500 personnel take part in Joint Logistics Over-the-Shore Training exercises that last up to 90 days. Maritime Prepositioning Force exercises include an average of approximately 600 to 1,500 personnel and last around 30 days. Field Exercise activities last 7 to 14 days and typically involve 30 to 800 personnel. Activities include projection of combat power ashore, followed by the ship-to-shore movement of supplies and personnel to sustain further operations, which may involve pile driving, beach landing, and equipment transfer. The HSTT EIS/OEIS analyzes those portions of amphibious warfare training that occur at sea (up to the mean high tide mark), to include pile driving and vessel movement. The Joint Logistics Over-the-Shore Environmental Assessment (EA) analyzed the potential impacts associated with the land-based portions of amphibious training at Marine Corps Base (MCB) Camp Pendleton, and there has not been significant new information or substantial change in the action to warrant further review.	Restore beach, including excavation and reestablishment and stabilization of grade and slope. Observation for marine mammals, sea turtles, rocky reef, understory algal communities, surfgrass, kelp, sea fans, sea palms, grunion spawning, and other threatened and endangered species; ceasing of activities in response to sightings. Minimization of noise, especially associated with pile driving activity.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Joint Logistics Over-the-Shore, Maritime Prepositioning Force, and Field Exercise Training (continued)		The implementation of impact avoidance/minimization measures will mitigate environmental impacts from the exercises, which may include temporary and minor impacts on marine sediments, beach contours, and topography from anchors and surf zone/beach activities and direct and indirect impacts on marine organisms from strike, disturbance, noise, and turbidity.				
Fuel Pier Replacement and Dredging	Naval Base Point Loma, San Diego California	Replaced the existing fuel pier and dredged approximately 87,000 cubic yards of sediment to facilitate ongoing navigation in the vicinity of the pier (U.S. Department of the Navy, 2013b). Dredge material was disposed in SSTC Boat Lanes as beach nourishment. No increased operational impacts above those already occurring. No long-term environmental impacts from construction or dredging. Vessel traffic through the channel and to the pier would be maintained, as would the risk for vessel strikes; however, slow speeds would be maintained and the risk for inadvertent marine mammal strikes would be minimal.	N/A	C	O	O
Replacement of the Fuel Storage and Distribution System	Naval Base Coronado, Naval Auxiliary Landing Field, San Clemente Island, California	Retirement in place and replacement of the aging underground JP-5 jet fuel tanks and improvement of fuel receipt, storage, and delivery capabilities (U.S. Department of the Navy, 2012c). No long-term environmental impacts anticipated.	N/A	C		
Helicopter Wings Realignment and MH-60R/S Helicopter Transition	Naval Base Coronado - North Island, California	Added four west coast helicopter squadrons, including three new squadrons and the relocation of one east coast squadron, anticipated to increase helicopter operations by up to 30 percent. Construction included a new organizational maintenance hangar and supporting facilities to accommodate 800 support personnel (U.S. Department of the Navy, 2011a).	N/A	C	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Helicopter Wings Realignment and MH-60R/S Helicopter Transition (continued)		As determined by the California Coastal Management Program, the action would have no effect on coastal resources. Minimal noise increase would be largely contained within installation footprint, and risk of bird/aircraft strikes increased.				
The Transition from C-2A to Navy V-22 Aircraft at Fleet Logistics Centers	Naval Air Station North Island, San Diego, California	The Proposed Action provides facilities and functions to replace the C-2A Greyhound with the newer CMV-22B Osprey at either Naval Air Station North Island, California (within the consortium of Naval Base Coronado installations) or Chambers Field within Naval Station Norfolk, Virginia. The project expands logistics support and training operations, establishes a Navy V-22 training squadron and maintenance school, and constructs and renovates facilities to accommodate Navy V-22 squadron aircraft and personnel. The Proposed Action would be implemented over a 10-year period beginning in 2018. Eventually, the Navy training squadron and maintenance school would be established, either on the west or east coast, to support Navy training requirements. The Proposed Action is expected to be complete in the 2028 timeframe. Impacts would be chiefly terrestrial, but ongoing operations might include increased noise and disturbance over the marine environment resulting from additional operations and personnel.	Mitigation measures have yet to be identified.			C/O
Pier 12 Replacement and Dredging	Naval Base San Diego, California	Demolition and replacement of Pier 12 and associated pier utilities, dredging in berthing and approach for the new pier, dredged material disposal at an approved ocean disposal site and permitted upland landfill, and reuse of demolition concrete to create fish enhancement structures (artificial reefs) (U.S. Department of the Navy, 2011c). No long-term environmental impacts are anticipated.	N/A	C	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Pier 8 Replacement	Naval Base San Diego, California	Demolition of Pier 8 and construction of a new pier and associated utilities with the infrastructure necessary to support modern Navy ship classes (U.S. Department of the Navy, 2015b). Demolition would temporarily increase noise in the local marine environment. Marine mammals are not known to visit Naval Base San Diego and any occurrence in the project area would be very rare. Green sea turtles may occur in the project area.	Observation for marine mammals and sea turtles; ceasing of activities in response to sightings.			C
Military Mission, Testing, and Training Activities: Multiple Locations						
Navy Hawaii-Southern California Fleet Training and Testing	Over the air and seaspace within established operating and warning areas across the north-central Pacific Ocean, from the mean high tide line in Southern California west to Hawaii and the International Date Line, as well as Navy pierside locations in Pearl Harbor and San Diego Bay, and a transit corridor	The Navy At-Sea Policy directs the Navy to develop a comprehensive, programmatic approach to environmental compliance for exercises and training at sea (U.S. Department of the Navy, 2000). The Navy has evaluated impacts from past activities as well as present training and testing activities based on changing operational requirements, new platforms, and new systems. The Navy uses these analyses to support incidental take authorizations under the Marine Mammal Protection Act (MMPA). Prior to this EIS/OEIS, the 2013 Phase II HSTT Final EIS/OEIS provided the most recent comprehensive analysis of the full geographic scope of areas where Navy training and testing activities have historically occurred as well as those projected for a 5-year range (U.S. Department of the Navy, 2013a). The full breadth of activities, and their potential impacts, were similar in nature to those analyzed in this EIS/OEIS, and 57,940 hours of hull-mounted mid-frequency sonar use were anticipated between 2013 and 2018; although, in practice the actual hours of sonar were significantly lower (Figures 2.5-1 through 2.5-3). Likewise, the detonation of a maximum of 170,105 explosives was evaluated over the 5-year period, 58 percent of which were Explosive Class 1 (0.1 to 0.25 lb) (Section 2.5.4. Comparison of Proposed Sonar and Explosive Use in the Action Alternatives to the 2013–2018 MMPA Permit Allotment).	Mitigation measures established for most in-water activities, including specific lookout procedures and recommended mitigation zones and protection focus. A Scientific Advisory Group of leading marine mammal scientists assisted the development of an Integrated Comprehensive Monitoring Program, which coordinated monitoring efforts across all regions where the Navy trains.	O	O	

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Navy Hawaii-Southern California Fleet Training and Testing (continued)	on the high seas (see Figure 1.1-1)	During the 2013 HSTT Phase II EIS/OEIS effort, MMPA incidental take authorizations and incidental take statements under the Endangered Species Act (ESA) were issued by National Marine Fisheries Service (NMFS) to the Navy for three existing range complexes (Southern California Range Complex, Hawaii Range Complex, and Silver Strand Training Complex) plus pierside locations and areas on the high seas where maintenance, training, or testing may occur (*Federal Register* 78(247): 78016-78158, December 24, 2013; *Federal Register* 79(88): 26188-26189, May 7, 2014). Negligible to no impacts have been observed to populations of marine mammals, sea turtles and other marine reptiles, birds, marine vegetation, marine invertebrates, and fish from acoustic, energy, physical disturbance and strike, entanglement, ingestion, and other secondary stressors associated with Navy training and testing activities. Monitoring occurred during training and testing events and generally through the Integrated Comprehensive Monitoring Program (Section 3.0.1.1, Marine Species Monitoring and Research Programs).				
Surveillance Towed Array Sensor System Low Frequency Active Sonar	Pacific (including the Study Area), Atlantic, and Indian Ocean and Mediterranean Sea. Undersea, 12 NM away from any coastline, 400 ft. below surface	Training and testing with Surveillance Towed Array Sensor System Low Frequency Active Sonar systems has been analyzed for potential environmental effects in a study area that overlaps with the Hawaii Range Complex. The Navy utilizes Surveillance Towed Array Sensor System Low Frequency Active Sonar systems onboard several stalwart-class auxiliary general ocean surveillance ships in the North Pacific (which includes waters east of Japan; the north Philippine Sea; the west Philippine Sea; offshore Guam; the Sea of Japan; the East China Sea; the South China Sea; offshore Japan, and northeast of Japan), the Central North Pacific (which includes waters north and south of Hawaii) and the Indian oceans (which includes waters within the Arabian Sea, the Andaman Sea and northwest of Australia). The Navy is currently conducting covered Surveillance Towed Array Sensor System Low Frequency Active Sonar activities pursuant to a National Defense Exemption (under the MMPA). This exemption expires in August of 2019 and the Navy is in the process of updating its relevant environmental planning and compliance documents.	Monitoring (visual, passive acoustic, and active acoustic) and enforcing delay/suspension protocols. Use of “fish finder” (HF/M3 sonar) detects, locates, and tracks marine mammals and, to an extent, sea turtles, that may pass close enough to the Surveillance Towed Array Sensor System Low Frequency Active sonar’s transmit array to enter the mitigation zone.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Surveillance Towed Array Sensor System Low Frequency Active Sonar (continued)		Additional information can be found here: http://www.surtass-lfa-eis.com/ The Navy has been operating Surveillance Towed Array Sensor System Low Frequency Active Sonar systems since 2002 and plans to continue into the reasonably foreseeable future (U.S. Department of the Navy, 2017a). In general, the operation of Surveillance Towed Array Sensor System Low Frequency Active Sonar has low to moderate potential to affect marine mammals, sea turtles, and fishes. Anticipated impacts on turtles include ESA harassment, including non-auditory, auditory, behavioral, masking, or physiological stress impacts when turtles are in close proximity. Impacts to marine mammals are anticipated to be Level B harassment, including auditory or behavioral impacts. However, due to the infrequent of use SURTASS within the HSTT Study Area, these impacts are not likely to affect wide-ranging individuals that traverse the HSTT Study Area.		O	O	O
U.S. Coast Guard Training Activities	U.S. Coast Guard District 11, Southern California and District 14, Hawaii Southward from the Dana Point Harbor to the Mexico border	The U.S. Coast Guard performs maritime humanitarian, law enforcement, and safety services in estuarine, coastal, and offshore waters. Equipment utilized by the Southern California Coast Guard includes 25-foot response boats, 41-foot utility boats, and 87-foot patrol boats, as well as HH-60 helicopters. Training events include search and rescue, maritime patrol training, boat handling, and helicopter and surface vessel live-fire training with small arms. Similarly, the Coast Guard's 14th District carries out its mission and conducts unit training in and around Hawaii. U.S. Coast Guard training in Hawaii includes surface vessel live-fire training with small- and medium-caliber weapons, primarily conducted in Warning Areas 189, 193, and 194 within the Hawaii Range Complex.	Establishing and monitoring safety zones; observation for marine mammals and sea turtles; ceasing of activities in response to sightings. Enhanced environmental protection measures for marine protected species and areas occurring in District 11 and 13, including broadcasting Notice to Mariners advising caution in known areas of high marine protected species.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
U.S. Coast Guard Training Activities (continued)		U.S. Coast Guard mission and training activities contribute vessel noise and could result in collisions with marine mammals and sea turtles. Sonar detection systems could have impacts on marine mammals, including toothed whales and pinnipeds, but only short-term, minor, adverse effects would be expected as the high frequency is not unlike common commercial fish finder systems (U.S. Coast Guard, 2013). Gunnery activities could contribute military expended material to the benthic environment; however, results of Navy modeling efforts discussed for the Proposed Action indicate a low risk that marine mammals or sea turtles would be struck by military expended material during training activities, and it is likely that similar U.S. Coast Guard activities would have a similarly low risk.	concentration in bays (U.S. Coast Guard, 2010)			
Introduction of the P-8A Multi-Mission Maritime Aircraft into the U.S. Navy Fleet	NAS Whidbey Island, Washington; Marine Corps Base Kaneohe Bay, Oahu, Hawaii; Naval Air Station North Island, San Diego CA	Provide facilities and functions to support the homebasing of 12 P-8A Mission Maritime Aircraft fleet squadrons (72 aircraft) and one fleet replacement squadron (12 aircraft) at established maritime patrol home bases (U.S. Department of the Navy, 2008c). Project did not involve in-water or over-water construction activities, although air operations would increase. Increased population would increase nearshore population density, including additional participation in recreation and consumptive activities.		C	O	O
Military Mission, Testing, and Training Activities: Hawaii						
Basing of MV-22 and H-1 Aircraft in Support of III Marine Expeditionary Force Elements in Hawaii	Hawaii Kaneohe Bay, Oahu, and the islands of Kauai, Oahu, Molokai, Maui, and Hawaii Kaneohe Bay, Hawaii, Army Training Areas	Basing up to two Marine Medium Tiltrotor squadrons with a total of 24 MV-22 Osprey aircraft and one Marine Light Attack Helicopter squadron with 15 AH-1 Cobra and 12 UH-1 Huey attack and utility helicopters. Conducting aviation training, readiness, and special exercise operations at training facilities statewide (U.S. Department of the Navy, 2012b). Basing facilities would be developed at Marine Corps Base Hawaii Kaneohe Bay; conducting aviation operations at training areas on the islands of Kauai, Oahu, Molokai, Maui, and Hawaii; and constructing improvements at three existing training facilities.		O	O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Basing of MV-22 and H-1 Aircraft in Support of III Marine Expeditionary Force Elements in Hawaii (continued)	on Oahu (Kahuku Training Area, Kawailoa Training Area, Schofield Barracks East Range, and Dillingham Military Reservation), and Pohakuloa Training Area, and Molokai Training Support Facility	For the second MV-22 squadron, construct new and renovate existing facilities near the southeast end of the runway at Marine Corps Base Hawaii Kaneohe Bay (U.S. Department of the Navy, 2015f). Noise impacts from the new aircraft mix are expected to be less than the previous aircraft mix, reducing impacts on Hawaiian monk seal habitat. Increased population would increase nearshore population density, including additional participation in recreation and consumptive activities.				
Long-Range Strike Weapons Systems Evaluation Program	Pacific Missile Range Facility, Kauai, Hawaii 44 miles offshore Kauai in the Barking Sands Underwater Range Extension	The long-range evaluation tests include live and inert weapon systems deployed from aircraft for detonation in the air as well as at and below the water surface (U.S. Air Force, 2016b). Missions in 2017–2020 would occur once a year over 5 consecutive days. Detonation would produce underwater noise and explosions; however, due to shallow detonations, it is not anticipated that cratering would occur at the seafloor. Metals would sink, disperse, or bind to sediments. Individual fish in the area may be killed by the strike or the associated pressure bubble. An Incidental Take Authorization for marine mammals and sea turtles (hawksbill, loggerhead, olive Ridley, leatherback, and Central North Pacific distinct population segment of green sea turtle) was issued for the 2016 event; and a similar Authorization is anticipated for the 2017–2020 tests (U.S. Air Force, 2016c).	Observation for marine mammals and sea turtles; ceasing of activities in response to sightings.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Photovoltaic and Battery Energy Storage Systems	Pacific Missile Range Facility, Kauai, Hawaii	Proposed renewable energy project consisting of combined utility-scale photovoltaic array on 87 acres and 94 acres. The project improves power quality and energy resiliency in support of the Pacific Missile Range Facility by supplementing the more vulnerable and lower quality power from the local power plant (U.S. Department of the Navy, 2015e). The solar array system could generate up to 44 megawatts of direct current electrical power and would feed this electricity into the Kauai Island Utility Cooperative electrical grid for all users, public and military. New electrical transmission lines would be installed either overhead or underground. Environmental impacts are primarily terrestrial, but may offset energy demand and expand the existing energy portfolio that would reduce the need for development of offshore energy resources (i.e., fuel tanker traffic, wind energy development).				C/O
T-Pier Demolition	Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii	Demolition of Facility 1662, the former Naval Ocean Systems Command Pier, to include removal of concrete decking, support pilings, and existing utility lines associated with the pier. No long-term environmental impacts are anticipated; short-term noise and turbidity in the nearshore marine environment during demolition activities expected.				C
Pali Kilo Beach Cottages Expansion	Marine Corps Base Hawaii, Kaneohe Bay, Pali Kilo District, Oahu, Hawaii	Existing services include 12 single and duplex recreational cottages. Expansion would occur on a previously developed 0.44-acre site used to store emergency generators and other portable equipment and would construct 19 new cottages (49 total new lodging units) adjacent to the shoreline. Construction would be implemented throughout 2016 to 2026 (U.S. Department of the Navy, 2016b). The proposed action is generally terrestrial; however, future impacts on nearshore environments and essential fish habitat are possible resulting from increased recreational activity. With mitigation measures,	Construction best management practices and conservation measures; measures addressing ocean recreation behavior (designation of watercraft launch areas, controlling vehicle access, etc.), and extensive outreach and guest education.	O	O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Pali Kilo Beach Cottages Expansion (continued)		construction and operation may affect, but are not likely to adversely affect, ESA-listed sea turtles or the Hawaiian monk seal.				
Cove Outdoor Recreation Center and Marina Improvements	Marine Corps Base Hawaii, Kaneohe Bay, Oahu, Hawaii	Improvement of the Cove facilities to address deficiencies and increased demand for outdoor recreational resources, including construction of a wave attenuator to protect existing and proposed boating/recreation facilities; construction of additional boat slips, storage, parking, and pavilion; onshore and underwater improvements to three existing boat launches and seawall improvement (U.S. Marine Corps, 2010). Although temporary noise increases in the marine environment may be experienced as associated with construction activities, the project is not likely to adversely affect Hawaiian monk seal, Hawaiian stilt, green sea turtle, and hawksbill sea turtle and was exempt from a negative determination from the Hawaii Coastal Zone Management Program. Ongoing impacts associated with increased capacity and use of recreation resources may occur.	Mitigation and best management practices, including minimizing shading from built structures and enforcement of appropriate boating practices.	C/O	C/O	C/O
Submarine Drive-In Magnetic Silencing Facility	Joint Base Pearl Harbor-Hickam, Beckoning Point, Oahu, Hawaii	Construction of a new drive-in submarine magnetic silencing facility was completed in December 2010. The project replaced existing submarine deperming piers and structures and constructed land-based support facilities. Deperming is accomplished by wrapping heavy gauge copper cables around the hull and superstructure of the vessel; then very high electrical currents are pulsed through the cables to erase the permanent magnetism from ships and submarines. This camouflages them against magnetic detection vessels, marine mines with magnetic detection sensors, and interference with communications and navigation equipment (U.S. Department of the Navy, 2008a, 2008b).		C	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Submarine Drive-In Magnetic Silencing Facility (continued)		No ongoing environmental impacts are associated with construction activities; however, use of the facility is ongoing and risk for impacts associated with vessel traffic (such as strikes and noise) are present but negligible due to the reduced speed of vessels in this location.				
Naval Special Warfare Undersea Enterprise Consolidation	Joint Base Pearl Harbor-Hickam, Oahu, Hawaii	Consolidation of continental U.S.-based Naval Special Warfare Undersea Enterprise units and an existing unit currently located at Joint Base Pearl Harbor-Hickam. Approximately 200,000 square feet of working space and supporting infrastructure would be provided through adaptive reuse of a historic property on Ford Island (Building 55), improvements to existing facilities, and new construction within the existing unit's Pearl City Peninsula compound. Personnel and dependents would increase the population on Oahu by approximately 1,200, and implementation would occur over a 5 to 10 year period (U.S. Department of the Navy, 2011b). The Proposed Action would not involve in-water or over-water construction activities, and in-water operations are anticipated to remain consistent with normal base activity. Increased population would increase nearshore population density, including additional participation in recreation and consumptive activities.		C	O	O
Naval Special Warfare Operations Training	Selected coastal nearshore waters and selected shoreline and inland locations throughout the State of Hawaii (Oahu, Hawaii, Kaui, Maui, Molokai, Lanai)	Historical and proposed Special Operations Forces includes water-based training, land-based training, and air-based training (U.S. Department of the Navy, 2018). Water-based training generally includes diving/swimming, launching/recovering small vehicles designed to operate underwater (submersible) as discreet activities, or in combination and inserting and extracting naval special operations personnel or equipment using watercraft. Land-based training would include personnel transiting over the beach on foot, simulating building clearance activities using simulated munitions, in limited areas engaging in high angle climbing, and using observation techniques in a pre-arranged scenario. Air-based training would include the use of unmanned aircraft systems or aircraft utilizing drop zones or landing zones for	Aircraft flight restrictions would reduce risk of adverse effect on migratory bird populations.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Naval Special Warfare Operations Training (continued)		parachute or rope suspension training activities (Naval Special Warfare Command, 2016). Environmental impacts may include additional stress on or temporary disturbance to nearshore marine resources; however, Level A or Level B harassment of marine mammals is not anticipated.				
U.S. Outer Continental Shelf Energy Development						
Oil and Gas Leasing Programs	Federal Waters: Outer Continental Shelf, approximately 200 to 350 NM seaward from California jurisdictional boundary	Twenty-three oil and gas production facilities, operated by six different companies, are located off the coast of California (Bureau of Ocean Energy Management, 2017b). Twenty-two of these facilities produce oil and gas, while the other is a processing facility. There are 43 active leases encompassing 217,669 acres with an associated 213 miles of pipeline in the Pacific Continental Shelf Oil Region, Southern California Planning Area. Hawaii does not produce offshore oil or gas (U.S. Energy Information Administration, 2017). Oil and gas leasing activities may occur on a given lease tract for 40 – 70 years and include geophysical (sonar) surveys, exploration drilling, development and production wells; installation and operation of platforms, pipelines, and support facilities; transport of hydrocarbons using pipelines or tankers to processing locations; and decommissioning. The Final Five-Year Program does not propose additional lease sales for the Pacific Outer Continental Shelf; but existing activities would continue. The majority of oil and gas structures and the pipelines linking those structures with onshore processing and refining facilities are located north of the Study Area, with one (near Long Beach) that overlaps with Navy testing ranges and Operational Areas (OPAREAs) (Figures 3.11-2 and 3.11-3). Potential impacts associated with Outer Continental Shelf federal oil and gas leasing activities include those associated with noise, traffic, waste discharges, sediment disturbance, and risk of accidental spills (Bureau of	Avoidance/protection of sensitive benthic communities, including no activity zone within 500 feet of live bottom habitat, 1,000 feet of deep-water live corals, and 500 feet of chemosynthetic habitats. Avoidance of impacts within National Marine Sanctuaries, and air gun exploration timing restrictions pertinent to sea turtle requirements. Site-specific mitigation measures evaluated per project at lease sale offering.	C/O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Oil and Gas Leasing Programs (continued)		Ocean Energy Management, 2016a). These impacts are generally assumed to be negligible due to the dispersed and relatively small footprint of normal operations. In the event of small to catastrophic spills, however, impacts grow increasingly detrimental to marine life.				
	Outer Continental Shelf	The Executive Order *Implementing an America-First Offshore Energy Strategy* (April 2017) and Department of the Interior Secretary Order 3350 *Implementing the America-First Offshore Energy Strategy* (May 2017) require the immediate development of a new 5-Year Outer Continental Shelf Oil and Gas Leasing Program with full consideration of areas currently withdrawn from exploration, leasing, and development. Additionally, the Executive and Secretarial Orders require the expedited consideration of NMFS Incidental Take Authorization requests and seismic permitting applications; review of costs, opportunity costs, and adequacy of previous consultations for National Marine Sanctuaries and Marine Monuments; reconsideration of the Bureau of Safety and Environmental Enforcement *Oil and Gas and Sulfur Operations in the Outer Continental Shelf-Blowout Preventer Systems and Well Control Rule* (April 2016); and ceasing all promulgation of the Offshore Air Quality Control, Reporting, and Compliance Proposed Rule (2016). Additionally, the Executive and Secretary Orders require a review with intent to rescind or revise the National Oceanic and Atmospheric Administration (NOAA) *Technical Memorandum NMFS-OPR-55, Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (July 2016).				O
	State Waters: Pacific Outer Continental Shelf, 0 to 3 miles offshore of California	There are four offshore wells operating in California state waters within the Project Area (California Department of Conservation, 2017). Hawaii does not produce oil or gas (U.S. Energy Information Administration, 2017). Activities and potential impacts for these programs are similar as described above for the federal program.	Site-specific mitigation measures evaluated per project at lease sale offering.	C	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe C = Construction O = Operation*		
				Past	*Present*	*Future*
Oil and Gas Structure Removal Operations	Outer Continental Shelf, all water depths	Decommissioning seafloor obstructions (wellheads, caissons, casing strings, platforms, and mooring devices) includes the explosive and non-explosive severing of structures and subsequent salvage and site-clearance operations (Minerals Management Service, 2005). Decommissioning operations generally occur after lease expiration, when the well or facility is no longer deemed economically viable, or when the physical condition of the structure becomes unsafe or a navigation hindrance. Potential environmental impacts, such as injury or death to marine mammals, fish, sea turtles, and other animals due to nearby underwater blasts and site-clearance trawling activities would be mitigated to negligible most of the time, with occasional impacts being potentially adverse but not significant (Minerals Management Service, 2007). The effects of bottom-disturbing activities, such as anchoring and toppling structures, on sensitive benthic habitat and resources may include physical damage to hard bottom features, increased turbidity, and covering or smothering of sensitive habitats with re-suspended sediments. Site-specific NEPA analyses will be conducted on individual applications specifying supplementary mitigation.	General blasting criteria and scenario-specific requirements such as avoidance of hard bottom habitats and anchor restrictions for support vessel and transport use; use of turtle exclusion devices and 30 minute limits for site-clearance trawling; and observation for marine mammals and turtles, pausing activities in response to sightings	C	C	C
Commercial Wind Energy Development	Pacific Ocean Outer Continental Shelf Federal waters (approximately 200 to 350 nautical miles seaward from California and Hawaii state	Although the Bureau of Ocean Energy Management and the State of California are planning for potential leasing for offshore wind in federal waters, no projects have been developed or proposed in California to date (Bureau of Ocean Energy Management, 2017a). Three offshore wind projects have been proposed for federal waters around Oahu, Hawaii (U.S. Energy Information Administration, 2017). Commercial-scale offshore wind facilities are similar to onshore wind facilities, and, depending on rotor size and spacing requirements, can include from 14 (110 meter rotor diameter) to 40 (150 meter rotor diameter) turbines in one Outer Continental Shelf block (3 statute miles by 3 statute miles) (Bureau of Ocean Energy Management, 2013).	Implementation of proper siting and mandatory design criteria; sonic pingers and/or turtle exclusion devices to minimize entanglement and entrainment potential; adherence to U.S. Coast Guard oil spill response plans; use of environmentally friendly chemicals.			C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Commercial Wind Energy Development (continued)	jurisdictional boundary)	Average leaseholds are 8 blocks and current technology limits development to waters no deeper than 100 meters. Development includes installing the substructure, which is typically a large steel tube (up to 20 feet in diameter) driven 80 to 100 feet below the mudline in 15–100 feet water depths, with the pole and turbine mounted on top (Minerals Management Service, 2007). Each turbine is connected by power cable to an electric service platform/substation, typically located somewhere within the turbine array, from which buried high voltage cables transmit the power to an onshore substation for integration into the onshore grid. Total heights can reach upwards of 460 feet with blade tip speeds from 140 to 180 miles per hour over a rotor-swept area between 1.1 and 3.3 acres (American Wind Wildlife Institute, 2017). Site characterization activities include geophysical surveys, sub-bottom sampling, and biological surveys. Site assessment activities include installation of meteorological towers and meteorological buoys, data collection, and decommissioning of the towers and buoys (Bureau of Ocean Energy Management, 2012). Most impacts occur during the construction phase, which involves the highest amount of vessel traffic, noise generation (pile driving), seafloor disturbance (transmission cabling), and air emissions; however, ongoing impacts would occur from vessel and turbine strikes; moderate operational noise; disturbance of nesting areas; alteration of key habitat; or potential fuel, oil, or dielectric fluid spills (Minerals Management Service, 2007). Potential population-level impacts on marine mammals, fish, birds, and sea turtles would be mitigated in site-specific environmental review and permitting processes. In particular, impacts on sea turtles could be minor to moderate because of the technologies' potential to impede sea turtle movement and the potential of entrainment in overtopping devices. Additionally, if related onshore facilities are located in nesting areas, operation could cause minor to				

