Draft
Environmental Impact Statement/Overseas Environmental Impact Statement
Atlantic Fleet 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 the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the 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, 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 Atlantic Fleet Training and Testing (AFTT) Study Area (Figure 2.1-1), 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 indefinite 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 (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), as well as 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 3.0-1 through 3.0-4, which depict the Study Area, boundaries of individual training and testing locations, and large marine ecosystems and open ocean areas within and adjacent to the Study Area.

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 X=Other*		
				Past	*Present*	*Future*
Military Mission, Testing, and Training Activities						
Construction of the Undersea Warfare Training Range	500 square nautical miles (NM^2) of Naval Air Station Jacksonville Operating Area (OPAREA) Undersea (120 to 900 feet [ft.] deep)	Includes the installation of undersea cables and up to 300 transducer nodes linked to Naval Air Station Jacksonville, approximately 50 NM offshore from Mayport, Florida (U.S. Department of the Navy, 2009a, 2009b). The use of the range for anti-submarine warfare training and testing activities is analyzed in this EIS/OEIS as part of the Proposed Action (Section 2.0, Description of the Proposed Action and Alternatives). Construction began in Fiscal Year 2014, and initial operational capability is anticipated in Fiscal Year 2019. Short-term sedimentation/turbidity may occur with construction activities; however, no long-term impacts on any biological receptors are anticipated from the development of the Undersea Warfare Training Range.		C	C	O

[1] Some projects/activities did not list specific impacts minimization measures (such as avoidance techniques, standard operating procedures, or industry best management practices) or mitigation requirements; either official documentation of project descriptions could not be obtained or did not specify these actions. In most cases, site-specific actions are to be developed as specific projects are developed.

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 X = Other*		
				Past	*Present*	*Future*
Training Activities at Eglin Gulf Test and Training Range	Warning Areas (W-151, W-168, and W-470) and Eglin Water Test Areas WTA-1 through WTA-6 Undersea, Surface, Airspace	The Eglin Gulf Test and Training Range supports a variety of air operations and ordnance training and testing activities accomplished predominately over the Gulf of Mexico (Eglin Air Force Base, 2015). Eglin Gulf Test and Training Range warning areas are adjacent to Navy-operated W-155 offshore Pensacola and W-174 west of the Florida Keys. Specific actions and authorizations include the following activities: • U.S. Air Force Precision Strike Weapon and Air-to-Surface Gunnery exercises include the use of explosive rounds. Marine Mammal Protection Act (MMPA) Letter of Authorization for the incidental Level A harassment (injury) of Atlantic bottlenose dolphins, Atlantic spotted dolphins, pantropical spotted dolphins, spinner dolphins, dwarf sperm whales, and pygmy sperm whales is valid through March 4, 2019 (National Marine Fisheries Service, 2014b). • Naval Explosive Ordnance Disposal School training includes underwater detonations of small (5 to 10 pounds (lb.) net explosive weight) high-explosive charges. Authorization for the incidental Level B harassment (disturbance) of Atlantic bottlenose dolphins is valid through April 24, 2017 (National Marine Fisheries Service, 2012). Further LOAs to extend similar activities are in process. • Precision strike weapon testing missions involve air-to-surface impacts of the Joint Air-to-Surface Stand-off Missile and the small-diameter bomb. These result in air and underwater detonations of up to 300 and 96 lb. of net explosive weight (NEW), respectively. Up to two high-explosive and four non-explosive missiles per year may be launched from an aircraft and as many as 6 high-explosive and 12 non-explosive small-diameter bombs can be dropped on targets annually. Because of implementation of mitigation and monitoring measures, takes are expected to be limited to Level B harassment in the form of a temporary change in the hearing threshold in the dolphin and whale species that might be in the vicinity of the detonations. No behavioral responses anticipated due to short duration/single explosion. • Weapon System Evaluation Program operational training and testing involves the use of live munitions on small boat targets delivered by fighter jets, bombers, and gunships offshore of Santa Rosa Island in water depth of approximately 115 ft. (National Marine Fisheries Service, 2017). Although authorized, Level A takes would be avoided through mitigation and Level B takes	Pre- and post-event monitoring; observation for marine mammals and turtles (including indicators such as *Sargassum* rafts and large schools of fish, jellyfish, and diving birds); 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 X = Other*		
				Past	*Present*	*Future*
		would be reduced for bottlenose and spotted dolphins and sea turtles (Eglin Air Force Base, 2014). Overall, training and testing at Eglin Gulf Test and Training Range includes detonation and live munitions that have the potential for causing harassment, injury, or mortality to marine mammals and sea turtles; however, although authorized, Level A takes would be avoided and Level B takes would be reduced to the greatest extent possible through mitigation measures (Eglin Air Force Base, 2002).				