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Commercial Wind Energy Development (continued)		moderate adverse impacts on sea turtles due to hatchling disorientation from lighting, with possible major impacts if turtle nests or aggregates of hatchlings are destroyed. Proper siting, design, and other mitigation measures would minimize potential impacts on coastal sediment transport processes, marine navigation, commercial shipping, fishing activities, seafloor habitats, marine life, areas of special concern, archaeological sites, and U.S. Department of Defense training and exercise activities.				
Marine Hydrokinetic		Emerging waterpower technologies offer the potential to capture energy from waves, thermal gradients, tides, and ocean currents. Presently, there is significant research into the performance and economic viability of hydropower technologies. There is one project in the licensing process off the coast of Oregon, one in Alaska, and two projects underway in the Atlantic Ocean (Federal Energy Regulatory Commission, 2017a, 2017b). Concerns regarding waterpower technologies include the potential for collisions, noise, physical disturbance, disruption of marine species' behavioral patterns, impacts on local community and fishing industry, ability to monitor projects, cumulative impacts of multiple hydrokinetic projects along the coasts, habitat alteration due to anchors and cables, and release of toxins and chemicals by the projects or by vessels servicing the projects. Other considerations include habitat disturbance and the displacement of benthic organisms. These concerns provide the potential for habitat loss and changes to the ecology of a region (Pacific Fishery Management Council, 2011); however, initial studies have indicated that with appropriate protocols for siting and design, these impacts are likely to be minimal (Union of Concerned Scientists, 2008).				C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Marine Corps Base Hawaii Wave Energy Test Site	Marine Corps Base Hawaii, Oahu, Hawaii, off the north coast of Mokapu Peninsula In water depths of approximately 197 feet and 262 feet 6,500 feet and 8,200 feet	The Marine Corps Base Hawaii Wave Energy Test Site has constructed two wave energy test sites and is testing offshore wave energy conversion devices. Construction included installation and operation of moorings, trunk power and communications transmission cables, in-water scientific data gathering equipment, and associated shoreside electrical transmission and monitoring equipment. Ongoing environmental considerations for operation and maintenance include noise, entanglement and collision hazard, electrical leakage, heat, and electric and magnetic fields. It was determined that construction and operation are not likely to adversely affect any ESA-listed species or their designated or proposed critical habitat (U.S. Department of the Navy, 2012a).	Surveying for and avoidance of marine resources (especially ESA-listed species and coral substrate) prior to all activities.	C/O	O	O
Other Commercial Industries						
Maritime Traffic (Section 3.11.2.1, Commercial Transportation and Shipping)	U.S. West Coast/Pacific Ocean	The California and Hawaii coasts are heavily traveled by commercial, recreational, and government marine vessels with several commercial ports near Navy OPAREAs (see Figures 3.0-11 through 3.0-14, 3.11-1 through 3.11-6 and Tables 3.11-1 through 3.11-4). The United States has grown increasingly dependent on international trade over the past 50 years. As a result, the number of active ports in the Study Area increased, ship traffic increased, and ships are larger. In 2015, privately owned, ocean-going merchant vessels over 1,000 gross tons and transporting various types of cargo made approximately 82,044 calls at U.S. ports (U.S. Maritime Administration, 2016). Key California ports include Los Angeles, Long Beach, San Diego, and Port Hueneme. In 2015, nearly 4,500 port calls from privately owned, ocean-going merchant vessels over 1,000 gross tons and transporting various types of cargo occurred at these four ports (U.S. Maritime Administration, 2016). Based on the assumption that every port call has two ship transits, one inbound and one outbound, approximately 9,000	Continued adherence to state and federal marine traffic and operations regulations.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Maritime Traffic (Section 3.11.2.1, Commercial Transportation and Shipping) (continued)		ship transits of ocean-going merchant vessels occurred at the four ports in 2015 (see Table 3.11-4 and Figure 3.11-7). From 2011 to 2015, total estimated vessel presence in the Southern California Study Area was a total of 28,493,000 hours, 96 percent of which was non-military craft (Table 3.0-6). Primary environmental concerns regarding increased maritime traffic include vessels striking marine mammals and sea turtles, introduction of non-native species through ballast water, and underwater sound from ships and other vessels. Additionally, air and water quality in busy ports can be diminished due to engine emissions and fuel leaks. Secondary impacts include development and maintenance of port infrastructure, which often include dredging requirements to maintain channel depths and habitat loss and degradation in coastal habitats.				
	Hawaii	Ten harbors located on six major Hawaiian Islands serve the commercial cargo, passenger, and fishing industries. Major inter-island ports include Honolulu (Oahu), Barbers Point (Oahu), Hilo (Hawai'i), Kawaihae, and Kahului (Maui) (see Figures 3.0-10 and 3.0-11 and Table 3.11-2). The commercial harbors system receives 98 percent of all consumable goods, building materials and fuel imported to Hawaii. In 2015, 723 port calls from privately owned, ocean-going merchant vessels over 1,000 gross tons and transporting various types of cargo occurred at the four Hawaii ports (Honolulu, Barbers Point, Kahului, and Hilo) (U.S. Maritime Administration, 2016). Based on the assumption that every port call has two ship transits, one inbound and one outbound, approximately 1,446 ship transits of ocean-going merchant vessels occurred at the four ports in 2015 (see Table 3.11-5 and Figure 3.11-8). From 2011 to 2015, total estimated vessel presence in the Hawaii Study Area was a total of 4,371,000 hours, 92 percent of which was non-military craft (Table 3.0-6).	Continued adherence to state and federal marine construction and operational regulations.	O	O	C/O
	Kalaeloa Barbers Point, Honouliuli, Ewa	Oahu is served by two commercial harbors: Honolulu Harbor and Kalaeloa Barbers Point Harbor, which receive nearly all consumable goods and materials brought to Hawaii for shipment to neighbor Islands.		O	O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Maritime Traffic (Section 3.11.2.1, Commercial Transportation and Shipping) (continued)	District, Kapolei, Oahu	Kalaeloa Barbers Point Harbor is in the planning stages to implement harbor improvements, including the addition of berthing, yard space, and other infrastructure including a fuel pier and fuel terminal at Piers 3 and 4. Pier construction in harbor waters and dredging (both new and maintenance) will include impacts on the marine environment such as temporary turbidity, underwater noise/vibration due to pile-driving, habitat fragmentation, and dispersal of invasive species (Hawaii Department of Transportation, 2017). Long-term effects on marine resources along the harbor walls from shading from permanent pier structures and armoring preventing vegetation regrowth. Increased vessel traffic and harbor operations could also cause long-term effects on threatened and endangered species, although potential impacts are expected to be minimal as there are no known use or occurrence of sea turtles, whales, dolphins, or monk seals within the harbor.				
Commercial Fishing (Section 3.11.2.2 [Commercial and Recreational Fishing])		Twenty major fisheries in Hawaiian waters include tuna, billfish, bottom fish, other species of pelagic fish, and a smaller invertebrate fishery. These fisheries all have gear, seasonal, and geographical prohibitions depending on the ecological conditions of the area and the target species (Section 3.11.2.2.1.1, Commercial Fishing). Commercial landings for all fisheries in 2015 in Hawaiian waters exceeded 36 million pounds (see Table 3.11-5). Thirty-nine fisheries in Southern California include groundfishes (e.g.,	Various bycatch mitigation technologies, quotas, and seasonal restrictions required per the fishery-specific permit process.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Commercial Fishing (Section 3.11.2.2 [Commercial and Recreational Fishing]) (continued)		flatfishes, skates, some sharks, and rockfishes), highly migratory species (e.g., tuna, billfish, some sharks, dolphinfish, and swordfish), coastal pelagic species (e.g., anchovies, mackerel, and sardines), and invertebrates (e.g., California spiny lobster, several crab species), and market squid are harvested and sold commercially. The NMFS issues fishing vessel, dealer, and commercial operator permits and fishing authorizations as required under the various Federal Fishery Regulations. Commercial landings for all fisheries in 2017 in California waters exceeded 140 million pounds (see Table 3.11-7). Commercial fishing can adversely affect fish populations, non-target species, and habitats. Bycatch includes the unintentional capture of fish, marine mammals, sea turtles, seabirds, and other non-targeted species that occur incidental to normal fishing operations. Fisheries bycatch has been identified as a primary driver of population declines in several groups of marine species, including sharks, mammals, seabirds, and sea turtles (Wallace et al., 2010). Commercial fishing often includes the use of mobile fishing gear, such as bottom trawls, which increases turbidity, alters surface sediment and bottom habitats, removes prey (leading to declines in predator abundance), removes predators, and generates marine debris. Ghost fishing occurs when lost and abandoned fishing gear, such as gill nets, purse seines, and long lines, continue to ensnare fish and other marine animals without human oversight and removal. Lost gear fouls and disrupts bottom habitats and has the potential to entangle, or be ingested by, marine animals.				

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Recreational Fishing (Section 3.11.2.2 [Commercial and Recreational Fishing]) (continued)		Although target species vary from year to year, from 2013 through 2017, recreational fishers caught just under 12 million fish in marine and estuarine waters in Hawaii (see Figure 3.11-6 and 3.11-12). Recreational fishing is also significant in southern California, where over 3.3 million days of recreational fishing were recorded in 2013 (National Marine Fisheries Service, 2015b) (see Figure 3.11-15, 3.11-22 through 3.11-24). More than 200 for-hire fishing vessels operate from 15 separate ports between Point Conception and the U.S.–Mexico border (California Marine Life Protection Act Initiative, 2009). Recreational fishing includes impacts from vessel traffic (strike, noise, water pollution, marine debris) and can compound impacts on fish stocks already experiencing exploitation. Recreational fishing and boat traffic usually occurs nearshore rather than in the deeper open ocean, and recreational traffic typically frequents popular locations, which can concentrate damage in these areas from anchors or other bottom-disturbing equipment.	Operational regulations, seasonal restrictions, licensing, and quotas used to manage mitigate negative effects of recreational fishing.	O	O	O
Coastal Land Development and Tourism (Section 3.11.2.4, Tourism)	California and Hawaii Coastline	Coastal land development adjacent to the Study Area is both intensive and extensive, including development of homes, businesses, recreation, vacation, and ship traffic at port facilities and marinas. The Study Area coastline also includes extensive coastal tourism (hotels, resorts, restaurants, food industry, and vacation homes) and its supporting infrastructure (retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, and recreational fishing and whale watching). New development in the coastal zone requires a permit from the state or local government per the Coastal Zone Management Act (Chapter 6, Regulatory Considerations). Tourism is the single biggest industry in Hawaii, and on any given day, over 200,000 visitors are in Hawaii (Hawaii Tourism Authority, 2015). In 2016, nearly 9 million tourists arrived in Hawaii (Hawaii Tourism Authority, 2017). Significant activities include SCUBA diving, snorkeling	Site-specific mitigation often determined during Coastal Consistency Review by the respective state's Coastal Zone Management Program	C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures[1]*	*Project Timeframe C = Construction O = Operation*		
				Past	*Present*	*Future*
Coastal Land Development and Tourism (Section 3.11.2.4, Tourism) (continued)		and whale watching (see Figures 3.11-17 through 3.11-19). Likewise, tourism is a substantial industry in Southern California (National Ocean Economics Program, 2015). Coastal development intensifies use of coastal resources through dune and nearshore habitat loss and disturbance, point and nonpoint source water pollution, entrainment in outflows and other structures, and air quality degradation. SCUBA diving and snorkeling have the potential to degrade reef systems through disturbance and specimen collecting, and collisions between whale watching ships and whales are common.				
Undersea Communications Cables	Oceans worldwide	Submarine cables provide the primary means of voice, data, and Internet connectivity between the mainland United States and the rest of the world (Federal Communications Commission, 2017). The Federal Communications Commission grants licenses authorizing cable applicants to install, own, and operate submarine cables and associated landing stations in the United States. Cables are installed by specialized boats across flat ocean surfaces and dug into the seabed in shallow areas. Over 550,000 mi. of cables currently exist in the world's oceans. Potential impacts of installation and maintenance activities would include noise and vessel strikes from boat traffic and increased seafloor disturbance and sedimentation in localized areas where the cable is installed. Likewise, electromagnetic fields are generated by some cables that may be sensed by and affect the migration behavior of some fish, sharks, rays, and eels (Bureau of Ocean Energy Management, 2016c).	Continued adherence to international marine construction and operational regulations.	C/O	C/O	C/O
Aquaculture		Aquaculture is the farming of aquatic organisms such as fish, shellfish, and plants. Globally, 29 percent of stocks are fished at biologically unsustainable levels, and aquaculture helps meet demand and offsets stress to wild populations (National Marine Fisheries Service, 2015c). Aquaculture production reached an all-time high of 97 million metric tons in 2013 and is the fastest growing form of food production, at 6 percent		C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Aquaculture (continued)		per year globally. Forty-seven percent of aquaculture operations occur in the Pacific Ocean. The threats of aquaculture operations on wild fish populations include reduced water quality, competition for food, predation by escaped or released farmed fishes, spread of disease and parasites, and reduced genetic diversity (Kappel, 2005). These threats become apparent when farmed fish escape and enter the natural ecosystem (Hansen & Windsor, 2006; Ormerod, 2003). The Marine Aquaculture Policy provides direction to enable the development of sustainable marine aquaculture (National Marine Fisheries Service, 2015c).				
	7.2 kilometers (4.5 statute miles) west of Mission Bay in San Diego, California	Establishment of the first commercial-scale offshore aquaculture project in U.S. federal waters, which will gradually expand to produce up to 5,000 metric tons per year (expected by year eight) of yellowtail jack, white seabass, and striped bass (Hubbs-Seaworld Research Institute, 2008; U.S. Army Corps of Engineers, 2015). Submersible sea cages will be deployed and improved as the project progresses. The project could have potential impacts to marine biological resources and water quality, both of which will be extensively mitigated, in order to minimize marine mammal, sea turtle, bird, and predator fish entanglement, proper mesh size netting will be used and the farm will be located away from known seal and sea lion haul-out areas. The project will also implement a comprehensive health management program to prevent the transfer of pathogens or diseases to wild fish stocks as well as a comprehensive loss-control plan to prevent escape from containment and potential impacts to genetic integrity of wild population.	Ongoing monitoring of seafloor chemistry below cages (sediments, water quality) and benthic infaunal communities; abatement measures due to excess feed, fecal matter, antibiotics, and other chemicals; appropriate exclusion netting to avoid entanglement of marine mammals, sea turtles, birds, and predator fish species; avoidance of anchoring on hard bottom habitats; vessel operation protocols			C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Research and Conservation						
Geological and Geophysical Oil and Gas Survey Activities	Outer Continental Shelf	Offshore geological and geophysical research may include seismic airgun surveys and high resolution geophysical surveys supporting oil and gas, renewable energy, and marine minerals exploration (Bureau of Ocean Energy Management, 2014b). Seismic surveys are accomplished by towing a sound source such as an air gun array that emits acoustic energy in timed intervals behind a research vessel. Seismic pulses are typically emitted at intervals of 5 to 60 seconds and source levels are 230.7 decibels referenced to 1 micropascal (dB re 1 µPa) for the large air gun array and 210.3 dB re 1 µPa for the small array. Seismic air gun surveys are loud enough to penetrate hundreds of km into the ocean floor, even after going through thousands of meters of ocean (Weilgart, 2013). Oil exploration is less prevalent in the Pacific Ocean as it is in the Gulf of Mexico and may potentially become in the Atlantic, but it may occur or increase within the existing Pacific Ocean lease tracts discussed above. Vessel strikes and especially seismic sound production in excess of 180 dB could cause adverse impacts on marine mammals (Bureau of Ocean Energy Management, 2014a). Additionally, air guns are known to kill zooplankton for at least 0.75 miles from the point of origination (Tollefson, 2017). All seismic surveys conducted by U.S. vessels are subject to required mitigation measures, the MMPA authorization process administered by the NMFS, as well as the NEPA process associated with issuing MMPA.	Typically include establishing and monitoring (visual, passive acoustic, and active acoustic) safety and acoustic exclusion zones and enforcing delay/ suspension and spacing protocols. Seasonal management may include avoidance of critical habitat for specific vulnerable species. Maximum sound level thresholds established and enforced.			
Academic Research	Global	Wide-scale academic research is conducted in the study area by federal entities, such as the Navy and the National Oceanic and Atmospheric Administration/NMFS, as well as state and private entities and other partnerships, such as the California Cooperative Oceanic Fisheries Investigations program. Although academic research aims to capture data without disturbing the ambient conditions of the ocean environment, vessels contribute traffic,	NMFS and states manage scientific research permits for certain activities	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Academic Research (continued)		noise, and strike hazard; seismic activity contributes noise; and various other collection methods, such as trawling, could be disruptive to the ecosystems under observation. Impacts from academic research operations can be similar to the impacts expected from oil and gas air gun survey activities.				
Field Operations at National Marine Sanctuaries and Marine National Monuments (see Section 6.1.2, Marine Protected Areas)	Sanctuaries located in the West Coast and Pacific Islands	NOAA conducts field operations within Marine Sanctuaries and Monuments, which include vessel operations; vessel maintenance; aircraft operations; non-motorized craft operations; SCUBA or snorkel operations; onshore field work; deployment of autonomous underwater vehicles, remotely operated vehicles, gliders, or drifters; deployment of remote sensing equipment (including sonar); deployment of equipment on the seafloor; and other sampling activities (*Federal Register* 83 [152]: 38684–38685, August 7, 2018). The field operations primarily support resource protection, research, and education objectives of the National Marine Sanctuaries Act. The Programmatic EA of Field Operations in the West Coast National Marine Sanctuaries (Office of National Marine Sanctuaries, 2018a) and the Programmatic EA of Field Operations in the Pacific Islands National Marine Sanctuaries (Office of National Marine Sanctuaries, 2018b) analyze the options of maintaining the status quo and existing level of operations in National Marine Sanctuaries and Monuments for the next 5 years, or increasing the number of small boat operations and stopping the requirement for small boat best management practices in some locations.	Mitigation measures are determined on a project-by-project basis in accordance with the ESA, MMPA, Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation Management Act, and the National Historic Preservation Act.	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation		
				Past	Present	Future
Field Operations at National Marine Sanctuaries and Marine National Monuments (see Section 6.1.2, Marine Protected Areas) (continued)		These discontinued management practices may include existing actions such as enforcing permit and consultation mitigations, vessel speed restrictions, night operation prohibitions, onboard marine mammal and other species observer (unless specified as required or recommended mitigation measures), restrictions on transporting live organisms and ballast water discharges, disinfecting research tools and gear, and safe distance requirements from protected species.				
Naval Undersea Warfare Center Division Fixed Surface Ship Radiated Noise Measurement System	Barbers Point, Oahu, Hawaii and Surrounding Ocean, 3.5 miles offshore in Fleet Operational Readiness Accuracy Check Site	Includes the installation and operation of a hydrophone array, undersea data transmission cable, and a shore station cable landing to measure underwater vessel noise (propulsion, ship machinery, and flow noise) (U.S. Department of the Navy, 2015c). Temporary impacts associated with sediment suspension during drilling operations for undersea cable installation are anticipated. Negligible impacts to marine wildlife are anticipated during construction, but may include avoidance by individuals. No long-term impacts anticipated.	Industry best management practices for drill fluid management, avoidance of ESA-listed marine mammals, sea turtles, fish, Essential Fish Habitat, and vegetation; diver-assisted avoidance of live coral or coral reef ecosystem and weighting cables for long-term stability; and full restoration in ‘Ewa hinahina critical habitat.	C	O	O

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends

Stressor	*Location*	*Description*
Climate Change (Section 3.1, Air Quality; Section 3.2.2.2.4, Climate Change on Water Quality)	Global	Predictions of long-term negative environmental impacts due to climate change include sea level rise; changes in ocean surface temperature, acidity/alkalinity, and salinity; changing weather patterns with increases in the severity of storms and droughts; changes to local and regional ecosystems (including the potential loss of species); shrinking glaciers and sea ice; thawing permafrost; a longer growing season; and shifts in plant and animal ranges, fecundity, and productivity. Anthropogenic greenhouse gas emissions have changed the physical and chemical properties of the oceans, including a 1-degree Celsius temperature rise, increased carbon dioxide absorption, decreased pH, and alteration of carbonate chemistry, decline in dissolved oxygen, and disruption of ocean circulation (Poloczanska et al., 2016). Observations of species responses that have been linked to anthropogenic climate change are widespread, and trends include shifts in species distribution to higher latitudes and to deeper locations, earlier onset of spring and later arrival of fall, declines in calcification, and increases in the abundance of warm-water species. Climate change is likely to negatively impact the Study Area and will contribute added stressors to all resources in the Study Area (as noted in the discussion for each resource in the Sections to follow).
Noise	Global	Ambient noise is the collection of ever-present sounds of both natural and human origin. Ambient noise in the ocean is generated by sources that are natural physical (earthquakes, rainfall, waves breaking, and lightning hitting the ocean); natural biological (snapping shrimp and the vocalizations of marine mammals), and anthropogenic (human-generated) sources. Anthropogenic sources have substantially increased ocean noise since the 1960s, and include commercial shipping, oil and gas exploration and production activities (including air gun, sonar, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), military (testing, training and mission activities), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry). The contribution of military and non-military vessel traffic to the underwater noise experienced in the Study Area is discussed in Section 3.0.3.3.1.4 (Vessel Noise).

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends (continued)

Stressor	*Location*	*Description*
Marine Debris (Section 3.2.2.2.3,Marine Debris and Water Quality)	Global	Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned that enters the marine environment. An estimated 75 percent or more of marine debris consists of plastic, and approximately 80 percent of marine debris originates onshore and 20 percent from offshore sources (Derraik, 2002; Hardesty & Wilcox, 2017). Marine debris is governed internationally by the 1972 London Convention and 1996 London Protocol and regulated in the U.S. through the Marine Protection, Research, and Sanctuaries Act. Marine debris has been discovered to be accumulating in gyres throughout the oceans, and two major accumulation zones exist in the Pacific Ocean and in the Atlantic east of Bermuda. The Hawaiian Archipelago is located within the North Pacific Gyre, which consolidates debris originating in various areas of the Pacific Ocean. Anthropogenic marine debris is also widespread along the continental shelf and upper slope of the U.S. West Coast (Washington to southern California). Military expended materials (ammunition boxes, helmets, rocket boosters and launchers, etc.) were the highest contributors to recovered metals in deeper waters off California in areas known for Navy activities and military dump sites, including around Catalina and San Clemente Islands (Keller et al., 2010). Recent studies in the Southern California Bight found that marine debris (primarily plastic) occurred in about one-third of seafloor areas surveyed (Moore et al., 2016). Microplastic particles were more prevalent in shallow nearshore areas (ports, marinas, bays, and estuaries) than in offshore areas. Marine debris degrades marine habitat and water quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service, 2006).
Pollution (Section 3.2, Sediments and Water Quality)	Global	Common ocean pollutants are generally derived from land-based activities and include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from nonpoint sources (stormwater runoff from watersheds), point sources (wastewater treatment plant discharges), other land-based sources (windblown debris), spills, dumping, vessels, and atmospheric deposition. Bilge water is a mix of water, oily fluids, lubricants and grease, cleaning fluids, and other wastes that are pumped out periodically from vessel holding tanks, either to a reception facility on shore or treated with a bilge oil-separator and discharged at sea. Discharging sewage is largely prohibited under the Clean Water Act. The main risk of oil or other petroleum product spills is from ships, whether carrying petroleum to and from ports or in fuel tanks, and from pipelines and onshore facilities that transport and store oil and gas.
	Hawaii	One of the largest oil tanker spills in the Study Area occurred in 1989 when the tanker Exxon Houston broke away from its moorings and ran aground Barbers Point on Oahu, spilling approximately 117,000 gallons (U.S. Coast Guard, 1992).
	California	In 1969, a federal platform offshore Santa Barbara experienced a blowout in one of its wells; an estimated 80,000 barrels (3,360,000 gallons) of oil was released into the ocean. Since 1969, about 883 barrels of oil have been spilled

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends (continued)

Stressor	*Location*	*Description*
Pollution (Section 3.2, Sediments and Water Quality) (continued)		due to natural gas and oil operations offshore California. This spillage represents the cumulative loss from small spills ranging in size from a few drops to a 163-barrel spill from a pipeline in State waters carrying Outer Continental Shelf production to shore. Several redundancies are provided in all platform systems associated with drilling and production operations to ensure safety and to prevent flow from wells during a contingency such as an earthquake. Sewage outflow systems in both Hawaii and California can impact nearshore water quality. For example, during wet weather/heavy rain events, hundreds of millions of gallons of untreated wastewater can enter the inshore waters of the Southern California Range Complex in San Diego resulting in beach closures and impacts on training due to stormwater runoff from Mexico's Tijuana River (U.S. Department of the Navy, 2015d).
Harmful Algal Blooms (Section 3.2.1.1.2.3, Coastal Water Quality, and Section 3.3.2.1.2.3, Disease and Parasites)	Global	Elevated nutrient loading has also been identified as a potential contributing cause of the increased incidence of harmful algal blooms, proliferations of certain marine and freshwater toxin-producing algae (National Oceanic and Atmospheric Administration, 2016, 2017b). Of the 5,000 known species of phytoplankton, there are about 100 species known to be toxic or harmful. Harmful algal blooms cause human illness and animal mortalities, including species of fish, bird, and marine mammals (Anderson et al., 2002; Corcoran et al., 2013; Sellner et al., 2003). Harmful algal blooms can be natural phenomena but are occurring in increasing size and frequency due to human-induced nonpoint source water pollution (National Oceanic and Atmospheric Administration, 2016, 2017b). With the projection of warming ocean waters, these harmful blooms may become more prevalent—beginning earlier, lasting longer, and covering larger geographic areas (Edwards, 2013; Moore et al., 2008).
Hypoxic Zones (Section 3.6.2.1.4.1, Water Quality)	Global	Hypoxia, or low oxygen, is an environmental phenomenon where the concentration of dissolved oxygen in the water column decreases to a level that can no longer support living aquatic organisms. Hypoxia occurs from the rapid growth and decay of algal blooms in response to excess nutrient loading (primarily nitrogen and phosphorus from agriculture runoff, sewage treatment plants, bilge water, and atmospheric deposition). Animals that encounter the Dead Zones flee, experience physiological stress, or suffocate (National Oceanic and Atmospheric Administration, 2016; Texas A&M University, 2011, 2014). Hypoxic zones can be natural phenomena but are occurring in increasing size and frequency due to human-induced nonpoint source water pollution (National Oceanic and Atmospheric Administration, 2016, 2017b).

4.3 Cumulative Impacts on Environmental Resources

Since the information available on past, present, and reasonably foreseeable actions varies in quality and level of detail, impacts of these actions were quantified where available data made it possible; otherwise, professional judgment and experience were used to make a qualitative assessment of impacts. Due to the large-scale of the Study Area and multiple activities and stressors interacting in the ocean environment (Table 4.2-1 and Table 4.2-2), the analysis for the incremental contribution to cumulative stress that the Proposed Action may have on a given resource is largely qualitative and speculative. Chapter 3 (Affected Environment and Environmental Consequences) includes a robust discussion of cumulative effects in a meaningful sense. To a great extent, the Chapter 3 (Affected Environment and Environmental Consequences) analysis is cumulative in that it takes into account the current condition of each resource as impacted by past and present human activity, and by prospects for recovery reflecting relevant future activity. Chapter 3 (Affected Environment and Environmental Consequences) includes discussion of the "general threats", an analysis of aggregate project effects, and a broader level analysis specific to areas where impacts are concentrated (i.e., ranges/OPAREAS). Therefore, the Chapter 3 (Affected Environment and Environmental Consequences) analysis is referenced and briefly summarized in each section below to provide context and perspective to the rationale for the conclusions that the Proposed Action would have an insignificant contribution to the cumulative stress experienced by these resources, when specific past, present, and reasonably foreseeable future actions are added to the analysis.

In this chapter, cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the Proposed Action. Analysis was not separated by Alternative because the data available for the cumulative effects analysis was mostly qualitative in nature and, from a landscape-level perspective, these qualitative impacts are expected to be generally similar.

Under Alternative 1 or Alternative 2 of the Proposed Action, the Navy would implement the mitigation detailed in Chapter 5 (Mitigation) to avoid or reduce potential impacts on biological, socioeconomic, and cultural resources in the Study Area.

4.4 Resource-Specific Cumulative Impacts

In accordance with Council on Environmental Quality guidance (Council on Environmental Quality, 1997), the following cumulative impacts analysis focuses on impacts that are "truly meaningful." The level of analysis for each resource is commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences) or the level to which impacts from the Proposed Action are expected to mingle with similar impacts from existing activities. A full analysis of potential cumulative impacts is provided for marine mammals, reptiles, and invertebrates. Rationale is also provided for an abbreviated analysis of the following resources: air quality, sediments and water quality, vegetation, habitat, fishes, marine mammals, reptiles, birds, cultural resources, socioeconomics, and public health and safety.

4.4.1 Air Quality

As described in Section 3.1.2.1.1 (Region of Influence), the region of influence for air quality is dependent on the type of pollutant, emission rates, other emission sources, and meteorology. For inert pollutants, the region of influence is generally limited to a few miles downwind from the source. For a photochemical pollutant, such as ozone, the region of influence may extend much farther downwind.

The concentration of many small emission sources in a particular airshed, under the right circumstances, could incrementally contribute to regional air quality degradation.

The context for air quality analysis provided in Section 3.1 (Air Quality) includes adherence to state and federal plans enacted to achieve and maintain air quality, and these plans were developed with direct, indirect, and cumulative impacts in mind. As the plans are developed, the establishment of significance criteria includes an inventory of existing emissions and the development of thresholds that ensure new activities avoid or mitigate significant air quality impacts. A majority of the activities included in the Proposed Action are ongoing, and any emissions associated with these activities that reach land are captured in any ambient air monitoring data collected and used to quantify area air quality.

Unlike other resource areas, the analytical construct for this air quality analysis in Section 3.1 (Air Quality) is effectively a quantified look at applicable training and testing activity emissions and a region's ability to maintain or recover air quality as measured by the criteria air pollutants in light of other, existing emissions. As a whole, the air quality throughout the Study Area is generally very good or excellent as shown by ongoing monitoring of all criteria pollutants against National Ambient Air Quality Standards and State Ambient Air Quality Standards (Section 3.1.2.2, Existing Air Quality). A small proportion of nonattainment and maintenance areas are generally concentrated in the inland, urban, industrialized areas off the coast of Southern California. Much of the air pollutants found in offshore areas are transported there from adjacent land areas by low-level offshore winds, so concentrations of criteria air pollutants generally decrease with increasing distance from land. The good quality of the ocean atmosphere, including Hawaii and the Transit Corridor, results from the relatively low number of air pollutant sources, as well as the size, topography, and prevailing meteorological conditions throughout the Study Area.

Other activities in the Study Area that contribute to emissions of criteria air pollutants include other vessel traffic and oil and gas production activities, as well as from landside power-generating stations, petroleum refining, agriculture, other industry, vehicle traffic, and volcanoes (Hawaii). Oil and gas production is regulated under state and federal programs to ensure new activities avoid or mitigate significant air quality impacts (Bureau of Ocean Energy Management, 2016b). Sulfur dioxide, nitrogen dioxide, and particulate matter air emissions from non-military vessel operations operating within 200 miles of coastal areas off the U.S. and Canada and the U.S. Caribbean Sea area (around Puerto Rico and the U.S. Virgin Islands) are regulated by the International Maritime Organization. These areas are known as Emission Control Areas and were created because of the ability of these pollutant emissions to travel long distances, thus potentially impacting coastal zones and further inland.

As noted above, the majority of proposed activities are ongoing and would be captured in most states' air quality measurements. As detailed in Section 3.1 (Air Quality) sources of emissions from the proposed alternatives would include Navy vessels, aircraft, and to a lesser extent, munitions training and testing activities conducted throughout the Study Area. The Proposed Action would result in localized and temporarily elevated emissions, but criteria pollutant emissions in nonattainment or maintenance areas would not exceed *de minimis* thresholds. Hazardous air pollutant emissions are anticipated to be small and were dismissed as a stressor of impact.

It is anticipated that emissions resulting from the Proposed Action would be released outside of state waters and would quickly disperse in the open ocean environment. These emissions would largely disperse rather than concentrate due to meteorological and air chemistry processes, and these emissions could mix with emissions from other vessel traffic in the open ocean. The incremental additive impacts from these combined emissions occurring beyond state water boundaries would be minor, localized, intermittent, and unlikely to contribute to future degradation of the ocean atmosphere in a way that would harm ocean ecosystems or nearshore communities. Thus, based on the analysis presented in Section 3.1 (Air Quality) and given the meteorology of the Study Area, the frequency and isolation of proposed training and testing activities, and the quantities of expected emissions, it is anticipated that the incremental contribution of the Proposed Action beyond state waters, when added to the impacts of all other past, present and reasonably foreseeable future actions would not result in measurable additional impacts to air quality in the Study Area or beyond.

A cumulative analysis of greenhouse gas emissions and climate change is provided in Section 3.1 (Air Quality).

4.4.2 Sediments and Water Quality

The region of influence for sediments and water quality includes estuaries, nearshore areas, and the open ocean. Although most impacts from anthropogenic sources tend to be geographically isolated in proximity to the source, more widespread impacts can extend over time into the offshore ocean environment due to transport through currents, storms, and persistent winds as well as vertical mixing in the water column. The fate of materials deposited in the marine environment and the formation of degradation or corrosion products depends on geochemical conditions that may influence precipitation by chemical reaction, adsorption, and biodegradation. Transport mechanisms, such as advection by currents, dispersion, and dissolution can cause wide distribution of chemicals and small, buoyant particle debris. While this dynamic movement generally causes chemical contaminants and debris to degrade or dilute, it can also concentrate materials in areas of the seafloor or water column. Persistent currents, upwelling, eddies, and large-scale gyres can result in convergence zones that accumulate debris, particularly plastics, in the marine environment (e.g., the "garbage patches" in the North Pacific Ocean and east of Bermuda).

In order to protect sediment and water quality, several U.S. and international laws govern the discharge of fouling materials into the marine environment. Both nearshore discharge as well as discharges from open ocean activities and vessels in federal waters are regulated by the U.S. Environmental Protection Agency (USEPA) and state environmental programs through the Clean Water Act National Pollutant Discharge Elimination System. The deliberate disposal of waste or other matter into the ocean is governed internationally by the 1972 London Convention and 1996 London Protocol, implemented in the U.S. through the Marine Protection, Research, and Sanctuaries Act. The International Convention for the Prevention of Pollution from Ships is incorporated into U.S. law and addresses pollution generated by normal vessel operations (Section 3.2.1.2, Methods lists applicable water and sediment quality standards, regulations, and guidelines).

Sediment quality of the Study Area is detailed in Section 3.2.2.1 (Sediments) and is generally rated "good" by the USEPA with most instances of lower quality in nearshore waters adjacent to population centers or areas that are geologically more enclosed (e.g., Pearl Harbor) (Table 3.2-1 and 3.2-2; Figures 3.2-2 and 3.2-3). Poor sediment quality related to metals contamination occurs in Waimea Bay, Kauai; Pearl Harbor; Keehi Lagoon on Oahu; Hilo Bay on Hawaii; and other harbors. Off the California coast, sediments are rated good except for areas adjacent to Los Angeles (outside of the Study Area), and farther south in the California Bight from Santa Catalina Island to the Mexico border. The outer continental shelf and submarine canyons are experiencing decreasing sediment quality, likely due to the migration of sediments contaminated in the past by poorly regulated waste and chemical disposal processes.

Water quality of the Study Area is detailed in Section 3.2.2.2 (Water Quality). Threats to water quality are detailed in Section 3.2.2.2.3 (Marine Debris and Water Quality). Population growth is the primary cause of impacts on coastal water quality, including marine debris, land-based garbage, and solid wastes that deposit toxic chemicals and nutrients in the ocean. Water quality in the open ocean portion of the Study Area tends to be rated good, but in nearshore areas water quality ranges from good to poor, and is often compromised due to increased use of and development in coastal waters (see Figures 3.2-4 and 3.2-5). Pearl Harbor is on the Clean Water Act Section 303(d) List of Water Quality Limited Segments as are many of the streams draining into the San Diego Bay. Persistent organic pollutants such as polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and pesticides; nutrients; bacteria; and some metals are common components of discharge into rivers, bays, and the ocean. The major pollutant encountered in the open ocean is oil from accidental spills (including chemical dispersants used in response to spills) as well as natural seeps.

All past, present, and reasonably foreseeable activities listed in Table 4.2-1, and the stressors listed in Table 4.2-2, affect marine sediments and water quality. In particular, activities contributing to climate change, continued runoff and discharge from nearshore land uses and coastal land development, maritime traffic, leakages and spills from oil and gas development, commercial fishing, mineral extraction, offshore energy development and removal operations, and marine trash impact water and sediment quality. Commercial, recreational, and institutional vessels discharge water pollutants into the Southern California portion of the HSTT Study Area as part of normal operations. Shipboard waste-handling procedures governing the discharge of Hawaii-Southern California nonhazardous waste streams have been established for commercial and Navy vessels. These categories of wastes include solids (garbage) and liquids, including "black water" (sewage); "grey water" (water from deck drains, showers, dishwashers, laundries, etc.); and oily wastes (oil-water mixtures). Global climate change is linked to increasing ocean acidity (pH), increasing sea surface temperatures, and increasing frequency and intensity of storms. These factors influence marine chemistry and the transport and persistence of chemical contaminants within sediment and the water column. Chemicals that remain in particulate form below a certain temperature may dissolve into the water column at a higher rate as water temperatures rise, and they may become more widely dispersed due to storms or changing currents. Particularly in nearshore areas and bays, the concentration of Navy stressors in designated ranges and ports may combine with non-Navy stressors, which may also be concentrated in these areas, to exacerbate already impacted sediments and water quality (Figures 2.1-1 through 2.1-10).

The analysis in Section 3.2 (Sediments and Water Quality) indicates that certain training and testing activities could result in localized, short- and long-term impacts on sediment and water quality. Activities that use explosive munitions would introduce explosives byproducts, metals, and other constituent chemicals directly into the water column when the munition detonates or into marine sediments if an explosive munition fails to detonate. Explosives byproducts from munitions that detonate are expected to disperse rapidly near the water's surface after detonation. Explosive materials and metal corrosion products from munitions that fail to detonate and thus reside on the seafloor would be released into adjacent sediments (within a few feet) over the long-term (years to decades). However, analysis of decades-old munitions dump sites in multiple locations, including Hawaii, indicates that chemical contaminant concentrations in impacted sediment would not be expected to differ substantially from the chemical composition of control sediments located within the general area of impact (see Section

3.2.3 Environmental Consequences). Other military expended materials, such as marine markers and flares, chaff, unrecovered towed and stationary targets, sonobuoys, fiber optic cables, and miscellaneous plastic and rubber components of other expended objects are expected to sink to the seafloor and become buried in sediments. Depending on the environmental conditions, including the availability of oxygen in sediments, water temperature at the seafloor and the type of material (e.g., metal or plastic), expended material may degrade relatively quickly or persist in the environment indefinitely. Plastics and other buoyant, persistent materials could incrementally contribute to marine “garbage patches” or other areas with accumulated debris.

Short-term impacts from activities using vessels may include increased turbidity and suspension of sediments in the water column (dependent on water depth). Most explosives are fully consumed in detonation, and chemical, physical, or biological changes to sediments or water quality, if detectable, would be below applicable standards, regulations, and guidelines and would be within existing conditions or designated uses. Military expended materials associated with the Proposed Action do not generally include the same chemical constituents typically affecting coastal water quality. With the exception of the few training and testing activities that occur in bays and harbors, it is unlikely that short-term increases in turbidity from training and testing activities would overlap in time and space with other past, present, or future actions. For example, training and testing with explosives would not occur near an oil rig structure-removal operation that could use explosives or at the same time or place as other bottom-disturbing activities such as trawling or laying electrical transmission or communications cables.