Surveillance Towed Array Sensor System Low Frequency Active Sonar	Pacific, Atlantic (including the Study Area), and Indian Ocean, and Mediterranean Sea Undersea, 12 NM away from any coastline, 400 ft. below surface	The Navy has been operating Surveillance Towed Array Sensor System Low Frequency Active Sonar systems since 2002 and plans to continue the operation of up to four systems for use in routine training, testing, and military operations (U.S. Department of the Navy, 2016). Low Frequency Active /Compact Low Frequency Active sonar would operate for less than 255 hours per vessel (1,020 total) over 240 days per year. Surveillance Towed Array Sensor System Low Frequency Active sonar is unlikely to be used in the Study Area until further MMPA authorization. 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 Endangered Species Act (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.	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 X = Other*		
				Past	*Present*	*Future*
Joint Logistics Over-the-Shore Training	Joint Expeditionary Base Little Creek-Fort Story, Virginia or Marine Corps Base Camp Lejeune, North Carolina	Joint Logistics Over-the-Shore Training may be conducted jointly by the Navy, Marine Corps, and Army and consists of loading/unloading of cargo and personnel onto ships without fixed port facilities. Training includes in-water and land-based activities such as ferrying cargo to land from anchored ships, construction and use of an elevated causeway system from beach to water, use of water purification and liquid (fuel) transfer systems from shore to watercraft, and establishment of onshore temporary tent encampments (U.S. Department of the Navy, 2015). Impacts from Joint Logistics Over-the-Shore Training are mitigated to the greatest extent possible and include the potential to contribute minimal in-water noise from pile driving and removal (up to 30 days annually); temporary, localized impacts on soft bottom habitat and shoreline environment; temporary physiological or behavioral impacts on individual birds, sea turtles, and marine mammals. Activities may affect, but are not likely to adversely affect, the fin whale, humpback whale, the North Atlantic right whale, and West Indian manatee and would not be expected to result in any Level A or Level B incidental takes.	Dune and seabeach amaranth avoidance; soft starts (pile driving); observation for marine mammals and turtles; ceasing of activities in response to sightings.	O	O	O
Homeporting of Littoral Combat Ships	Naval Air Station Mayport	Includes the construction of facilities and establishment of functions required to support the homeporting of up to 14 Littoral Combat Ships (U.S. Department of the Navy, 2013). The first ships began to arrive in 2016 and the action is scheduled to be completed by 2020. Aircraft systems and personnel associated with the Littoral Combat Ships were analyzed in previous documents and are already established and based at Navy installations on the East Coast. Vessel transport and training activities were analyzed in the Navy's 2009 Virginia Capes, Navy Cherry Point, and Jacksonville Range Complex OEIS/EIS (U.S. Department of the Navy, 2009c). Littoral Combat Ships transits, training, and testing activities are currently being addressed in this the AFTT Phase II EIS/OEIS (U.S. Department of the Navy, 2013).		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 X = Other*		
				Past	*Present*	*Future*
		No long term impacts are anticipated from construction and demolition activities.				