It is possible that Navy stressors would combine with non-Navy stressors, particularly in more heavily used nearshore areas and bays, such as Pearl Harbor and San Diego Bay, to exacerbate already impacted sediments and water quality. Although impacts may occur coincident with other stressors in areas with degraded existing conditions, most of the Navy impacts on water quality, such as increases in turbidity, are expected to be isolated and short-term, with disturbed sediments and particulate matter quickly dispersing within the water column or settling to the seafloor and turbidity conditions returning to background levels. The Proposed Action could incrementally contribute to increases in persistent metal and plastic materials accumulating in the offshore marine environment. However, the relatively minute concentrations of Navy stressors are not likely to meaningfully contribute to sediment or water quality degradation, and it is anticipated that the incremental contribution of the Proposed Action when added to the impacts of all other past, present and reasonably foreseeable future actions would not result in measurable additional impacts on sediment or water quality in the Study Area or beyond.

4.4.3 Vegetation

The Study Area for vegetation includes the sunlit portions of the open-ocean, coastal, and inshore waters, including the surface, water column and benthic habitat to a maximum depth of roughly 200 meters. Vegetation of the Study Area includes algae (phytoplankton and seaweeds), and vascular plants that include seagrasses, emergent marsh vegetation such as cordgrass, and mangroves. Commercial activities are conducted under permits and regulations that require companies to avoid and minimize impacts on sensitive vegetation, and some harvested seaweeds are managed under Fishery Management Plans and in Hawaii are regulated by the Department of Land and Natural Resources.

Seagrasses are susceptible to damage from storms and human activities but can regrow quickly if the root structure is intact and the substrate is not eroded away. Stressors include decreased light penetration and impacts on photosynthesis, particularly from sustained turbidity and nutrient loading, which can cause algal blooms. They are also susceptible to changes in environmental factors such as salinity, pH, water temperature, and physical damage. Section 3.3.2.1.2 (General Threats) includes an extensive discussion of the existing stressors to marine vegetation, including diminished water quality from excessive nutrient input, siltation, pollution (from oil, oil spills, and cleanup chemicals; sewage; and trash), climate change, fishing practices (trawling and raking), anchoring, shading from structures, propeller/vessel traffic, construction and dredging, commercial harvest, and introduced or invasive species. Many of these stressors are components of other activities in the Study Area described in Table 4.2-1. The coverage of seagrass in the Study Area has decreased over time; from 1879 to 2006 global seagrass coverage decreased by 75 percent (Waycott et al., 2009). By comparison, algae includes a much greater diversity of species, forms, life histories, and environmental tolerances, and are thus resilient to stressors and able to rapidly recolonize disturbed environments (Levinton, 2009).

Mitigation measures within the Navy's seafloor resource mitigation areas would avoid or reduce potential impacts of the Proposed Action on vegetation species that are associated with shallow-water coral reefs, precious coral beds, live hard bottom, artificial reefs, and shipwrecks, and pre-activity observations monitor for the occurrence and avoidance of seagrasses, macroalgae, *Sargassum,* and detached (free-floating) kelp. However, even with these mitigation measures, vegetation may be impacted directly by explosions, interactions with vessels, in-water and seafloor devices, and military expended materials. The analysis presented in Section 3.3 (Vegetation) indicates that impacts on marine vegetation are limited to destroying or damaging individual plants, and no persistent or large-scale effects on the growth, survival, distribution, or structure of vegetation are anticipated due to relatively fast growth, resilience, and abundance of the affected species in anticipated activity areas. Likewise, the short-term, localized nature of most activities further diminishes the potential effects on marine vegetation.

The effects of other past, present, and reasonably foreseeable actions on vegetation occur primarily in the coastal and inshore waters and are associated with coastal development, maritime commerce/dredging, and the discharge of sediment and other pollutants. The Proposed Action is not expected to substantially contribute to losses of vegetation that would interfere with recovery in these regions. The incremental contribution of the Proposed Action would be insignificant as most of the proposed activities would occur in areas where seagrasses and other attached marine vegetation do not grow; impacts would be localized; recovery would occur quickly; and the Proposed Action would not compound impacts that have been historically significant to marine vegetation (loss of habitat due to development; nutrient loading; shading; turbidity; or changes in salinity, pH, or water temperature). Although vegetation is impacted by stressors throughout the Study Area, the Proposed Action is not likely to incrementally contribute to population- or ecosystem-level changes in the resource, and it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on vegetation in the Study Area or beyond.

4.4.4 INVERTEBRATES

4.4.4.1 Region of Influence

The region of influence for invertebrates includes the entire Study Area as invertebrates occur in all habitats and depths, including both the water column and benthic habitat. It has been estimated that nearly 6,000 species of invertebrates are present in the Insular Pacific Hawaii large marine ecosystem and over 8,000 species may occur in the California Current large marine ecosystem (Fautin et al., 2010). Invertebrate groups in the Study Area are listed in Table 3.4-2 and include microscopic zooplankton that drift with currents (e.g., invertebrate larvae, copepods, protozoans), larger invertebrates living in the water column (e.g., jellyfish, shrimp, squid), and benthic invertebrates that live on or in the seafloor (e.g., clams, corals, crabs, worms). Shallow-water corals typically occur in water depths less than 30 m. Corals are specifically extensive throughout the Hawaiian Archipelago, which supports over 250 separate species. Deep-water corals occur at depths below 50 m (potentially extending to about 3,000 m) where there is no or low sunlight penetration. Deep-water corals typically do not form biogenic reefs, but rather form mounds of intermediate substrate over hard bottom areas. Corals may also occur in a transition zone of reduced light levels, called the mesophotic zone, between the water depths typically associated with shallow-water and deep-water species.

4.4.4.2 Resource Trends

As discussed in Section 3.4.2.1 (General Background), marine invertebrates are ecologically and economically important, performing essential ecosystem services such as coastal protection, nutrient recycling, food for other animals, and habitat formation, as well as providing income from tourism and commercial fisheries. The health and abundance of marine invertebrates are vital to the marine ecosystem and the sustainability of the world's fisheries. Invertebrates are fished for food (e.g., shrimps, lobsters, crabs, scallops, clams, oysters, sea urchins, sea cucumbers, squids, and octopuses); harvested for jewelry, curios, and the aquarium trade; and some are known to secrete medicinal compounds of interest to the health industry.

Two abalone species (black abalone and white abalone) found in the Study Area are listed as endangered under the ESA, and two additional abalone species (green abalone and pink abalone) are designated as Species of Concern. Abalones occur on hard substrate from the intertidal zone to depths of 30 to 60 m, depending on the species. NMFS maintains a species website that provides additional information on the biology, life history, species distribution (including maps), and conservation of invertebrates in the Study Area (accessible at: https://www.fisheries.noaa.gov/invertebrates).

4.4.4.3 Impacts of Other Actions

Section 3.4.2.1.4 (General Threats) includes an extensive discussion of the existing stressors to marine invertebrates, including overexploitation and destructive fishing practices, habitat degradation resulting from pollution and coastal development, disease, invasive species, oil spills, oil and gas seismic air gun exploration, global climate change and ocean acidification, human-generated noise, and bioprospecting for pharmaceutical products. Stressors specific to reef-building corals, which are generally located in more shallow zones with adequate sunlight penetration and a mean annual water temperature greater than about 64 degrees Fahrenheit, include thermal stress, disease, tropical storms, coastal development and pollution, erosion and sedimentation, tourism/recreation, fishing, trade in coral and live reef species, vessel anchoring or groundings, marine debris, predation, invasive species, military and other security-related activities, and hydrocarbon exploration. Primary threats to deep-water or cold-water corals include bottom fishing, marine debris, hydrocarbon exploration, petroleum contamination, cable and pipeline placement, waste disposal (such as lost fishing equipment or dredged sediments), and other various bottom-disturbing activities. Deep corals are susceptible to physical disturbance due to the branching and fragile growth form of some species, slow growth rate (colonies can be hundreds of years old), and low reproduction and recruitment rates. All activities described in Table 4.2-1 and stressors described in Table 4.2-2 have the potential to impact marine invertebrates due to their ubiquitous presence and relative vulnerability.

Climate Change. As detailed in Section 3.4.2.1.4.2 (Climate Change), one of the primary threat to corals and other types of invertebrates is the occurrence of global climate change, which has and is projected to continue to seriously impact coral reefs in the near and known future. The effects of climate change include increased water temperature, ocean acidification, increased frequency or intensity of cyclonic storm events, and sea level rise, which can cause direct damage to these crucial and sensitive ecosystems as well as increase their susceptibility to and resilience from encounters with all other threats, including disease, pathogens, and genetic disorders.

Increases in ocean temperature can lead to coral stress, bleaching, and mortality. Coral bleaching, which occurs when corals expel the symbiotic algae living in their tissues, is a stress response often tied to atypically high sea temperatures or changes in light availability but also can be attributed to nutrients, toxicants, and pathogens (National Oceanic and Atmospheric Administration, 2017a). Bleaching events have increased in frequency in recent decades and coral bleaching on a global scale has occurred during the summers of 2014, 2015, and 2016. Compared to other regions of the world, few major coral bleaching events have occurred in the Hawaiian Islands. The first known large-scale bleaching event occurred in 1996, primarily affecting portions of the Main Hawaiian Islands. A second event occurred in 2002 in the Northwestern Hawaiian Islands. More recently, bleaching events were documented at Kane'ohe Bay on the northeast coast of Oahu in 2014 and other portions of the Main Hawaiian Islands in 2014 and 2015. NOAA coral reef watch modeling has the main Hawaiian Islands bleaching annually by 2040 under current carbon emission levels (van Hooidonk et al., 2014).

In addition to elevated sea temperatures, atypically low sea temperatures may also cause mortality to corals and most other reef organisms, suggesting that widening climate extremes could proliferate bleaching events. Likewise, ocean acidification has the potential to reduce calcification and growth rates in species with calcium carbonate skeletons, including shellfish, corals, and sponges, certain kinds of algae, and possibly even lobsters and sea cucumbers. In addition to physical effects, increased acidity may result in behavioral changes in some species, such as burrowing behavior and juvenile dispersal patterns of the soft-shell clam and reduction in the loudness and number of snaps in the snapping shrimp.

Although the potential effects that climate change could have on future storm activity are uncertain, numerous researchers suggest that rising temperatures could result in little change to the overall number of storms, but that storm intensity could increase. Increased storm intensity could result in increased physical damage to individual corals and reefs constructed by the corals (which support numerous other invertebrate taxa), overturning of coral colonies, and a decrease in structural complexity (due to disproportionate breakage of branching species). However, large storms such as hurricanes may also have positive impacts on corals, such as lowering the water temperature and removing less resilient macroalgae from reef structures, which can overgrow corals.

Sea level rise could affect invertebrates by modifying or eliminating habitat, particularly estuarine and intertidal habitats bordering steep and artificially hardened shorelines. Likewise, changes in ocean circulation patterns could affect the planktonic food supply of filter- and suspension-feeding invertebrates. Cumulative effects of threats from fishing, pollution, and other human disturbance may reduce the tolerance of corals and other invertebrates to global climate change.

4.4.4.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

The analysis presented in Section 3.4 (Invertebrates) indicates that the Proposed Action could impact marine invertebrates through acoustic stressors (sonar and other transducers, air guns, pile driving, vessel noise, weapons noise), explosives (explosions in water), energy stressors (in-water electromagnetic devices, high-energy lasers), physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (wires and cables, decelerators/parachutes, biodegradable polymers), and ingestion of military expended materials. Potential impacts include short-term behavioral and physiological responses (Celi et al., 2015; Edmonds et al., 2016; Roberts et al., 2016). Some stressors could also result in injury or mortality to a relatively small number of individuals. The potential for impacts on ESA-listed abalone species (Table 3.4-1) would be minimized by mitigation designed to avoid seafloor resource mitigation areas where abalones are located. For example, the Navy will not conduct certain activities within a specified distance of shallow-water coral reefs, precious coral beds, live hard bottom, artificial reefs, and shipwrecks (Chapter 5, Mitigation). These measures will help avoid potential impacts on invertebrates that inhabit these areas, including several areas inhabited by ESA-listed abalone species.

4.4.4.5 Cumulative Impacts on Invertebrates

Some direct impacts on invertebrates are expected, and the impacts of the Proposed Action could be cumulative with other actions that cause disturbance and mortality of marine invertebrates. However, it is anticipated that the incremental contribution of the proposed alternatives would be insignificant for the following reasons:

- Invertebrates are generally abundant and relatively short-lived, thus, with the exception of sessile species located near areas of repeated Navy activities (e.g., pierside locations, established channels near large naval port facilities); few individuals would likely be affected repeatedly by the same event.
- With the exception of some species such as deep-water corals, invertebrates generally have high reproductive rates, short reproductive cycles, and resilient dispersal mechanisms; thus, local communities are likely to reestablish quickly.
- Most of the proposed activities would impact small, dispersed, deep water areas where marine invertebrates are more sparsely distributed. Navy activities may occur in the same general area (ranges), but do not occur at the same specific point each time and would therefore be unlikely to affect the same individual invertebrates.
- Marine invertebrates are not particularly susceptible to energy, entanglement, or ingestion stressors resulting from Navy activities, and none of the alternatives would result in or interact with impacts that have been historically significant to marine invertebrates, such as overfishing, nutrient loading, disease, or the presence of invasive species.
- None of the alternatives would result in long-term or widespread changes in environmental conditions such as turbidity, salinity, pH, or water temperature that could impact marine habitats or interact with existing trends affecting these parameters.
- The Navy will not conduct certain activities within a specified distance of surveyed shallow-water coral reefs, precious coral beds, live hard bottom, artificial reefs, or shipwrecks. All features that have been identified are included in Chapter 5 (Mitigation).

Although the aggregate impacts of other stressors in the ocean environment continue to have significant impacts on some marine invertebrate species in the study area, particularly the effects of global climate change on corals, the Proposed Action is not likely to incrementally contribute to population-level stress and decline of the resource. Due to the effects of global climate change, corals may be less resilient to additional stressors; however, it is not anticipated that the Navy will cause direct effects to surveyed reef systems. As impacts would be isolated, localized, and not likely to overlap with other relevant stressors, it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on invertebrates in the Study Area or beyond.

4.4.5 Habitats

Habitats refers to the marine and estuarine nonliving (abiotic) substrates found throughout the Study Area, which are often colonized by biotic (vegetation and invertebrate) communities. Habitats vary according to geographic location, underlying geology, hydrodynamics, atmospheric conditions, and suspended particulate matter. Habitat types within the Study Area are described in Table 3.5-1 and depicted on Figures 3.5-1 through 3.5-8. There are basically three types of abiotic substrates based on the grain size of unconsolidated material, referred to as soft, intermediate, and hard. The soft habitats are generally comprised of fine grains that are more fluid and dynamic, whereas hard substrate does not repair and thus is susceptible to long-term scarring and damage. Artificial structures, such as shipwrecks oil and gas platforms, underwater cables, and outflows also provide habitat for many marine organisms. Additionally, as detailed in Chapter 6, Other Regulatory Considerations, there are 380,000 square km of designated National Marine Sanctuaries in the total HSTT Study Area (8.32 percent of total Study Area), but none occurring within Range Complexes, Testing Ranges, or OPAREAs.

Section 3.5.2.1.4 (General Threats) includes an extensive discussion of the existing stressors to abiotic marine habitats, including urbanization (modification of shorelines and estuaries, dredging and maintenance of ports, bays, and harbors, and creation of artificial structure habitats such as breakwaters, jetties, rock groins, seawalls, oil and gas platforms, docks, piers, wharves, underwater cables and pipelines, artificial reefs); accumulation of marine debris; and commercial activities (oil/gas development, telecommunications infrastructure, steam and nuclear power plants, desalinization plants, alternative energy development, shipping and cruise vessels, commercial fishing, aquaculture, and tourism operations). The impact of commercial fishing trawling practices has a significant impact on bottom habitats. Most activities in Table 4.2-1 are conducted under permits and regulations that require the avoidance and minimization of impacts on marine habitats, especially shoreline and sensitive hard bottom and biogenic habitats (e.g., coral reefs and shellfish beds). Tourism is an additional stressor in urbanized areas. Nearshore coral reefs along the more developed main Hawaiian Islands have been impacted by trampling; damage from divers and swimmers touching, kicking, breaking, sitting, or standing on coral; and improper boat anchoring. Within the highly urbanized Southern California portion of the Study Area, human visitation and disturbances impact rocky intertidal (trampling, overturning of rocks, collecting) and sandy beach (mechanical beach grooming) habitats.

The analysis presented in Section 3.5 (Habitats) indicates that marine habitats could be affected by underwater detonations, interactions with vessels (including wave erosion and sediment suspension), military expended materials, or seafloor devices. Potential impacts include localized disturbance of the seafloor, cratering of soft bottom sediments, and structural damage to hard bottom habitats. Although some direct impacts on abiotic habitats are expected, it is anticipated that the incremental contribution of the Proposed Action would be cumulatively insignificant for the following reasons:

- Most detonations would occur at or near the water surface and would not affect bottom habitats.
- Impacts to soft bottom habitat from bottom-laid explosives would be confined to a limited area, and it is anticipated that soft bottom habitats would recover (fill in) quickly.

- Proposed Action activities are not likely to occur at the same time/place as other activities in the Study Area, including commercial fishing operations, which have a large effect on bottom habitats. Thus, it is likely that soft bottom habitats would have the opportunity to recover from the Proposed Action before impacts from fishing or other operations could interact or compound additional stress to the ecosystems.
- Per analysis detailed in Section 3.5.3.2.1 (Impacts from Explosives) and Appendix F (Military Expended Material and Direct Strike Impact Analyses), the area of hard bottom potentially impacted represents a negligible percentage in each of the range complexes (less than 0.1 percent) of the total hard bottom habitat in the Study Area (Figures 3.5-1 through 3.5-8). The Navy will implement mitigation to avoid or reduce potential impacts from explosives, physical disturbance, and strike stressors on seafloor resources, including shallow-water coral reefs, live hard bottom, and artificial reefs, as described in Chapter 5 (Mitigation) and National Marine Sanctuaries, as described in Chapter 6 (Regulatory Considerations). Potentially sensitive habitats such as artificial reefs, hard bottom, shallow water coral reefs, and shipwrecks are typically avoided. Training and testing units are reminded of the presence of potentially sensitive areas through the Protective Measures Assessment Protocol program, which limits certain activities in these areas within the HSTT Study Area.

Although it is anticipated that damage to abiotic soft bottom habitat resulting from the Proposed Action would be limited and would recover, many other activities in the ocean are also impacting ocean bottom habitat. However, it is not likely that past, present, and future impacts would overlap Proposed Action activities in place or time before the craters or other impressions in soft bottom substrate fill in. Likewise, hard bottom habitat would be avoided to the greatest extent possible. Based on the analysis presented in Section 3.5 (Habitats) and the reasons summarized above, it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on habitats, including National Marine Sanctuaries, in the Study Area or beyond.

4.4.6 Fishes

The general region of influence for fishes extends beyond the Study Area boundaries for some species because the Study Area represents only a portion of the available habitat during its lifecycle, such as anadromous species that spend part of their lifecycle in freshwater. Fishes are usually not distributed uniformly throughout the Study Area, but are typically associated with a specific habitat type (e.g., soft bottom, reef, or open water) or can utilize a variety of habitats at different life stages. The distribution and specific habitats in which an individual of a single fish species occurs may also be influenced by its size, sex, reproductive condition, and other factors such as water temperature and depth. The highest number and diversity of fishes typically occur where the habitat is most diverse; thus, coastal ecosystems tend to support a greater diversity of species than oceanic and deep-sea habitats (Moyle & Cech, 2004).

It is estimated that there are currently over 34,000 species of fish worldwide (Eschmeyer & Fong, 2017), with greater than half that number of species inhabiting the oceans. There are approximately 1,260 marine fish species reported in the Study Area, approximately 65 percent of which occur in the coastal zone and the remaining 35 percent occurring in the deeper oceanic zone. Table 3.6-2 lists the groups of fishes known to occur in the Study Area.

Table 3.6-1 lists the regulatory status and occurrence of ESA-listed fishes known to occur in the Study Area. Fishes are protected by the ESA, the Magnuson-Stevens Fishery Conservation and Management Act, and the Sustainable Fisheries Act. The Study Area overlaps with the jurisdiction of two regional fishery management councils (Western Pacific Regional Fishery Management Council [includes Hawaii, American Samoa, Guam, and the Northern Mariana Islands] and Pacific Fishery Management Council [includes Washington, Oregon, and California]), as well as the range of the highly migratory species (e.g., sharks, billfish, swordfish, and tunas), which are managed by NMFS. Despite regulation, oversight, and technological improvements, the commercial fishing industry continues to have significant impacts on fish populations, including overfishing and bycatch of non-target species (Moyle & Cech, 2004). By the end of 2015, 28 fish stocks were on the overfishing list and 38 stocks were on the overfished list, while the number of rebuilt fish stocks since 2000 increased to 39 (National Marine Fisheries Service, 2016b). The current aggregate impacts of past and present human activities are significant for some fish species, especially those that are globally in serious decline. Very few ocean habitats remain unaffected by human influence, and these stressors have shaped the condition of marine fish populations, particularly those species with large body size, late maturity ages, and/or low fecundity such as sharks, Pacific cod, and Pacific bluefin tuna (Reynolds et al., 2005).

Section 3.6.2.1.4 (General Threats) includes an extensive discussion of the existing stressors, which often act on fish populations simultaneously, including habitat alteration (coastal development, deforestation, road construction, dam development, water control structures, and agricultural activities), exploitation and bycatch (commercial and recreational fisheries), vessel strikes, diseases and parasites (susceptibility and incidence increases with habitat alteration and exposure to individuals that escaped sea farms), introduction of non-native species, pollution (oil spills, marine debris, noise, hypoxia, and harmful algal blooms), and climate change. The additional threat of living in a noisy environment, such as produced by offshore wind energy developments, construction noise within inshore waters such as pile-driving, sonar, seismic activity, shipping, and offshore construction projects, may contribute to cumulative stress as experienced by some fish populations.

It is anticipated that the Proposed Action would affect fish species within the Study Area, including ESA-listed fish species. The analysis presented in Section 3.6 (Fishes) indicates that fishes could be affected by acoustic stressors (sonar and other transducers, air guns, pile driving, vessel noise, and weapons noise), explosives, energy stressors, physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (wires and cables, decelerators/parachutes), and ingestion of military expended materials. The majority of potential impacts include short-term behavioral and physiological responses. For example, fish species that are exposed to sonar and other transducers within their hearing range or that are within close proximity to vessel or weapons noise may experience brief periods of masking or behavioral reactions, such as startle or avoidance responses, or no reaction at all. Other stressors (such as explosives) could also result in injury or mortality to a relatively small number of individuals. Overall, long-term consequences for most individual fishes or populations are unlikely because exposures from the majority of stressors are intermittent, transient, and unlikely to repeat over short periods.

An individual fish could be exposed to a combination of stressors from multiple activities over the course of its life, and multiple stressors may have synergistic effects such as reducing its overall fitness and ability to recover quickly from additional, compounding stressors. If the health of an individual fish is compromised, it is possible this condition could alter the animal’s expected response to stressors associated with the Proposed Action. Exposure to multiple stressors is most likely to occur in nearshore areas where training and testing activities are more concentrated and overlap the other nearshore stressors listed in Table 4.2-1 and Table 4.2-2. Likewise, animals with a home range intersecting concentrated Navy activities may be subjected to elevated exposure risks compared to those fishes that simply transit the area. Fishes that are malnourished, diseased, or experience temporary hearing loss, injury, or disorientation from acoustic stressors could suffer behavioral and physiological consequences such as decreased ability to detect and avoid predators, oncoming vessels, or entanglement risks.

The aggregate impacts of past, present, and other reasonably foreseeable future actions contributing multiple water quality, noise, and physical risks to fishes would likely continue to have significant effects on individual fishes and fish populations. However, Navy training and testing activities are generally isolated from other activities in space and time and the majority of the proposed training and testing activities occur in well-known, previously established training range areas; are spatially distributed and not generally concentrated in any one location for any extended period of time; have few participants; and are of a short duration. Although it is possible that the Proposed Action could contribute incremental stressors to a small number of individuals, which would further compound effects on a given individual already experiencing stress, it is not anticipated that the Proposed Action has the potential to put additional stress on entire populations. Therefore, it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional significant impacts on fishes in the Study Area or beyond.

4.4.7 Marine Mammals

4.4.7.1 Region of Influence

The general region of influence for marine mammals extends beyond the Study Area boundaries as for some species the Study Area represents only a portion of the full extent of the species' range during their lifecycle. Baleen whales (e.g., humpbacks) and toothed whales (e.g., sperm whales and killer whales) seasonally migrate great distances, as do some pinnipeds (e.g., elephant seals, fur seals, sea lions). Pinnipeds will spend time on land, and except for brief excursions, otters occur mostly in coastal habitats remaining close to the coast. Activities are evaluated for their potential impact on individual marine mammals, on stocks and populations as appropriate, and on species or distinct population segments listed under the ESA.

Table 3.7-1 lists the current abundance of marine mammal species that utilize the Study Area and describes the locations within the Study Area that they may be encountered. There are 39 marine mammal species known to exist in the Study Area, including 7 mysticetes (baleen whales), 25 odontocetes (dolphins and toothed whales), 6 pinnipeds (seals and sea lions), and the southern sea otter. Populations are varied; while the average population of certain dolphin and some whale populations include thousands of individuals (such as humpback whales in Hawaii and the short-beaked common dolphin in the southern California portion of the HSTT Study Area), other stock populations are unknown or estimated to be in the hundreds (such as some stocks of spinner dolphins in Hawaii). As with other marine resources, distribution is patchy and can be temporarily concentrated in specific areas depending on the species.

4.4.7.2 Resource Trends

Relevant information on the status, distribution, population trends, and ecology is presented for each species and stock in the HSTT Study Area in Section 3.7.2 (Affected Environment). The current aggregate impacts of past human activities are significant for some marine mammal species, many of which were in serious decline across the world's oceans. Other populations, such as the humpback whale, are increasing in abundance in much of their range (National Marine Fisheries Service, 2015d). All marine mammals in the U.S. are protected under the MMPA, and some species receive additional protection under the ESA. Of the 39 species of marine mammals known to exist within the Study Area, there are 10 populations listed as endangered under the ESA and classified as strategic stocks under the MMPA (humpback whale, blue whale, fin whale, sei whale, gray whale [Western North Pacific stock], sperm whale, false killer whale [Main Hawaiian Islands Insular stock], Guadalupe fur seal, Hawaiian monk seal, and southern sea otter).

4.4.7.3 Impacts of Other Actions

4.4.7.3.1 Overview

Section 3.7.2.1.5 (General Threats) discusses the specific stressors within the affected environment that impact marine mammal populations in the Study Area, which include water quality degradation (chemical pollution), commercial industries (fisheries bycatch, explosive pest deterrents, and other interactions), noise, hunting, vessel strike, marine debris, disease and parasites, power plant entrainment, and climate change. Potential impacts of actions that affect marine mammals include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success. The susceptibility of marine mammals to these outcomes often depends on proximity, severity, or vulnerability to the stressor and vulnerability can be increased as multiple stressors compound on an individual.

Stranded marine mammals include alive or dead individuals that swim or float to shore and are incapable of returning to sea or individuals that have wandered outside of their “normal” habitat. Investigations of stranded marine mammals can provide indications of the general threats to marine mammals in a given location, and causes of strandings include navigation error, predator avoidance, population and climate shifts, infectious disease, parasite infestation, starvation, pollution exposure, trauma (e.g., injuries from ship strikes or fishery entanglements), sound (human-generated or natural), harmful algal blooms and associated biotoxins, tectonic events such as underwater earthquakes, and ingestion or interaction with marine debris (National Marine Fisheries Service, 2016b). The activities as described in Table 4.2-1 each potentially contribute multiple stressors in the region of influence experienced by marine mammals, including vessel traffic, underwater noise, and water pollution (Table 4.2-2). For example, most actions include marine vessel operations, which contribute to vessel strikes and underwater noise. Many of the actions also contribute underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, construction activities, and other military operations. Bycatch and entanglement, the main threats to marine mammal populations, are chiefly associated with fishing. While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to marine mammals are detailed in Section 3.7.2.1.5 (General Threats) and further described below. Data availability is inconsistent between species and activities, but quantitative estimations are presented where available.

4.4.7.3.2 Commercial Fishing and Entanglement

Past and present commercial fishing activities have had a profound effect on some marine mammal species and, despite continued improvements in bycatch avoidance and the implementation of regulatory efforts, fisheries interactions continue to be the primary human-related source of mortality for most marine mammal stocks (Knowlton et al., 2012; Roman et al., 2013; Van der Hoop et al., 2013). In recent years, the overall number of commercial fishing vessels has decreased, which may be attributed to changes in environmental conditions, fishing regulations, and market forces (California Department of Fish and Wildlife, 2008). Eleven ports in Southern California contain both commercial fishing fleets and commercial passenger fishing vessels (i.e., recreational) that use the ocean areas within the Southern California Range Complex portion of the Study Area (Naval Undersea Warfare Center, 2009).

4.4.7.3.2.1 Bycatch

Potential impacts from commercial fishing activities include marine mammal injury and mortality from bycatch, which refers to when animals are caught in commercial fishing operations targeting a different species. Total bycatch interactions are difficult to estimate as numbers are based on observations by NMFS staff or on numbers received from individual operations that self-report bycatch interactions. In 1994, the MMPA was amended to formally require the development of a take reduction plan when bycatch exceeds a level considered unsustainable by the marine mammal population and will lead to marine mammal population decline. Although marine mammal bycatch has generally declined since the implementation of take reduction measures, and new management practices and consistent regulatory oversight could result in future reductions, bycatch is expected to remain a leading cause of mortality for the reasonably foreseeable future (Read et al., 2006).

At least in part as a result of the MMPA bycatch amendment, estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer & Read, 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period. In the Hawaii portion of the Study Area, bycatch has contributed substantially to the decline of the Hawaiian population of false killer whales (Oleson et al., 2010). Between 2008 and 2012, 27 known instances of false killer whale injury or mortality from bycatch were observed during Hawaii longline fishery activities as well as similar cases for 11 other species (Bradford & Forney, 2014; Bradford & Lyman, 2015; Bradford & Forney, 2016).

The impacts of bycatch on marine mammal populations vary based on removal rates, population size, and reproductive rates. Small populations with relatively low reproductive rates are most susceptible. Bycatch rates for about 12 percent of United States marine mammal stocks (almost all cetaceans) exceed their Potential Biological Removal levels (Read, 2008). The Potential Biological Removal level is the number of animals that can be removed each year without preventing a stock from reaching or maintaining its optimal sustainable population-level.

Fisheries operations also result in profound changes to the structure and function of marine ecosystems that adversely affect marine mammals, including loss of prey species and alteration of benthic structure. Overfishing of many fish stocks results in significant changes in trophic structure, species assemblages, and pathways of energy flow in marine ecosystems (Jackson et al., 2001; Myers & Worm, 2003). These ecological changes may have important, and likely adverse, consequences for populations of marine mammals (DeMaster et al., 2001). For instance, depletion of preferred prey could lead to a less nutritional diet and decreased reproductive success.

4.4.7.3.2.2 Entanglement

As discussed in Section 3.7.2.1.5 (General Threats), entanglement in fishing gear, such as abandoned or partial nets, fishing line, and the ropes and lines connected to fishing gear, is another major threat to marine mammals in the Study Area. National Oceanic and Atmospheric Administration Marine Debris Program (2014) reports that abandoned, lost, or otherwise discarded fishing gear still constitutes the vast majority of mysticete entanglements. In the Southern California portion of the Study Area, there were 36 marine mammal bycatch entanglements from civilian fishing activities off San Diego from 2010 through 2014 (Carretta et al., 2016). For the area off the coasts of northern California, Oregon, and Washington between 1982 and 2010, Saez et al. (2013) reported there were 272 large whales entangled in fishing gear (whales in this area of the United States West Coast are generally from the same stock as in the Southern California portion of the HSTT Study Area).

For cetaceans in Hawaii during the 5-year period between 2007-2012, there were 48 humpback whales, a sperm whale, a bottlenose dolphin, three spinner dolphins, and a pantropical spotted dolphin entangled in fishing gear (Bradford & Lyman, 2015). One humpback whale was injured, and it is believed that interaction with fishing gear debris led to the mortality of a second humpback whale and a spinner dolphin (Bradford & Lyman, 2015). Over the 30-year period between 1982 and 2012, approximately 11 Hawaiian monk seals annually have been observed entangled in fishing gear or other marine debris, with nine documented deaths (Carretta et al., 2015).

4.4.7.3.2.3 Recreational Fishing and Hunting

Recreational fishing also impacts marine mammals. In Hawaii in 2013, 14 Hawaiian monk seals were observed hooked and one was observed with an embedded fishing spear (Carretta et al., 2015). Along the U.S. West Coast, hook and line entanglements and gunshot wounds are two of the primary causes of pinniped injuries found in strandings (Carretta et al., 2013). Within the Southern California portion of the Study Area, there were 50 marine mammal hook and line interactions (48 pinnipeds, 2 dolphins) reported off San Diego from 2010 through 2014 (Carretta et al., 2016).

With the enactment of the MMPA, hunting-related mortality has decreased over the last 40 years; however, unregulated harvests and extensive illegal whaling activity still occur in areas outside of U.S. waters. Between 1948 and 1979, the Union of Soviet Socialist Republics' whale harvest totaled 195,783 in the North Pacific Ocean. Subsistence harvest of marine mammals by Russian and Alaska Natives occurs in the North Pacific, Chukchi Sea, and Bering Sea affecting marine mammal stocks that may be present in the HSTT Study Area. For example, in 2 years of hunting (2010 and 2011) on St. Paul Island and St. George Island in the Bering Sea there were 878 northern fur seals harvested for subsistence (Testa, 2012). In Russian waters in 2013, there were 127 gray whales "struck" during subsistence whaling by the inhabitants of the Chukchi Peninsula between the Bering and Chukchi Sea (Ilyashenko & Zharikov, 2014). These gray whales, harvested in Russian waters, may be individuals from either the endangered Western North Pacific stock or the non-ESA-listed Eastern North Pacific stock that may migrate through the Southern California portion of the HSTT Study Area.

4.4.7.3.2.4 Other Fishery Interactions

Common practice in offshore waters off Southern California, Washington, and Alaska include the routine use of non-military explosives at-sea for explosive pest control, or marine mammal deterrents known as "seal bombs." Seal bombs are used by commercial fishermen to deter marine mammals from preying upon their catch or to prevent interaction or entanglement with fishing gear (U.S. Department of the Navy, 2016a). This practice is not observed in Hawaii. In the Southern California region, several fisheries including purse seine and set gillnet fisheries use seal bombs as deterrents (Baumann-Pickering et al., 2013). In the 7 months from May to November 2013, over 24,000 explosions identified as seal bombs were recorded at a passive acoustic monitoring site off Long Beach, California approximately 10 kilometers north of the Southern California portion of the HSTT Study Area (Debich et al., 2015). From August 2012 to August 2013, there were fewer than 400 underwater explosions resulting from Navy training and testing in the entire Southern California portion of the HSTT Study Area (Baumann-Pickering et al., 2013). The prevalent and continued use of seal bombs seems to indicate that, while a potential threat, their use has had no significant effect on populations of marine mammals given that it is likely that individuals, if not larger groups of marine mammals, have been repeatedly exposed to this explosive stressor.

4.4.7.3.3 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and vessel traffic is expected to continue to increase in the Study Area due to continued economic globalization, widening of the Panama Canal, and increases in energy development and other offshore activities. While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by ongoing and future education and awareness, marine mammal reporting, ship speed reduction measures, and maritime traffic planning and management. An examination of vessel traffic within the HSTT Study Area determined that Navy vessel occurrence is two orders of magnitude lower than that of commercial traffic. The study also revealed that while commercial traffic is relatively steady throughout the year, Navy vessel use is episodic and based on specific exercises being conducted at different times of the year (Mintz, 2012); however, Navy vessel use within inshore waters occurs regularly and routinely consists of high-speed small vessel movements.

Most reported marine mammal vessel strikes involve commercial vessels and occur over or near the continental shelf (Laist et al., 2001). The most vulnerable marine mammals are thought to be those that spend extended periods at the surface or species whose unresponsiveness to vessel sound makes them more susceptible to vessel collisions (Gerstein, 2002; Laist & Shaw, 2006; Nowacek et al., 2004). Marine mammals such as dolphins, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes.

From 2007 to 2012 in Hawaii, there were 39 vessel collisions between humpback whales and vessels (Bradford & Lyman, 2015). Lammers et al. (2013) reported that from 1975 to 2011, 61 percent of witnessed collisions between humpback whales and vessels in Hawaii involved tour vessels. The U.S. Coast Guard and the U.S. Navy report all vessel collisions with whales, thus, under-reporting of collisions by other vessel types may make the characterization of the civilian vessel percentage an underestimate. Within the Southern California portion of the Study Area, there were 7 marine mammal vessel or boat strikes reported off San Diego from 2010 through 2014 (Carretta et al., 2016). The strikes were on two California sea lions, one fin whale, two gray whales, and two humpback whales. None of these strikes was from Navy vessels or boats (National Marine Fisheries Service, 2015b).

4.4.7.3.4 Ocean Pollution

As discussed in Table 4.2-2, multiple pollutants from numerous sources are present in, and continue to be released into, the oceans. These releases that affect marine mammals include water pollution as well as the discharge of marine debris and the proliferation of ambient as well as impulsive noise in the underwater ecosystem. Section 3.7.2.1.5 (General Threats) provides an overview of these potential impacts, which include morbidity and mortality from acute toxicity; disruption of endocrine cycles and developmental processes causing reproductive failures or birth defects; suppression of immune system function; and metabolic disorders resulting in cancer or genetic abnormalities (Reijnders et al., 2009). The effects of exposure to and concentration of persistent organic pollutants in marine mammals, especially from pesticides, includes the accumulation of DDT and PCBs in certain species, and high concentrations of organochlorines in tissues appear to have occurred with increasing frequency disease outbreaks involving marine mammals. In addition, experimental and other evidence has shown that persistent contaminants often found in the tissues of marine mammals have deleterious effects on reproduction and the immune system (O'Shea et al., 1999).

4.4.7.3.5 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-2 and specific stressors to marine mammals in Section 3.7.2.1.5 (General Threats). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals. Noise can cause behavioral disturbances; mask other sounds (including their own vocalizations); and may result in injury, including hearing loss in the form of temporary threshold shift (TTS) or permanent threshold shift (PTS) or, and, in some cases, death.

Anthropogenic noise is generated from a variety of sources throughout the region of influence, including commercial shipping, oil and gas exploration and production activities (including air gun, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, acoustic deterrent, and harassment devices), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry).

Shipping channels leading to and from the ports of Los Angeles and Long Beach between the Channel Islands National Marine Sanctuary and the coast may have degraded the habitat for blue, fin, and humpback whales due to the loss of communication space where important habitat for these species overlaps with elevated noise from commercial vessel traffic (Redfern et al., 2017). The San Pedro Channel is at the northeastern corner of the Southern California portion of the HSTT Study Area and is where the Traffic Separation Scheme’s southern entrance and exit is located for these same ports (Los Angeles and Long Beach). A similar concentration of commercial vessel traffic moving through the San Pedro Channel into and out of the Southern California portion of the HSTT Study Area is also likely to impact marine mammal communication space in a similar manner.

The military activities addressed in Table 4.2-1 include various training and testing operations that contribute vessel noise, underwater and surface explosions, and sonar. Use of mid-frequency sonar between 1950 and 2001 has been correlated with 12 of 126 beaked whale mass strandings during five separate exercises (U.S. Department of the Navy, 2017b). Of these exercises, four were multi-nation (North Atlantic Treaty Organization countries) and one was solely an U.S. Navy exercise occurring near the Bahamas. In the Bahamas event, seven stranded animals died, and ten returned to the water. Although sonar activity has historically been correlated to various negative impacts on marine mammals, with the implementation of required mitigation measures, sonar operations are not expected to result in mortality to any stock of marine mammals and minimal injury or behavioral changes are anticipated. Although various other military training and testing activities involve surface or undersea detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones, and are infrequent, isolated events. As described in Table 4.2-1, many activities incorporate best management practices or standard operating procedures to minimize noise generation. Likewise, any in-water construction that may occur at naval piers would utilize dampening and attenuation technologies and other practices that reduce impacts on bottlenose dolphins and other sensitive receptors in the vicinity of pile driving activities.

4.4.7.3.5.1 Water Pollution

Section 3.7.2.1.5 (General Threats) provides an overview of these potential impacts, which include morbidity and mortality from acute toxicity (although mortality has not yet specifically been shown in marine mammals); disruption of endocrine cycles and developmental processes causing reproductive failures or birth defects; suppression of immune system function; and metabolic disorders resulting in cancer or genetic abnormalities (Reijnders et al., 2009). The effects of exposure to and concentration of persistent organic pollutants in marine mammals, especially from pesticides, includes the accumulation of dichlorodiphenyltrichloroethane and polychlorinated biphenyls in certain species, and high concentrations of organochlorines in tissues appear to have occurred with increasing frequency among marine mammals infected with secondary diseases. In addition, experimental and other evidence has shown that persistent contaminants often found in the tissues of marine mammals have deleterious effects on reproduction and the immune system (O'Shea et al., 1999).

4.4.7.3.5.2 Marine Debris and Ingestion

Interactions between marine mammals and marine debris, including derelict fishing gear (as discussed in Section 4.4.7.3.2.2 Entanglement) and plastics, are significant sources of injury and mortality (Baulch & Perry, 2014), and the percentage of marine mammal species with documented records of entanglement in or ingestion of marine debris has increased from 43 to 66 percent over the past 18 years (Bergmann et al., 2015). Ingestion of plastic bags and Styrofoam has been identified as a cause of injury or death of minke whales and deep-diving odontocetes, including beaked whales, pygmy sperm whales, and sperm whales. On the United States West Coast, marine debris resulted in mortalities to 90 pinnipeds (the majority was California sea lions), two gray whales, and one each of the following species: humpback whale, minke whale, bottlenose dolphin, long-beaked common dolphin, and harbor porpoise (Carretta et al., 2016). From 2010 through 2014, within the Southern California portion of the Study Area, there were six marine mammal entanglements in marine debris (four pinnipeds, two dolphins) from marine debris reported off San Diego (Carretta et al., 2016).

4.4.7.3.6 Power Plant Entrainment

Coastal power plants use seawater as a coolant during power plant operation. Intakes into these plants can sometimes trap (i.e., entrain) marine animals that swim too close to the intake pipe. There have been no entrainments of marine mammals reported for Hawaii. Within the Southern California portion of the Study Area, there were 97 marine mammal power plant entrainments (all pinnipeds) reported from San Diego, CA between 2010 and 2014 (Carretta et al., 2016).

4.4.7.3.7 Disease, Parasites, and Algae

Section 3.7.2.1.5.3 (Disease and Parasites) discusses the effects of disease and parasites in marine mammals. Just like humans, older animals are affected by disease and likewise can disease spread through a population affecting a significant number of otherwise healthy individuals. Mass die-off events can also occur as a result of toxic algal blooms, which may be increasing in frequency due to human nutrient input and climate change, and the spread of certain parasites (toxoplasmosis, hookworms, lungworms, and thorny-headed worms) to seals, sea lions, otters, and pinnipeds from feral cats.

4.4.7.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

Impacts of the Proposed Action are detailed in Section 3.7 (Marine Mammals). Impacts that may contribute to cumulative impacts on marine mammals can be generally categorized as mortality, injury (Level A harassment under the MMPA), and behavioral responses and TTS (Level B harassment under the MMPA). These impacts would be associated with certain acoustic (sonar and other transducers), physical disturbance, and strike stressors. Although behavioral impacts are possible from the remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft, and vessels), energy stressors (in-water electromagnetic devices and high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, and seafloor devices), entanglement stressors (wires and cables, decelerators/parachutes, and biodegradable polymers), ingestion stressors (munitions and military expended materials other than munitions), and secondary stressors, these stressors are not expected to result in behavioral harassment, TTS, PTS, injury, or mortality of marine mammals.

The analysis presented in Section 3.7 (Marine Mammals) concluded that some stressors associated with the Proposed Action could impact individuals of certain marine mammal species, but impacts are not expected to decrease the overall fitness of any marine mammal population. Species most likely to be impacted by training and testing activities are those that are most abundant in the Study Area, primarily delphinid species (dolphins and small whales) that have stocks with tens of thousands of animals. From a cumulative perspective, any potential impacts on species with small populations, especially ESA-listed species, are of particular concern, and the Navy has consulted with the NMFS, as required by Section 7(a)(2) of the ESA. NMFS issued a final Biological Opinion concluding that the Navy's proposed testing and training activities were not likely to jeopardize any ESA-listed marine mammals and provided measures that will minimize or avoid incidental take of such species. These measures are consistent with those included in the MMPA authorization for the same activities. The Navy will implement mitigation to avoid or reduce potential impacts from acoustic, explosive, and physical disturbance and strike stressors on marine mammals, as described in Chapter 5 (Mitigation).

As determined in Section 3.7.4 (Summary of Potential Impacts on Marine Mammals) it is not anticipated that the Proposed Action will result in measurable impacts to marine mammal populations. The majority of the proposed activities are unit level training and small testing activities, which are conducted in the open ocean. Unit level events occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less). Additionally, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual marine mammal would be exposed to stressors from multiple Navy activities within a short timeframe. Furthermore, research and monitoring efforts have included before, during, and after-event observations and surveys; data collection through conducting long-term studies in areas of Navy activity; occurrence surveys over large geographic areas; biopsy of animals occurring in areas of Navy activity; and tagging studies where animals are exposed to Navy stressors. To date, the findings from the research and monitoring (U.S. Department of the Navy, 2017b) and the regulatory conclusions from previous analyses by NMFS (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013) are that the majority of Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals.

4.4.7.4.1 Mortality

NMFS has previously concluded that the use of sonar and other transducers under the Proposed Action in the HSTT Study Area is possible but not expected to result in marine mammal mortality (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013). Mitigation measures discussed in Chapter 5 (Mitigation) are designed to avoid or reduce potential impacts of explosives, especially higher-order impacts such as injury and death. However, the acoustic analysis indicates that certain marine mammal species could be exposed to underwater pressure waves resulting from explosive detonations that could lead to mortality of up to 10 individuals over a 5-year period. The protections afforded by mitigation measures are conservatively factored into the quantitative analysis process. For a general discussion of strandings and their causes, as well as strandings in association with U.S. Navy activity, see the technical report titled Marine Mammal Strandings Associated with U.S. Navy Sonar Activities (U.S. Department of the Navy, 2017b). Although relatively unlikely, vessel strikes could result in mortality of a very small number of individuals of certain marine mammal species under the Proposed Action, and this likelihood is further reduced through implementation of the extensive standard operating procedures and mitigation, including newly developed large whale notification messaging systems. Based on historical records and the probability analysis presented in Section 3.7.3.4 (Physical Disturbance and Strike Stressors), the Navy predicts that large whales may potentially be struck by a large vessel as a result of training and testing activities in the offshore portion of the Study Area. While the species involved in a strike cannot be quantifiably predicted, the affected animals may include humpback whale, blue whale, Bryde's whale, fin whale, sei whale, gray whale, minke whale, and sperm whale.

4.4.7.4.2 Cumulative Impacts on Marine Mammals

In general, bycatch, vessel strikes, and entanglement are leading causes of injury and direct mortality to marine mammals throughout the region of influence, and, although mitigated to the greatest extent practicable, the Proposed Action could also result in injury and mortality to individuals of some marine mammal species from underwater explosions, vessel strikes, and potential auditory injury (i.e., PTS) from sonar. Implementation of measures discussed in Chapter 5 (Mitigation) would help avoid or reduce, but not absolutely eliminate, the risk for potential impacts, and any incidence of injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions in the region of influence. While it is more likely that an individual of an abundant, common stock or species would be affected, there is a chance that a less abundant stock could be affected.

Ocean noise is already significantly elevated over historic, natural levels, and acoustic stressors (underwater explosions and sonar, as well as increased Navy vessel noise) associated with the Proposed Action could also result in additive acoustic impacts on marine mammals. However, sonar is known to be neither a major threat to marine mammal populations nor a significant portion of the overall ocean noise budget (Bassett et al., 2010; Baumann-Pickering et al., 2010; International Council for the Exploration of the Sea, 2005; McDonald et al., 2006). Other current and future actions such as characterization, construction, and operation of offshore wind energy projects; seismic surveys; and construction, operation, and removal of oil and gas facilities could result in underwater sound levels that could cause behavioral harassment, TTS, PTS, or injury. Additionally, the constant elevation in ambient noise may produce physiological stress in individuals to which the Proposed Action would contribute.

Sounds from many of these sources travel over long distances, and it is possible that some would overlap in time and space with sounds from underwater explosions or Navy sonar use, in particular distant shipping noise, which is more widespread and continuous. It is not known whether the co-occurrence of shipping noise and sounds associated with underwater explosions and sonar use would result in harmful additive impacts on marine mammals. However, these activities are widely dispersed, the sound sources are intermittent, and mitigation measures would be implemented. Furthermore, safety, security, and operational considerations would preclude some training and testing activities in the immediate vicinity of other actions, further reducing the likelihood of simultaneous or overlapping exposure. For these reasons, it is unlikely that an individual marine mammal would be simultaneously exposed to sound levels from multiple actions that could cause behavioral harassment, TTS, PTS, or injury.

If the health of an individual marine mammal were compromised, it is possible this condition could alter the animal's expected response to stressors associated with the Proposed Action. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by various factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, and social position. Synergistic impacts are also possible; for example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter & Pouyatos, 2005). While the response of a previously stressed animal might be different from the response of an unstressed animal, no data are available at this time that accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with the Proposed Action.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on some marine mammal species in the Study Area. The Proposed Action could contribute incremental stressors to individuals, which would further compound effects on a given individual already experiencing stress. However, with the implementation of standard operating procedures reducing the likelihood of overlap in time and space with other stressors and the implementation of mitigation measures reducing the likelihood of impacts, the incremental stressors anticipated from the Proposed Action are not anticipated to be significant.

Furthermore, the regulatory process administered by NMFS, which includes Stock Assessments for all marine mammals and a 5-year review for all ESA-listed species, provides a backstop that informs decisions on take authorizations and Biological Opinions. Stock Assessments include estimates of Potential Biological Removal that stocks of marine mammals can sustainably absorb. MMPA take authorizations require that the proposed action have no more than a negligible impact on species or stocks, and that the proposed action imposes the least practicable adverse impact on the species. MMPA authorizations are reinforced by monitoring and reporting requirements so that NMFS is kept informed of deviations from what has been approved. Biological Opinions for federal and non-federal actions are similarly grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery after taking into account the effects of incidental take. These processes help to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Actions will not have a measurable effect on the resource.

4.4.8 REPTILES

4.4.8.1 Region of Influence

The general region of influence for reptiles includes the coastal waters and nesting beaches of the Hawaiian Islands, coastal waters of California, and in open ocean areas, potentially including the transit corridor. The sea turtle species occurring in the Study Area include green turtles (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), olive Ridley turtle (*Lepidochelys olivii*), leatherback turtle (*Dermochelys coriacea*), and loggerhead turtle (*Caretta caretta*). In general, sea turtles spend most of their time at sea, with female turtles returning to land to nest and often migrating long distances between feeding grounds and nesting beaches. As with other marine resources, distribution is patchy and can be concentrated in specific areas depending on the species, season, habitat, activity, and age of the individuals. The yellow-bellied sea snake (*Pelamis platura*) has been sighted with increasing frequency in waters off California, which has been attributed to both periodic El Niño cycles and longer oceanic warming trends. Yellow-bellied sea snakes often occur in large numbers associated with long lines of debris in pelagic and open ocean areas. Breeding areas are believed to be closer to shore within warmer waters outside of the Study Area (Brischoux et al., 2016).

4.4.8.2 Resource Trends

All sea turtles in the Study Area have experienced significant decline in population numbers over the past hundred years and are ESA-listed (Table 3.8-1). Because sea turtles are so long-lived, and because reliable data are only available for approximately the past 20 years, it is not possible to determine a reliable trend in abundance for most species; however, recent data show an increase in nesting trends for most species at some locations within the Study Area. The abundance and trends of sea snake populations are relatively unknown.

4.4.8.3 Impacts of Other Actions

4.4.8.3.1 Overview

Section 3.8.2.1.5 (General Threats) discusses the specific stressors within the affected environment that impact sea turtle and sea snake populations in the Study Area, which include water quality (marine debris and chemical contaminants), commercial industries (fisheries bycatch and other interactions, hunting/exploitation, vessel strike, oil and gas development, wind and hydrokinetic energy development, shoreline development and recreation, dredging, military activities, invasive species, disease, habitat destruction (loss of seagrass habitat and nesting beaches), and climate change. Potential impacts of actions that affect reptiles include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success.

The susceptibility of sea turtles to these outcomes often depends on proximity, severity, or vulnerability to the stressor, and vulnerability can be increased as multiple stressors compound on an individual. The abundance of the species, potential impacts that may affect localized nesting sites, and individual fatalities could have considerable impacts in localized populations.

The activities as described in Table 4.2-1 each potentially contribute multiple stressors in the Study Area experienced by reptiles, including vessel traffic, underwater noise, and water pollution (Table 4.2-2). For example, most actions include the operation of marine vessels, which contribute to vessel strikes and underwater noise. Many of the actions also contribute underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, construction activities, and military operations. Bycatch and entanglement, among the main threats to reptile populations in the Study Area, are chiefly associated with fishing and are discussed separately. While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to reptiles are detailed in Section 3.8.2.1.5 (General Threats) and further described below.

4.4.8.3.2 Commercial Fishing and Harvest

Past and present commercial fishing activities have had a profound global effect on the recovery and conservation of marine turtle populations and, despite continued improvements in bycatch avoidance and the implementation of regulatory efforts, fisheries interactions continue to be the primary human-related source of mortality for most sea turtles (National Research Council of the National Academies, 1990; Wallace et al., 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al., 2010). In United States' fisheries, bycatch resulted in 71,000 sea turtle deaths per year prior to effective protective sea turtle regulations (enacted in the mid-1990s); however, current mortality estimates are 94 percent lower than pre-regulation estimates (Finkbeiner et al., 2011). In the Pacific, NMFS requires measures (e.g., gear modifications, changes to fishing practices, and time/area closures) to reduce sea turtle bycatch in the Hawaii- and California-based pelagic longline fisheries and the California/Oregon drift gillnet fishery. The main threat to sea snakes globally is fisheries bycatch, although the impact is relatively low, with prawn fisheries presenting the highest risk to sea snakes.

In Pacific fisheries, the Hawaii pelagic shallow and deep set longline, and California set gillnet, drift gillnet, and pelagic deepset longline fisheries impact loggerhead, leatherback, green, and olive Ridley sea turtles. Within the HRC, a total of 146 turtle interactions were recorded between 2004 and 2016, including 7 green, 62 leatherback, 63 loggerhead, 11 olive Ridley, and 3 unidentified (National Marine Fisheries Service, 2016a). During the same timeframe in the Hawaiian portion of the Study Area, a total of 36 turtle interactions were recorded, including 9 leatherback, 4 loggerhead, and 23 olive Ridley. From 2011 to 2013, an estimated 55, 40, and 73 sea turtles were caught in the Hawaii-based deepset pelagic longline and 32, 13, and 17 in the shallow-set pelagic longline fishery (National Marine Fisheries Service, 2016b). The predominant sea turtles caught in 2012 and 2013 were leatherback, olive Ridley, and loggerhead, with olive Ridley representing the predominant species caught. In 2011, green sea turtles were the predominant species caught, but were not represented in the 2012 and 2013 bycatch observations. In California, five leatherback sea turtles were estimated as bycatch in 2012, but no sea turtles were observed caught in all other observed fisheries and years. Coastal gillnet and other fisheries conducted from a multitude of smaller vessels are of increasing concern. These fisheries, called artisanal fisheries, can collectively have a great impact on local turtle populations, especially leatherbacks and loggerheads (National Marine Fisheries Service, 2016b).

Globally, large-scale commercial exploitation also contributes to global decline in marine turtle populations. Currently, 42 countries and territories allow direct take of turtles and collectively take in excess of 42,000 turtles per year, the majority of which (greater than 80 percent) are green sea turtles (Humber et al., 2014). Illegal fishing for turtles and nest harvesting also continues to be a major cause of sea turtle mortality, both in countries that allow sea turtle take and in countries that outlaw the practice (Lam et al., 2011; Maison et al., 2010). For example, Humber et al. (2014) estimated that in Mexico 65,000 sea turtles were illegally harvested between 2000 and 2014. The authors, however, have seen legal and illegal direct take of sea turtles trending downward over the past three decades—citing a greater than 40 percent decline in green sea turtle take since the 1980s, a greater than 60 percent decline in hawksbill and leatherback take, and a greater than 30 percent decline in loggerhead take (Humber et al., 2014).

4.4.8.3.2.1 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and vessel traffic is expected to continue to increase in the Study Area in response to continued economic globalization, increases in energy development, and other offshore activities. Vessel strike has been identified as one of the important mortality factors in several nearshore turtle habitats worldwide. Precise data are lacking for sea turtle mortalities directly caused by ship strikes; however, live and dead turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al., 2007; Lutcavage et al., 1997). For example, scientists in Hawaii reported that 2.5 percent of green turtles found dead on the beaches between 1982 and 2003 were killed by boat strike (Chaloupka et al., 2008), and in the Canary Islands, 23 percent of stranded sea turtles showed lesions from boat strikes or fishing gear (Oros et al., 2005). Denkinger et al. (2013) reports that boat strikes in the Galapagos Islands were most frequent at foraging sites close to a commercial and tourism port.

Some vessel strikes could cause temporary impacts, such as diverting the turtle from its previous activity or causing minor injury. Major strikes could cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition. Numerous living sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls (Hazel et al., 2007; Lutcavage et al., 1997), suggesting that not all vessel strikes are lethal. While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by ongoing and future education and awareness, ship-speed reduction measures, and maritime traffic planning and management.

4.4.8.3.3 Coastal Land Development

The population along the United States coastline grew from 47 million in 1960 to 87 million in 2008, and during this timeframe, the Pacific Coast grew by 17 million people (U.S. Census Bureau, 2010). Human development now dominates the coastline almost continuously throughout its extent. The limited space for development in coastal areas results in greater population density in these locations. In the United States (excluding Alaska), non-coastal counties average 98 persons per square mile while coastal counties average 300 persons per square mile.

Female sea turtles migrate to their natal beaches to lay eggs, and pervasive coastal development often interferes with successful nesting at these locations. Shared use between turtles and human interests on increasingly populated and utilized beach areas has intensified the tendency for female turtles and their hatchlings to encounter various barriers and hazards accessing, nesting, and leaving these beaches. Beachfront construction of homes, hotels, restaurants, and roads; seawall construction, shoreline armoring, and beach erosion; ports and marinas; beach replenishment; nearshore dredging; and oil and gas activities can all prevent beach access and emigration; beach-going vehicles and watercraft cause injury and mortality; and abandoned debris and equipment are often insurmountable obstacles for both mother and offspring (SeeTurtles.org, 2017). Populated areas also often have excess nighttime lighting that confuses hatchlings' instincts to orient toward the moon to arrive at the ocean, and in this journey they often fall into and can remain trapped within pits and scars left on the beach. Conservation awareness has increased on many popular U.S. beaches and tourist destinations, but nesting success remains imperiled in many others.

4.4.8.3.4 Ocean Pollution

As discussed in Table 4.2-1 and Table 4.2-2, multiple pollutants from numerous sources are present in, and continue to be released into, the oceans. Section 3.8.2.1.5.1 (Water Quality) provides an overview of these potential impacts on sea turtles, which include the ingestion of and entanglement in marine debris as well as toxicity from bisphenol-A, phthalates, and heavy metals. Sea turtles often mistake debris for prey; one study found 37 percent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al., 2009). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles in all life stages.

4.4.8.3.5 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-2. Anthropogenic noise is generated from a variety of sources throughout the region of influence, including commercial shipping, oil and gas exploration and production activities (including air gun, drilling, explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, acoustic deterrent and harassment devices), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, telemetry). The military activities addressed in Table 4.2-1 include various training and testing activities that also contribute vessel noise, underwater and surface explosions, and sonar; however, due to the low risk of encounter and the implementation of required mitigation measures, sonar operations are not expected to result in mortality to any sea turtles and only minimal injury or behavioral changes are anticipated. Although various other military training and testing activities involve surface or undersea detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones, and are infrequent, and isolated events. Further, as described in Section 3.0.3.3.1.4 (Vessel Noise) it is estimated that the overall contribution of Navy vessel noise is less than 8 percent of the overall total vessel broadband noise in the HSTT study area.

In general, the potential concerns associated with ocean noise and sea turtles are not as well defined as those for marine mammals. While it is well known that many species of marine mammals use sound as a primary sense for navigating, finding prey, and communicating with other individuals, little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol & Musick, 2003; Bartol & Ketten, 2006; Ketten & Moein-Bartol, 2006; Levenson et al., 2004), 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 from breaking waves to identify nesting beaches, they also appear to rely on other nonacoustic cues for navigation, such as magnetic fields (Lohmann & Lohmann, 1992, 1996) and light (Avens, 2003). Additionally, sea turtles are not known to produce sounds underwater for communication. As a result, sound may play a limited role in a sea turtle's environment.

Nonetheless, as discussed in Section 3.8.3.1 (Acoustic Stressors), sea turtles could experience a range of impacts from ocean noise, depending on the sound source. The impacts could include permanent or temporary hearing loss, changes in behavior, physiological stress, and auditory masking. In addition, potential impacts from use of explosives could range from physical discomfort to nonlethal and lethal injuries.

4.4.8.3.6 Offshore Energy Development

Offshore energy development, including oil and natural gas extraction in coastal and deep waters on the continental shelf and renewable energy projects can degrade sea turtle habitats during pre-construction, construction, and operation phases. Prior to any drilling or pile driving operations, vessel traffic and seismic disturbances through exploration activities can degrade sea turtle coastal and open ocean foraging habitats.

4.4.8.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

The cumulative impacts analysis is generally focused on green, hawksbill, olive Ridley, leatherback, and loggerhead sea turtles, all of which are ESA-listed species. The analysis presented in Section 3.8 (Reptiles) concludes that some stressors associated with the Proposed Action could impact individuals of certain sea turtle species, but impacts are not expected to decrease the overall fitness of any sea turtle population. From a cumulative perspective, potential impacts on listed species are of particular concern, and mitigation measures designed to avoid or reduce potential impacts are discussed in Chapter 5 (Mitigation).

Impacts from the Proposed Action that may contribute to cumulative impacts on sea turtles can be generally categorized as behavioral responses, temporary and PTS, non-auditory injury (modeled as slight lung injury and gastrointestinal tract injury), and mortality. As summarized below, these impacts would be associated with certain acoustic and physical strike stressors:

- The use of sonar and other transducers may result in behavioral responses, TTS, and PTS in sea turtles, including ESA-listed sea turtles.
- Explosives may result in behavioral responses, TTS, PTS, injury, and mortality in sea turtles, including ESA-listed sea turtles.
- Vessel strikes may cause injury or mortality in sea turtles, including ESA-listed sea turtles.

The remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft overflight, vessels), energy stressors (electromagnetic, high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, seafloor devices), entanglement stressors (cables, wires, decelerators/parachutes), ingestion stressors (munitions, military expended materials other than munitions), and secondary stressors are not expected to result in temporary or PTS, injury, or mortality of sea turtles under the Proposed Action, including ESA-listed sea turtles. The Proposed Action would not introduce significant light sources that would disorient nesting turtles or their hatchlings. Because Navy training and testing activities analyzed in this EIS/OEIS do not co-occur with nesting activities, it is unlikely that stressors presented to sea turtles would contribute to other anthropogenic threats not caused by Navy activities.

Although sea turtles could be exposed to sound and energy from explosive detonations throughout the Study Area, the estimated impacts on individual sea turtles are unlikely to affect populations. Injured sea turtles could suffer reduced fitness and long-term survival. Sea turtles that experience TTS or PTS may have reduced ability to detect relevant sounds such as predators or prey, although some experiencing TTS would recover quickly, possibly in a matter of minutes. It is uncertain whether some permanent hearing loss over a part of a sea turtle's hearing range would have long-term consequences for that individual because the sea turtle hearing range is already limited (Section 3.8.3.1, Acoustic Stressors). Any significant behavioral reactions to acoustic stimuli could lead to a sea turtle expending energy and missing opportunities to secure resources. However, most individuals are not likely to experience long-term consequences from behavioral reactions because exposures would be intermittent and spatially distributed, allowing exposed individuals to recover. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

The Proposed Action is not anticipated to have any effect on sea turtle nesting beaches in the region of influence. The training and testing activities associated with the Proposed Action do not contribute to factors that impact nesting habitats for these species.

In summary and as determined in Section 3.8.4 (Summary of Potential Impacts on Reptiles), it is not anticipated that the Proposed Action would result in significant impacts to reptiles. Due to the wide dispersion of stressors and dynamic movement of many training and testing activities, it is unlikely that a sea turtle or sea snake would remain in the potential impact range of multiple sources or sequential exercises. Additionally, the majority of the proposed activities are unit-level training and small testing activities, which occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less). Likewise, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual sea turtle or sea snake would be exposed to stressors from multiple activities within a short timeframe. Furthermore, research and monitoring efforts have included before, during, and after-event observations and surveys, data collection through conducting long-term studies in areas of Navy activity, occurrence surveys over large geographic areas, biopsy of animals occurring in areas of Navy activity, and tagging studies where animals are exposed to Navy stressors. To date, the findings from the research and monitoring and the regulatory conclusions from previous analyses by NMFS (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013) are that the majority of impacts from Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of sea turtles.

4.4.8.5 Cumulative Impacts on Reptiles

The fact that all five species of sea turtles occurring in the Study Area are ESA-listed provides a clear indication that the current aggregate impacts of past human activities are significant for sea turtles. Bycatch, vessel strikes, coastal land development, and ocean pollution are the leading causes of mortality and population decline for sea turtles, and, although mitigated/avoided to the greatest extent practicable, the Proposed Action could result in stress, injury, and mortality to individuals of some sea turtle species from underwater explosions and vessel strikes. Implementation of mitigation measures discussed in Chapter 5 (Mitigation) would help avoid, but not absolutely eliminate, the risk for potential impacts, and any incidence of injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions in the region of influence.

Due to standard operating procedures and mitigation measures most impacts associated with the Proposed Action are not anticipated to interact with or increase similar stressors experienced throughout the region of influence. According to scientific studies, reptiles may rely primarily on senses other than hearing for interacting with their environment and appear to recover quickly from noise stressors (Section 3.8.3.1, Acoustic Stressors); thus, the acoustic stressors produced by Navy activities are anticipated to have minimal cumulative impact on sea turtles. The Proposed Action would not affect turtle nesting or sea snake habitat, and contaminants and debris discharged into the marine environment are expected to be negligible and not persistent (Section 4.4.1.2, Sediments and Water Quality). Affects from the Proposed Action to sea turtle food sources are avoided or insignificant (Section 4.4.4, Invertebrates and Section 4.4.3, Vegetation). Likewise, Navy actions generally would not overlap in space and time with other stressors as they occur as dispersed, infrequent, and isolated events that do not last for extended periods.

The potential exists for the impacts of ocean pollution (disease, malnourishment), injury, nesting habitat loss, starvation, and the composite increased underwater noise environment to contribute multiple stressors to an individual, and it is possible that the response of a previously stressed animal to impacts associated with the Proposed Action could be more severe than the response of an unstressed animal, or that impacts from the Proposed Action could make an individual more susceptible to other stressors. For example, if a Navy vessel were to strike an otherwise healthy sea turtle, exposure to multiple other stressors in the area may hinder the individual's recovery from any injury sustained in the accident. Likewise, depending on many factors, such as distance from and intensity of the stressor, a sea turtle near an underwater explosion or sonar activity may become stressed or disoriented, and the time to recover may be increased if that individual is likewise experiencing disease, malnutrition, or other strike injury that may increase its vulnerability to predation or decrease its ability to forage.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on all reptile species in the Study Area. The Proposed Action could contribute incremental stressors to individuals, which would further compound effects on a given individual already experiencing stress. However, with the implementation of standard operating procedures reducing the likelihood of overlap in time and space with other stressors and the implementation of mitigation measures reducing the likelihood of impacts, the incremental stressors anticipated from the Proposed Action are not anticipated to be significant. Additionally, as with marine mammals, the NMFS regulatory process includes Stock Assessments and 5-year reviews for all ESA-listed species, which provides a backstop that informs decisions on take authorizations and Biological Opinions. Biological Opinions for federal and non-federal actions are grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. This process helps to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Actions will be imperceptible.

4.4.9 Birds

Although not uniformly distributed, the region of influence for birds includes shorelines, surface water, water column and shallow bottom habitats, and airspace throughout the Study Area. The majority of species encountered in the Study Area are water birds, including seabirds, wading birds, shorebirds, and waterfowl that use Study Area habitat for breeding, foraging, roosting, and migration. An estimated 15 million seabirds inhabit the Hawaiian Islands; 22 species of seabirds regularly nest in the Hawaiian Islands, and many more pass through during migration to and from their breeding grounds elsewhere in the Pacific (Birding Hawaii, 2004). More than 195 species of birds use coastal or offshore aquatic habitats in the Southern California Bight, and more than 300 bird species have been documented to use San Diego Bay (Anderson et al., 2007; Bearzi et al., 2009; Hunt & Butler, 1980).

All projects in the Study Area that affect ESA-listed species, species protected under the Migratory Bird Treaty Act, and U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern are subject to regulatory processes and permitting that give agencies a landscape management perspective of population trends and conservation measures. ESA-listed species are described in Table 3.9-1. Despite numerous protective laws and regulations, seabirds are some of the most threatened marine animals in the world, with 29 percent of species at risk of extinction and approximately half of the 346 species of seabirds that depend on ocean habitats in decline (Section 3.9.2.1.5, General Threats).

Birds are susceptible to multiple stressors, and the susceptibility of many species could be enhanced by additive or synergistic effects of multiple stressors. Section 3.9.2.1.5 (General Threats) includes an extensive discussion of the existing stressors to bird populations in the Study Area, and all activities listed in Table 4.2-1 and stressors described in Table 4.2-2 contribute one or more of these stressors. Other activities in the Study Area that could have direct impacts on birds include wind energy development (strike mortality and forage displacement); noise, light, and water pollution (direct impacts from major spills, indirect impacts from habitat loss and degradation, and marine debris); commercial fishing (loss of food source, strike, and entanglement); climate change; coastal land development (disturbance, collisions, and loss of breeding, nesting, or foraging habitat); and operation of ports and terminals or military training areas (disturbance). Commercial fisheries are considered the most serious threat to the world's seabirds. Most of the birds in the Study Area are relatively long-lived and wide-ranging seabirds, making it likely that individuals would be exposed to multiple activities and stressors over the course of their lifespans.

The analysis in Section 3.9 (Birds) indicates that birds could potentially be impacted by in-air and underwater acoustic stressors (sonar and other transducers, pile driving, air guns, weapons firing, aircraft and vessel noise), explosives (shock wave, sound, fragments), energy stressors (electromagnetic devices, lasers), physical disturbance and strikes (aircraft, aerial targets, vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (fiber optic cables, guidance wires, vessel entanglement systems, and decelerators/parachutes), ingestion (military expended materials), and secondary stressors (explosives and explosion byproducts, unexploded munition, metals, chemicals, other materials, physical disturbance). Some stressors, including explosions, physical strikes, and ingestion of plastic military expended materials, could result in mortality. In general, however, the potential for training and testing activities to result in bird injury or mortality is considered low to discountable, depending on the specific training or testing activity being considered. The vast majority of impacts are expected to be nonlethal: the most likely responses to training and testing activities are short-term behavioral or physiological, such as alert response, startle response, cessation of feeding, fleeing the immediate area, and a temporary increase in heart rate. Recovery from the impacts of most stressor exposures that elicit such short-term behavioral or physiological responses would occur quickly. To further minimize the risk of potential impacts, the Navy has established mitigation measures for birds for explosive mine countermeasure and neutralization activities and explosive mine neutralization activities involving Navy divers (Chapter 5, Mitigation).

Impacts that elicit behavioral or physiological impacts can combine with other stressors experienced elsewhere and result in decreased fitness of the individual as it moves throughout the Study Area. However, most of the proposed activities would be widely dispersed in offshore areas where bird distribution is patchy and concentrations of individuals are often low; therefore, the potential for interactions between birds and training and testing activities is low. Likewise, for most stressors associated with the Proposed Action, impacts would be short term and localized, and physiological recovery would occur quickly for any individuals experiencing a stress response. It is unlikely that training and testing activities would influence nesting because most activities take place in water and away from nesting habitats on land.

Although other past, present, and reasonably foreseeable actions individually and collectively cause widespread disturbance and mortality of bird populations across the ocean landscape, the Proposed Action is not expected to substantially contribute to their diminishing abundance, induce widespread behavioral or physiological stress, or interfere with recovery from other stressors. It is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on birds in the Study Area or beyond.

4.4.10 Cultural Resources

As discussed in Section 3.10 (Cultural Resources), stressors, including explosive and physical disturbance and strike stressors, associated with the Proposed Action would not affect submerged prehistoric sites and submerged historic resources in accordance with Section 106 of the National Historic Preservation Act because mitigation measures have been implemented to protect and avoid these resources (Chapter 5, Mitigation). Furthermore, programmatic agreements between the Navy and State Historic Preservation Offices exist to address the protection and management of cultural resources. The Proposed Action is not expected to result in impacts on cultural resources in the Study Area and likewise would not contribute incrementally to cumulative impacts on cultural resources. Therefore, further analysis of cumulative impacts on cultural resources is not warranted.

4.4.11 Socioeconomic Resources

The analysis in Section 3.11 (Socioeconomic Resources) indicates that the Proposed Action is not expected to result in long-term impacts to socioeconomic resources in the Study Area, including commercial transportation and shipping, commercial and recreational fishing, subsistence fishing, and tourism. Temporary and short-duration (hours) impacts may occur from limits on accessibility to marine areas used by the public (e.g., for fishing and tourism); however, most limitations on accessibility are temporary and would be lifted upon completion of training and testing activities. The public may intermittently hear airborne noise from transiting ships or aircraft overflights if they are in the general vicinity of a training or testing activity. These occurrences would be of short duration (seconds to minutes) and infrequent, and other than transiting vessels and aircraft, most Navy training and testing that generates airborne noise occurs farther from shore than most recreational and tourism activities. Similarly, impacts on socioeconomic resources from physical disturbances and strikes are unlikely, given that most training and testing activities that pose a risk of a physical disturbance or strike (e.g., activities using munitions or military expended materials) occur farther from shore than most fishing or tourism activities. The Navy's standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using munitions or expended materials occurs.

Secondary or indirect cumulative impacts on socioeconomic resources are dependent on the availability of other marine resources (e.g., target fish species). Population-level impacts on fishes, marine mammals, and invertebrates, which are the primary resources indirectly affecting socioeconomics in the Study Area, are not anticipated. No cumulative impacts on commercial transportation and shipping are anticipated because commercial vessels and aircraft are primarily transiting through the Study Area along well-established navigable routes or air traffic corridors that are avoided by Navy vessels and aircraft conducting training and testing activities.

Temporary limitations on accessibility to marine areas and the infrequent exposure to airborne noise would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience. Short-term impacts, should they occur, would not contribute incrementally to cumulative impacts on the socioeconomic resources in the Study Area. Therefore, further analysis of cumulative impacts on socioeconomic resources is not warranted.

4.4.12 Public Health and Safety

All Proposed Actions would be accomplished by technically qualified personnel and would be conducted in accordance with applicable Navy, state, and federal safety standards and requirements. The analysis presented in Section 3.12 (Public Health and Safety) indicates that the Proposed Action is not expected to result in impacts on public health and safety and thus would not contribute incrementally to or combine with other impacts on health and safety within the Study Area. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 Summary of Cumulative Impacts

The Proposed Action would contribute incremental effects on the ocean ecosystem, which is already experiencing and absorbing a multitude of stressors to a variety of receptors. In general, it is not anticipated that the implementation of the Proposed Action would have a meaningful contribution to the ongoing stress or cause significant collapse of any particular marine resource, but it would contribute minute impacts on resources that are already experiencing various degrees of interference and degradation. It is intended that the mitigation measures described in Chapter 5 (Mitigation) will further reduce the potential impacts of the Proposed Action in such a way that they are avoided to the maximum extent practicable and to ensure that impacts do not become cumulatively significant to any marine resource.

Marine mammals and sea turtles are the primary resources of concern for cumulative impacts analysis, however, the incremental contributions of the Proposed Action are not anticipated to meaningfully contribute to the decline of these populations or affect the stabilization and recovery thereof. The Navy proposes to implement standard operating procedures that reduce the likelihood of overlap of Navy stressors in time and space with non-Navy stressors, and mitigation measures as described in Chapter 5 (Mitigation) reduce the risk of direct impacts of the Proposed Action to individual animals. The aggregate impacts of past, present, and other reasonably foreseeable future actions (Tables 4.2-1 and 4.2-2) have resulted in significant impacts on some marine mammal and all sea turtle species in the Study Area. However, the decline of these species is chiefly attributable to other stressors in the environment, including the synergistic effect of bycatch, entanglement, vessel traffic, ocean pollution, recreation and tourism, and coastal zone development. The analysis presented in this Chapter 4 (Cumulative Impacts) and Chapter 3 (Affected Environment and Environmental Consequences) indicates that the incremental contribution of the Proposed Action to cumulative impacts on air quality, sediments and water quality, vegetation, invertebrates, marine habitats, fishes, birds, cultural and socioeconomic resources, and public health and safety would not significantly contribute to cumulative stress on those resources.

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REFERENCES

American Wind Wildlife Institute. (2017). *Wind Turbine Interactions with Wildlife and Their Habitats*. Washington, DC: American Wind Wildlife Institute.

Anderson, D. M., P. M. Glibert, and J. M. Burkholder. (2002). Harmful algal blooms and eutrophication: Nutrient sources, composition, and consequences. *Estuaries, 25*(4, Part B), 704–726.

Anderson, D. W., C. J. Henny, C. Godinez-Reyes, F. Gress, E. L. Palacios, K. Santos del Prado, and J. Bredy. (2007). *Size of the California Brown Pelican Metapopulation during a non-El Niño year*. Reston, VA: U.S. Geological Survey.

Avens, L. (2003). Use of multiple orientation cues by juvenile loggerhead sea turtles *Caretta caretta*. *The Journal of Experimental Biology, 206*(23), 4317–4325.

Bartol, S. M., and J. A. Musick. (2003). Sensory Biology of Sea Turtles. In P. L. Lutz, J. A. Musick, & J. Wyneken (Eds.), *The Biology of Sea Turtles* (Vol. 2, pp. 16). Boca Raton, FL: CRC Press Books.

Bartol, S. M., and D. R. Ketten. (2006). *Turtle and Tuna Hearing* (NOAA Technical Memorandum NMFS-PIFSC-7). Honolulu, HI: Pacific Islands Fisheries Science Center.

Bassett, C., J. Thomson, and B. Polagye. (2010). *Characteristics of Underwater Ambient Noise at a Proposed Tidal Energy Site in Puget Sound*. Seattle, WA: Northwest National Marine Renewable Energy Center.

Baulch, S., and C. Perry. (2014). Evaluating the impacts of marine debris on cetaceans. *Marine Pollution Bulletin, 80*(1–2), 210–221.

Baumann-Pickering, S., L. K. Baldwin, A. E. Simonis, M. A. Roche, M. L. Melcon, J. A. Hildebrand, E. M. Oleson, R. W. Baird, G. S. Schorr, D. L. Webster, and D. J. McSweeney. (2010). *Characterization of Marine Mammal Recordings from the Hawaii Range Complex*. Monterey, CA: Naval Postgraduate School.

Baumann-Pickering, S., A. J. Debich, J. T. Trickey, A. Širović, R. Gresalfi, M. A. Roche, S. M. Wiggins, J. A. Hildebrand, and J. A. Carretta. (2013). *Examining Explosions in Southern California and Their Potential Impact on Cetacean Acoustic Behavior*. La Jolla, CA: Southwest Fisheries Science Center.

Bearzi, M., C. A. Saylan, and J. Feenstra. (2009). Seabird observations during cetacean surveys in Santa Monica Bay, California. *Bulletin of Southern California Academy of Sciences, 108*(2), 63–69.

Bergmann, M., L. Gutow, and M. Klages. (2015). *Marine Anthropogenic Litter*. New York, NY and London, United Kingdom: Springer.

Birding Hawaii. (2004). *Annotated list of Hawaii's breeding birds*. Retrieved from http://www.birdinghawaii.co.uk/Annotatedlist2.htm.

Bradford, A. L., and K. A. Forney. (2014). *Injury Determinations for Cetaceans Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2008–2012* (NOAA Technical Memorandum NMFS- PIFSC-41). Honolulu, HI: Pacific Islands Fisheries Science Center.

Bradford, A. L., and E. Lyman. (2015). *Injury Determinations for Humpback Whales and Other Cetaceans Reported to NOAA Response Networks in the Hawaiian Islands During 2007–2012* (NOAA Technical Memorandum NMFS- PIFSC-45). Honolulu, HI: Pacific Islands Fisheries Science Center.

Bradford, A. L., and K. A. Forney. (2016). *Injury Determinations for Marine Mammals Observed Interacting with Hawaii and American Samoa Longline Fisheries During 2009–2013* (NOAA Technical Memorandum NMFS-PIFSC-50). Honolulu, HI: Pacific Islands Fisheries Science Center.

Brischoux, F., C. Cotte, H. B. Lillywhite, F. Bailleul, M. Lalire, and P. Gaspar. (2016). Oceanic circulation models help to predict global biogeography of pelagic yellow-bellied sea snake. *Biology Letters, 12*(8).

Bureau of Ocean Energy Management. (2012). *Final Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia*. Washington, DC: Office of Renewable Energy Programs.

Bureau of Ocean Energy Management. (2013). *Revised Environmental Assessment for Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Rhode Island and Massachusetts*. Washington, DC: Office of Renewable Energy Programs.

Bureau of Ocean Energy Management. (2014a). *Record of Decision for Final Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas*. New Orleans, LA: U.S. Department of the Interior.

Bureau of Ocean Energy Management. (2014b). *Final Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas*. New Orleans, LA: U.S. Department of the Interior.

Bureau of Ocean Energy Management. (2016a). *Final Programmatic Environmental Impact Statement for the Outer Continental Shelf Oil and Gas Leasing Program: 2017–2022*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2016b). *2017–2022 Outer Continental Shelf Oil and Gas Leasing Proposed Final Program*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management.

Bureau of Ocean Energy Management. (2016c). *Fact Sheet: Environmental Studies–Electromagnetic Fields*. Sterling, VA: U.S. Department of the Interior, Bureau of Ocean Energy Management. Retrieved from www.boem.gov.

Bureau of Ocean Energy Management. (2017a). *California Activities*. Retrieved from https://www.boem.gov/California/.

Bureau of Ocean Energy Management. (2017b). *Pacific Region Facts and Figures*. Retrieved from https://www.boem.gov/Pacific-Facts-and-Figures/.

California Department of Conservation. (2017). *2015 Report of California Oil and Gas Production Statistics*. Sacramento, CA: Division of Oil, Gas, & Geothermal Resources.

California Department of Fish and Wildlife. (2008). *Digest of California fishing laws and licensing requirements*. Sacramento, CA: California Department of Fish and Wildlife.

California Marine Life Protection Act Initiative. (2009). *Regional Profile of the Marine Life Protection Act South Coast Study Region (Point Conception to the California/Mexico Border)*. Sacramento, CA: California Resources Agency.

Carretta, J. V., S. M. Wilkin, M. M. Muto, and K. Wilkinson. (2013). *Sources of Human-Related Injury and Mortality for U.S. Pacific West Coast Marine Mammal Stock Assessments, 2007–2011* (NOAA Technical Memorandum NMFS-SWFSC-514). La Jolla, CA: Southwest Fisheries Science Center.

Carretta, J. V., E. Oleson, D. W. Weller, A. R. Lang, K. A. Forney, J. Baker, M. M. Muto, B. Hanson, A. J. Orr, H. Huber, M. S. Lowry, J. Barlow, J. Moore, D. Lynch, L. Carswell, and R. L. Brownell. (2015). *U.S. Pacific Marine Mammal Stock Assessments: 2014* (NOAA Technical Memorandum NMFS-SWFSC-549). La Jolla, CA: Southwest Fisheries Science Center.

Carretta, J. V., M. M. Muto, S. Wilkin, J. Greenman, K. Wilkinson, M. DeAngelis, J. Viezbicke, D. Lawson, and J. Jannot. (2016). *Sources of Human-Related Injury and Mortality for U.S. Pacific West Coast Marine Mammal Stock Assessments, 2010–2014*. La Jolla, CA: Southwest Fisheries Science Center.

Celi, M., F. Filiciotto, M. Vazzana, V. Arizza, V. Maccarrone, M. Ceraulo, S. Mazzola, and G. Buscaino. (2015). Shipping noise affecting immune responses of European spiny lobster (*Palinurus elephas*). *Canadian Journal of Zoology, 93*, 113–121.

Chaloupka, M., T. M. Work, G. H. Balazs, S. K. K. Murakawa, and R. Morris. (2008). Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982–2003). *Marine Biology, 154*, 887–898.

Corcoran, A., M. Dornback, B. Kirkpatrick, and A. Jochens. (2013). *A Primer on Gulf of Mexico Harmful Algal Blooms*. College Station, TX: Gulf of Mexico Alliance and the Gulf of Mexico Coastal Ocean Observing System.

Council on Environmental Quality. (1997). *Considering Cumulative Effects Under the National Environmental Policy Act*. Washington, DC: The Council on Environmental Quality.

Debich, A. J., S. Baumann-Pickering, A. Širović, J. A. Hildebrand, A. L. Alldredge, R. S. Gottlieb, S. T. Herbert, S. C. Johnson, A. C. Rice, L. K. Roche, B. J. Thayre, J. S. Trickey, L. M. Varga, and S. M. Wiggins. (2015). *Passive Acoustic Monitoring for Marine Mammals in the SOCAL Naval Training Area Dec 2012–Jan 2014* (MPL Technical Memorandum #552). La Jolla, CA: Marine Physical Laboratory, Scripps Institution of Oceanography.

DeMaster, D. P., C. W. Fowler, S. L. Perry, and M. F. Richlen. (2001). Predation and competition: The impact of fisheries on marine-mammal populations over the next one hundred years. *Journal of Mammalogy, 82*(3), 641–651.

Denkinger, J., M. Parra, J. P. Muñoz, C. Carrasco, J. C. Murillo, E. Espinosa, F. Rubianes, and V. Koch. (2013). Are boat strikes a threat to sea turtles in the Galapagos Marine Reserve? *Ocean & Coastal Management, 80*, 29–35.

Derraik, J. G. B. (2002). The pollution of the marine environment by plastic debris: A review. *Marine Pollution Bulletin, 44*, 842–852.

Edmonds, N. J., C. J. Firmin, D. Goldsmith, R. C. Faulkner, and D. T. Wood. (2016). A review of crustacean sensitivity to high amplitude underwater noise: Data needs for effective risk assessment in relation to UK commercial species. *Marine Pollution Bulletin, 108*, 5–11.

Edwards, H. H. (2013). Potential impacts of climate change on warmwater megafauna: The Florida manatee example (*Trichechus manatus latirostris*). *Climatic Change, 121*(4), 727–738.

Eschmeyer, W. N., and J. D. Fong. (2017). *Catalog of Fishes*. San Francisco, CA: California Academy of Sciences. Retrieved from http://researcharchive.calacademy.org/research/ichthyology/catalog/SpeciesByFamily.asp.

Fautin, D., P. Dalton, L. S. Incze, J. Leong, C. Pautzke, A. Rosenberg, P. Sandifer, G. Sedberry, J. W. Tunnell, I. Abbott, R. E. Brainard, M. Brodeur, L. E. Eldredge, M. Feldman, F. Moretzsohn, P. S. Vroom, M. Wainstein, and N. Wolff. (2010). An overview of marine biodiversity in United States waters. *PLoS ONE, 5*(8), e11914.

Fechter, L. D., and B. Pouyatos. (2005). Ototoxicity. *Environmental Health Perspectives, 113*(7), 443–444.

Federal Communications Commission. (2017). *Submarine Cables*. Retrieved from https://www.fcc.gov/submarine-cables.

Federal Energy Regulatory Commission. (2017a). *Marine & Hydrokinetic Projects (as of April 10, 2017)*. Washington, DC: U.S. Department of Energy, Federal Energy Regulatory Commission.

Federal Energy Regulatory Commission (Cartographer). (2017b). Marine and Hydrokinetic Projects Map [Resource Map].

Finkbeiner, E. M., B. P. Wallace, J. E. Moore, R. L. Lewison, L. B. Crowder, and A. J. Read. (2011). Cumulative estimates of sea turtle bycatch and mortality in USA fisheries between 1990 and 2007. *Biological Conservation, 144*(11), 2719–2727.

Geijer, C. K. A., and A. J. Read. (2013). Mitigation of marine mammal bycatch in U.S. fisheries since 1994. *Biological Conservation, 159*, 54–60.

Gerstein, E. R. (2002). Manatees, bioacoustics and boats: Hearing tests, environmental measurements and acoustic phenomena may together explain why boats and animals collide. *American Scientist, 90*(2), 154–163.

Hansen, L. P., and M. L. Windsor. (2006). Interactions between aquaculture and wild stocks of Atlantic salmon and other diadromous fish species: Science and management, challenges and solutions. *ICES Journal of Marine Science, 63*(7), 1159–1161.

Hardesty, B. D., and C. Wilcox. (2017). A risk framework for tackling marine debris. *Royal Society of Chemistry, 9*, 1429–1436.

Hawaii Department of Transportation. (2017). *Draft Environmental Impact Statement for Kalaeloa Barbers Point Harbor Fuel Pier & Harbor Improvements*. Kapolei, HI: Hawaii Department of Transportation, Harbors Division.

Hawaii Tourism Authority. (2015). *Hawaii Tourism Facts*. Retrieved from http://www.hawaiitourismauthority.org/default/assets/File/HTA_Tourism%20Facts%20as%20of%20August%202015.pdf.

Hawaii Tourism Authority. (2017). *2017 Annual Report to the Hawaii State Legislature*. Honolulu, HI: Hawaii Tourism Authority.

Hazel, J., I. R. Lawler, H. Marsh, and S. Robson. (2007). Vessel speed increases collision risk for the green turtle *Chelonia mydas*. *Endangered Species Research, 3*, 105–113.

Hubbs-Seaworld Research Institute. (2008). *Offshore Aquaculture Demonstration Project*. San Diego, CA: Hubbs-Seaworld Research Institute.

Humber, F., B. J. Godley, and A. C. Broderick. (2014). So excellent a fishe: A global overview of legal marine turtle fisheries. *Diversity and Distributions, 20*(5), 579–590.

Hunt, G. L., Jr. , and J. L. Butler. (1980). Reproductive ecology of Western gulls and Xantus' murrelets with respect to food resources in the Southern California Bight. *CalCOFI Reports, XXI*, 62–67.

Ilyashenko, V., and K. Zharikov. (2014). *Aboriginal Harvest of Gray and Bowhead Whales in the Russian Federation In 2013* (SC/65b/BRG03). Washington, DC: International Whaling Commission.

International Council for the Exploration of the Sea. (2005). *Report of the Ad-Hoc Group on the Impact of Sonar on Cetaceans*. Copenhagen, Denmark: Conseil International pour l'Exploration de la Mer.

Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. M. Erlandson, J. A. Estes, T. P. Hughes, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner, and R. R. Warner. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science, 293*, 629–638.

Kappel, C. V. (2005). Losing pieces of the puzzle: Threats to marine, estuarine, and diadromous species. *Frontiers in Ecology and the Environment, 3*(5), 275–282.

Keller, A. A., E. L. Fruh, M. M. Johnson, V. Simon, and C. McGourty. (2010). Distribution and abundance of anthropogenic marine debris along the shelf and slope of the U.S. West Coast. *Marine Pollution Bulletin, 60*(5), 692–700.

Ketten, D. R., and S. Moein-Bartol. (2006). *Functional Measures of Sea Turtle Hearing*. Woods Hole, MA: Woods Hole Oceanographic Institution.

Knowlton, A. R., P. K. Hamilton, M. K. Marx, H. M. Pettis, and S. D. Kraus. (2012). Monitoring North Atlantic right whale *Eubalaena glacialis* entanglement rates: A 30 year retrospective. *Marine Ecology Progress Series, 466*, 293–302.

Laist, D. W., A. R. Knowlton, J. G. Mead, A. S. Collet, and M. Podesta. (2001). Collisions between ships and whales. *Marine Mammal Science, 17*(1), 35–75.

Laist, D. W., and C. Shaw. (2006). Preliminary evidence that boat speed restrictions reduce deaths of Florida manatees. *Marine Mammal Science, 22*(2), 472–479.

Lam, T., Lingxu, S. Takahashi, and E. A. Burgess. (2011). *Market Forces: An Examination of Marine Turtle Trade in China and Japan*. Hong Kong, China: TRAFFIC East Asia.

Lammers, M. O., A. A. Pack, E. G. Lyman, and L. Espiritu. (2013). Trends in collisions between vessels and North Pacific humpback whales (*Megaptera novaeangliae*) in Hawaiian waters (1975–2011). *Journal of Cetacean Resource Management, 13*(1), 73–80.

Levenson, D. H., S. A. Eckert, M. A. Crognale, J. F. Deegan, II, and G. H. Jacobs. (2004). Photopic spectral sensitivity of green and loggerhead sea turtles. *Copeia, 4*, 908–914.

Levinton, J. S. (2009). Seaweeds, sea grasses, and benthic microorganisms. In *Marine Biology: Function, Biodiversity, Ecology* (3rd ed., pp. 309–320). New York, NY: Oxford University Press.

Lohmann, K. J., and C. M. F. Lohmann. (1992). Orientation to oceanic waves by green turtle hatchlings. *The Journal of Experimental Biology, 171*, 1–13.

Lohmann, K. J., and C. M. F. Lohmann. (1996). Orientation and open-sea navigation in sea turtles. *The Journal of Experimental Biology, 199*, 73–81.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. (1997). Human impacts on sea turtle survival. In P. L. Lutz & J. A. Musick (Eds.), *The Biology of Sea Turtles* (pp. 387–409). New York, NY: CRC Press.

Maison, K. A., I. K. Kelly, and K. P. Frutchey. (2010). *Green Turtle Nesting Sites and Sea Turtle Legislation throughout Oceania* (National Oceanic and Atmospheric Administration Technical Memorandum NMFS-F/SPO-110). Silver Spring, MD: Scientific Publications Office.

McDonald, M. A., J. A. Hildebrand, and S. M. Wiggins. (2006). Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California. *The Journal of the Acoustical Society of America, 120*(2), 711–718.

Minerals Management Service. (2005). *Structure-Removal Operations on the Gulf of Mexico Outer Continental Shelf: Programmatic Environmental Assessment*. New Orleans, LA: Gulf of Mexico OCS Region.

Minerals Management Service. (2007). *Programmatic Environmental Impact Statement for Alternative Energy Development and Production and Alternate Use of Facilities on the Outer Continental Shelf: Final Environmental Impact Statement*. New Orleans, LA: Gulf of Mexico OCS Region.

Mintz, J. D. (2012). *Vessel Traffic in the Hawaii-Southern California and Atlantic Fleet Testing and Training Study Areas*. (CRM D0026186.A2/Final). Alexandria, VA: Center for Naval Analyses.

Moore, S., M. Sutula, T. Von Bitner, G. Lattin, and K. Schiff. (2016). *Southern California Bight 2013 Regional Monitoring Program: Volume III. Trash and Marine Debris*. (Technical Report 928). Costa Mesa, CA: Southern California Coastal Water Research Project.

Moore, S. K., V. L. Trainer, N. J. Mantua, M. S. Parker, E. A. Laws, L. C. Backer, and L. E. Fleming. (2008). Impacts of climate variability and future climate change on harmful algal blooms and human health. *Environmental Health, 7*(Supplement 2), S4.

Moyle, P. B., and J. J. Cech, Jr. (2004). *Fishes: An Introduction to Ichthyology* (5th ed.). London, United Kingdom: Pearson Educational, Inc.

Mrosovsky, N., G. D. Ryan, and M. C. James. (2009). Leatherback turtles: The menace of plastic. *Marine Pollution Bulletin, 58*(2), 287–289.

Myers, R. A., and B. Worm. (2003). Rapid worldwide depletion of predatory fish communities. *Nature, 423*, 280–283.

National Marine Fisheries Service. (2006). *Marine Debris: Impacts in the Gulf of Mexico*. Lafayette, LA: Southeast Regional Office, Protected Resources Division.

National Marine Fisheries Service. (2015a). *Reinitiated Biological Opinion and Conference Report on U.S. Navy Hawaii-Southern California Training and Testing*. Washington, DC: The United States Navy and National Oceanic and Atmospheric Administration's National Marine Fisheries Service, Office of Protected Resources' Permits and Conservation Division.

National Marine Fisheries Service. (2015b). *Fisheries of the United States 2014*. (NOAA Current Fishery Statistics No. 2014). Retrieved from https://www.st.nmfs.noaa.gov/commercial-fisheries/fus/fus14/index.

National Marine Fisheries Service. (2015c). *Marine Aquaculture Strategic Plan FY 2016–2020*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

National Marine Fisheries Service. (2015d). *Status Review of the Humpback Whale (Megaptera novaeangliae) Under the Endangered Species Act* (NOAA Technical Memorandum NMFS-SWFSC-540). La Jolla, CA: Southwest Fisheries Science Center.

National Marine Fisheries Service. (2016a). *Unpublished Sea Turtle Data 2004-2016*. Honolulu, HI: Pacific Island Fisheries Science Center.

National Marine Fisheries Service. (2016b). *U.S. National Bycatch Report First Edition Update 2*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Retrieved from http://www.st.nmfs.noaa.gov/observer-home/first-edition-update-2.

National Ocean Economics Program. (2015). *Market Data*. Retrieved from http://www.oceaneconomics.org/Market/ocean/oceanEcon.asp?IC=N&dataSource=E.

National Oceanic and Atmospheric Administration. (2013). Takes of Marine Mammals Incidental to Specified Activities; U.S. Navy Training and Testing Activities in the Hawaii-Southern California Training and Testing Study Area; Final Rule. *Federal Register, 78*(247), 78106–78158.

National Oceanic and Atmospheric Administration. (2016). *Average 'Dead Zone' for Gulf of Mexico Predicted*. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Retrieved from http://www.noaa.gov/media-release/average-dead-zone-for-gulf-of-mexico-predicted.

National Oceanic and Atmospheric Administration. (2017a). *Coral Bleaching and Disease*. Retrieved from https://www.pifsc.noaa.gov/cred/coral_bleaching_and_disease.php.

National Oceanic and Atmospheric Administration. (2017b). *What are HABs*. Retrieved from https://habsos.noaa.gov/about/.

National Oceanic and Atmospheric Administration Marine Debris Program. (2014). *Report on the Entanglement of Marine Species in Marine Debris with an Emphasis on Species in the United States*. Silver Spring, MD: National Oceanic and Atmospheric Administration.

National Research Council of the National Academies. (1990). *Decline of the sea turtles: Causes and prevention*. Washington, DC: The National Academies Press.

Naval Special Warfare Command. (2016). *Notification of Preparation of an Environmental Assessment for Naval Special Warfare Training Operations Within the State of Hawaii*. San Diego, CA: Naval Special Warfare Command.

Naval Undersea Warfare Center. (2009). *Southern California (SOCAL) Fisheries Study: Catch Statistics (2002-2007), Fishing Access, and Fishermen Perception*. Newport, RI: U.S. Department of the Navy.

Nowacek, D., M. Johnson, and P. Tyack. (2004). North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli. *Proceedings of the Royal Society of London, 271*(B), 227–231.

O'Shea, T. J., R. R. Reeves, and A. K. Long. (1999). *Marine Mammals and Persistent Ocean Contaminants.* Paper presented at the Marine Mammal Commission Workshop October 12–15 1998, Keystone, CO.

Office of National Marine Sanctuaries. (2018a). *Programmatic Environmental Assessment of Field Operations in the West Coast*. Silver Spring, MD: National Oceanic and Atmospheric Administration.

Office of National Marine Sanctuaries. (2018b). *Programmatic Environmental Assessment of Field Operations in the Paific Islands*. Silver Spring, MD: National Oceanic and Atmospheric Administration.

Oleson, E. M., C. H. Boggs, K. A. Forney, M. B. Hanson, D. R. Kobayashi, B. L. Taylor, P. R. Wade, and G. M. Ylitalo. (2010). *Status Review of Hawaiian Insular False Killer Whales (Pseudorca crassidens) under the Endangered Species Act* (NOAA Technical Memorandum NMFS-PIFSC-22). Honolulu, HI: Pacific Islands Fisheries Science Center.

Ormerod, S. J. (2003). Current issues with fish and fisheries: Editor's overview and introduction. *Journal of Applied Ecology, 40*(2), 204–213.

Oros, J., A. Torrent, P. Calabuig, and S. Deniz. (2005). Diseases and causes of mortality among sea turtles stranded in the Canary Islands, Spain (1998–2001). *Diseases of Aquatic Organisms, 63*, 13–24.

Pacific Fishery Management Council. (2011). *Habitat and Communities: Wave, Tidal, and Offshore Wind Energy*. Retrieved from http://www.pcouncil.org/habitat-and-communities/wave-tidal-and-offshore-wind-energy/.

Poloczanska, E. S., M. T. Burrows, C. J. Brown, J. G. Molinos, B. S. Halpern, O. Hoegh-Guldberg, C. V. Kappel, P. J. Moore, A. J. Richardson, D. S. Schoeman, and W. J. Sydeman. (2016). Responses of marine organisms to climate change across oceans. *Frontiers in Marine Science, 3*(62), 1–21.

Read, A., P. Drinker, and S. Northridge. (2006). Bycatch of marine mammals in U.S. and global fisheries. *Conservation Biology, 20*(1), 163–169.

Read, A. J. (2008). The looming crisis: Interactions between marine mammals and fisheries. *Journal of Mammalogy, 89*(3), 541–548.

Redfern, J. V., L. T. Hatch, C. Caldow, M. L. DeAngelis, J. Gedamke, S. Hastings, L. Henderson, M. F. McKenna, T. J. Moore, and M. B. Porter. (2017). Assessing the risk of chronic shipping noise to baleen whales off Southern California, USA. *Endangered Species Research, 32*, 153–167.

Reijnders, P. J. H., A. Aguilar, and A. Borrell. (2009). Pollution and marine mammals. In W. F. Perrin, B. Wursig, & J. G. M. Thewissen (Eds.), *Encyclopedia of Marine Mammals* (2nd ed., pp. 890–898). Cambridge, MA: Academic Press.

Reynolds, J. D., N. K. Dulvy, N. B. Goodwin, and J. A. Hutchings. (2005). Biology of extinction risk in marine fishes. *Proceedings of the Royal Society B: Biological Sciences, 272*(1579), 2337–2344.

Roberts, L., S. Cheesman, M. Elliott, and T. Breithaupt. (2016). Sensitivity of *Pagurus bernhardus* (L.) to substrate-borne vibration and anthropogenic noise. *Journal of Experimental Marine Biology and Ecology, 474*, 185–194.

Roman, J., I. Altman, M. M. Dunphy-Daly, C. Campbell, M. Jasny, and A. J. Read. (2013). The Marine Mammal Protection Act at 40: Status, Recovery, and Future of U.S. Marine Mammals. *Annals of the New York Academy of Sciences, 1286*, 29–49.

Saez, L., D. Lawson, M. DeAngelis, E. Petras, S. Wilkin, and C. Fahy. (2013). *Understanding the co-occurrence of large whales and commercial fixed gear fisheries off the west coast of the United States* (National Oceanic and Atmospheric Administration Technical Memorandum NMFS-SWR-044). Long Beach, CA: Southwest Regional Office, Protected Resources Division.

SeeTurtles.org. (2017). *Coastal Development and Sea Turtles*. Retrieved from http://www.seeturtles.org/coastal-development/.

Sellner, K., G. Doucette, and G. Kirkpatrick. (2003). Harmful algal blooms: Causes, impacts and detection. *Society for Industrial Microbiology, 30*, 383–406.

Testa, J. W. (2012). *Fur Seal Investigations, 2010–2011* (NOAA Technical Memorandum NMFS-AFSC-241). La Jolla, CA: Southwest Fisheries Science Center.

Texas A&M University. (2011). *2011 Gulf of Mexico "Dead Zone" could be biggest ever*. Retrieved from http://www.sciencedaily.com/releases/2011/07/110718141618.htm.

Texas A&M University. (2014). *Gulf Dead Zone this year is smaller*. Retrieved from http://today.tamu.edu/2014/07/15/gulf-dead-zone-this-year-is-smaller/.

Tollefson, J. (2017). Air-gun blasts kill plankton. *Nature, 546*, 586–587.

U.S. Air Force. (2016a). *Final Draft Supplemental Environmental Assessment for Boost-Back and Landing of the Falcon 9 Full Thrust First Stage at Iridium Landing Area Vandenberg Air Force Base, California and Offshore Landing Contingency Option*. Vandenberg Air Force Base, CA: U.S. Department of Defense, U.S. Air Force.

U.S. Air Force. (2016b). *Final Environmental Assessment/Overseas Environmental Assessment for the Long Range Strike Weapon Systems Evaluation Program at the Pacific Missile Range Facility at Kauai, Hawaii*. Washington, DC: U.S. Department of Defense, U.S. Air Force.

U.S. Air Force. (2016c). *Request for Letter of Authorization for the Incidental Taking of Marine Mammals Resulting from Long Range Strike Weapon Systems Evaluation Program at the Pacific Missile Range Facility at Kauai, Hawaii*. Washington, DC: U.S. Department of Defense, U.S. Air Force.

U.S. Army Corps of Engineers. (2015). *Application for Permit: Rose Canyon Fisheries Sustainable Aquaculture Project*. (SPL-2014-00600-MBT). San Diego, CA: Rose Canyon Fisheries.

U.S. Census Bureau. (2010). *Coastline Population Trends in the United States: 1960 to 2008* (P25-1139). Washington, DC: U.S. Census Bureau.

U.S. Coast Guard. (1992). *S/S Exxon Houston Grounding near Barbers Point, Hawaii on 2 March 1989 with Polution and Subsequent Constructive Loss of Vessel*. (USCG 16732/01 HQS 92). Washington, DC: Marine Board of Investigation.

U.S. Coast Guard. (2010). *Notice of Availability for Environmenttal Impact Statements U.S. Coast Guard Pacific Area Operaiions (Districts 11 and 13)*. Washington, DC: U.S. Coast Guard.

U.S. Coast Guard. (2013). *Final Programmatic Environmental Assessment for the Nationwide Use of High Frequency and Ultra High Frequency Active SONAR Technology*. Washington, DC: U.S. Coast Guard.

U.S. Department of the Navy. (2000). *Compliance with Environmental Requirements in the Conduct of Naval Exercises or Training at Sea*. Washington, DC: The Under Secretary of the Navy.

U.S. Department of the Navy. (2008a). *Fact Sheet—Submarine Drive-In Magnetic Silencing Facility (MSF) Beckoning Point, Oahu, Hawaii*. Pearl Harbor, HI: Naval Facilities Engineering Command, Hawaii.

U.S. Department of the Navy. (2008b). *Submarine Drive-In Magnetic Silencing Facility Beckoning Point, Oahu, Hawaii*. Washington, DC: Naval Facilities Engineering Command.

U.S. Department of the Navy. (2008c). *Final Environmental Impact Statement for the Introduction of the P-8A Multi-Mission Maritime Aircraft into the U.S. Navy Fleet*. Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2011a). *Environmental Assessment and Finding of No Significant Impacts Helicopter Wings Realignment and MH-60R/S Helicopter Transition Naval Base Cornado, California*. Norfolk, VA: U.S. Fleet Forces Command.

U.S. Department of the Navy. (2011b). *Environmental Assessment for Naval Special Warfare Undersea Enterprise Consolidation at Joint Base Pearl Harbor-Hickam*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2011c). *Environmental Assessment MCON P-327 Pier 12 Replacement and Dredging Naval Base San Diego*. San Diego, CA: Naval Base San Diego.

U.S. Department of the Navy. (2012a). *National Environmental Policy Act Environmental Assessment for the Proposed Installation and Operation of a Deep-Water Wave Energy Test Site Off North Beach at Marine Corps Base Hawaii Kaneohe Bay, Oahu, Hawaii*. Washington, DC: Commander Naval Facilities Engineering Services Center.

U.S. Department of the Navy. (2012b). *Final Environmental Impact Statement for the Basing of MV-22 and H-1 Aircraft in Support of III MEF Elements in Hawaii*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2012c). *Finding of No Significant Impact and Environmental Assessment for the Replacement of the Fuel Storage and Distribution System Naval Auxiliary Landing Field San Clemente Island, California*. San Diego, CA.

U.S. Department of the Navy. (2012d). *Environmental Assessment for the Homeporting of the Littoral Combat Ship on the West Coast of the United States*. San Diego, CA: U.S. Department of the Navy.

U.S. Department of the Navy. (2013a). *Hawaii-Southern California Training and Testing EIS/OEIS*. Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2013b). *Final Environmental Assessment Naval Base Point Loma Fuel Pier Replacement and Dredging (P-151/DESC1306)*. Washington, DC: U.S. Department of the Navy.

U.S. Department of the Navy. (2015a). *Environmental Assessment for the Joint Logistics Over the Shore, maritime Prepositioning Force, and Field Exercising Training Marine Corps Base Pendleton, Sand Diego County, California*. San Diego, CA: U.S. Department of the Navy.

U.S. Department of the Navy. (2015b). *Draft Environmental Assessment for Pier 8 Replacement Naval Base San Diego*. San Diego, CA: Naval Base San Diego.

U.S. Department of the Navy. (2015c). *Final Environmental Assessment For The Installation and Operation of a Fixed Surface Ship Radiated Noise Measurement System At the Fleet Test and Evaluation Center Barbers Point Oahu, Hawaii and Surrounding Ocean*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2015d). *Southern California and Northern California Range Complexes Encroachment Action Plan*. Washington, DC: U.S. Fleet Forces Command and Naval Facilities Engineering.

U.S. Department of the Navy. (2015e). *Environmental Assessment for Photovoltaic Systems Joint Base Harbor-Hickam, Oahu, Hawaii*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2015f). *Final Environmental Assessment for MV-22 Facilities Relocation Marine Corps Base Hawaii, Kaneohe Bay*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2016a). *Seal Bomb (Deterrent) Use in West Coast and Alaska Fisheries Account with Fishermen*. Washington, DC: Memorandum to NOAA Fisheries, Office of Protected Resources.

U.S. Department of the Navy. (2016b). *Environmental Assessment for MCB Hawaii Kaneohe Bay Pali Kilo Beach Cottages Expansion*. Pearl Harbor, HI: U.S. Department of the Navy.

U.S. Department of the Navy. (2017a). *Final Supplemental Environmental Impact Statement/Supplemental Overseas Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar*. Arlington, VA: U.S. Department of the Navy, Chief of Naval Operations.

U.S. Department of the Navy. (2017b). *Marine Mammal Strandings Associated with U.S. Navy Sonar Activities*. San Diego, CA: U.S. Navy Marine Mammal Program and SPAWAR Naval Facilities Engineering Command.

U.S. Department of the Navy. (2017c). *Draft Environmental Assessment for Ammunition Pier and Turning Basin Naval Weapons Station Seal Beach*. San Diego, CA: U.S. Department of the Navy.

U.S. Department of the Navy. (2018). *Draft Environmental Assessment for Naval Special Operations Training, State of Hawaii*. San Diego, CA: Naval Special Warfare Command.

U.S. Energy Information Administration. (2017). *Hawaii State Energy Profile*. Retrieved from https://www.eia.gov/state/?sid=HI.

U.S. Marine Corps. (2010). *Final Environmental Assessment for Cove Outdoor Recreation Center and Marina Improvement Marine Corps Base Hawaii, Kaneohe Bay*. Kaneohe Bay, HI: U.S. Marine Corps.

U.S. Maritime Administration. (2016). *2015 Vessel Calls in U.S. Ports, Selected Terminals and Lightering Areas*. Retrieved from http://www.marad.dot.gov/resources/data-statistics/#Reports.

Union of Concerned Scientists. (2008). *How Hydrokinetic Energy Works*. *Clean Energy.* Retrieved from http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how_.

Van der Hoop, J. M., M. J. Moore, S. G. Barco, T. V. Cole, P. Y. Daoust, A. G. Henry, D. F. McAlpine, W. A. McLellan, T. Wimmer, and A. R. Solow. (2013). Assessment of management to mitigate anthropogenic effects on large whales. *Conservation Biology: The Journal of the Society for Conservation Biology, 27*(1), 121–133.

van Hooidonk, R., J. A. Maynard, D. Manzello, and S. Planes. (2014). Opposite latitudinal gradients in projected ocean acidification and bleaching impacts on coral reefs. *Global Change Biology, 20*(1), 103–112.

Wallace, B. P., R. L. Lewison, S. L. McDonald, R. K. McDonald, C. Y. Kot, S. Kelez, R. K. Bjorkland, E. M. Finkbeiner, S. Helmbrecht, and L. B. Crowder. (2010). Global patterns of marine turtle bycatch. *Conservation Letters, 3*(3), 131–142.

Waycott, M., C. M. Duarte, T. J. B. Carruthers, R. J. Orth, W. C. Dennison, S. Olyarnik, A. Calladine, J. W. Fourqurean, K. L. Heck, Jr., A. R. Hughes, G. A. Kendrick, W. J. Kenworthy, F. T. Short, and S. L. Williams. (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences, 106*(30), 12377–12381.

Weilgart, L. (2013). A Review of the Impacts of Seismic Airgun Surveys on Marine Life. *CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, February 25–27, 2014*, 1–10.

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