Training Conducted by U.S. Army Vessels from Joint Base Langley-Eustis	Virginia Capes Range Complex (Warning Area 50)	The Army conducts approximately 10 surface-to-surface gunnery training events per year in the Virginia Capes Range Complex, which generally includes firing approximately 2,400 rounds (.50 caliber) from a Landing Craft Utility vessel at floating, plastic drum targets that are recovered after use. Although this action has the potential to affect marine mammals and sea turtles, 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 these similar Army activities would have a similarly low risk.	Requires standard 200 yard safety zone	O	O	O
U.S. Coast Guard Activities	U.S. Coast Guard District 1 (Maine to New York), District 5 (New Jersey to North Carolina), District 7 (South Carolina to Florida, including the Caribbean), and District 8 (Alabama to New Mexico)	The U.S. Coast Guard performs maritime humanitarian, law enforcement, and safety services in estuarine, coastal, and offshore waters. U.S. Coast Guard training and mission activities include boat and ship exercises; fixed-wing aircraft and helicopter activities; gunnery, including munitions and other expendables such as signal flares and marine markers; and the use of high frequency and ultra-high frequency sonar detection systems. 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.	Observation for marine mammals and 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 X = Other*		
				Past	*Present*	*Future*
National Aeronautics and Space Administration	Offshore Wallops Flight Facility, Virginia and Kennedy Space Center at Cape Canaveral, Florida	National Aeronautics and Space Administration has designated downrange danger zones and restricted areas that include hazard and debris areas from rocket tests, satellite launches, and other range mission activities. These activities are likely to have temporary, isolated impacts on local ecosystems, including the addition of marine debris, noise, and potential for take or harassment of individual marine mammals and sea turtles. National Marine Fisheries Service (NMFS) concluded that Wallops operations are infrequent enough to not warrant the need for an Incidental Take Statement for marine mammals or sea turtles from over-ocean rocket operations (U.S. Army Corps of Engineers, 2012).		O	O	O
U.S. Outer Continental Shelf Energy Development						
Oil and Gas Leasing Programs (Section 3.11.2.1.3, Oil and Gas)	Federal Waters: Gulf of Mexico Outer Continental Shelf, approximately 200 to 350 NM seaward from state (Texas, Louisiana, Alabama, Florida) jurisdictional boundary	Six million of the 160 million acres (ac) in the Gulf of Mexico Outer Continental Shelf are producing oil and natural gas (Bureau of Ocean Energy Management, 2017c). There are over 2,400 facilities and 27,000 miles (mi.) of pipeline (Bureau of Safety and Environmental Enforcement, 2017a). Oil and gas leasing activities may occur on a given lease tract for 40 to 70 years and include geophysical (sonar) surveys, drilling of exploration, development and production wells; installation and operation of platforms and pipelines and support facilities; transport of hydrocarbons using pipelines or tankers to processing locations; and decommissioning. The number of active leases and wells fluctuates regularly, but on average, the Gulf of Mexico has more than 2,400 production platforms and a weekly average of 37 drilling rigs (Bureau of Safety and Environmental Enforcement, 2017a). The majority of active platforms are located in water depths from 0 to 200 meters (m) (Bureau of Safety and Environmental Enforcement, 2017b). Specifically, as of March 1, 2017 there were 3,108 active oil and gas leases over 16,493,252 ac in the Gulf of Mexico Outer Continental Shelf Region (Western Area-Texas: 484 leases over 2,738,322 ac; Central Area- Alabama, Louisiana: 2,587 leases over 13,554,260 ac; and Eastern Area- Florida: 37 leases over	Avoidance/ protection of sensitive benthic communities, including no activity zone within 500 feet of live bottom habitat, 1,000 feet of deepwater live corals, and 500 feet of chemosynthetic habitats. Avoidance of impacts within National Marine Sanctuaries, and air gun exploration timing restrictions pertinent to North Atlantic Right Whale	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 X = Other*		
				Past	*Present*	*Future*
		200,670 ac) (Bureau of Ocean Energy Management, 2017d). Through March 2014, 51,305 productive wells had been drilled in the Gulf of Mexico Planning Areas, including 7,800 in the Western Area; 43,400 in the Central Area; and 105 in the Eastern Area (Bureau of Ocean Energy Management, 2015). (See Figures 3.11-1 and 3.11-2 for locations of Bureau of Ocean Energy Management planning areas and oil and gas exploration activities.) The Final Five-Year Program schedules an additional 10 potential lease sales in all three Gulf of Mexico Planning Areas from 2017 through 2022 (Bureau of Ocean Energy Management, 2017e). Up to 4,275 exploratory drilling wells are anticipated. No additional lease sales are proposed for the Pacific or Atlantic Outer Continental Shelf; but existing activities would continue (see Figures 3.11-1 and 3.11-2 for locations of Bureau of Ocean Energy Management planning areas and oil and gas exploration activities). Ten oil and gas lease sales were held in the Atlantic between 1976 and 1983 (Bureau of Ocean Energy Management, 2014a). Fifty-one wells were drilled on the Atlantic Outer Continental Shelf between 1975 and 1984, including one well in the Mid-Atlantic Planning Area and seven wells in the South Atlantic Planning Area. In April 2017 Executive Order Implementing an America-First Offshore Energy Strategy and May 2017 Department of the Interior Secretary Order 3350 Implementing the America-First Offshore Energy Strategy 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 (including the Atlantic Ocean and Gulf of Mexico). 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	and sea turtle requirements. Site-specific mitigation measures evaluated per project at lease sale offering.			

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 X = Other*		
				Past	*Present*	*Future*
		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). The majority of oil and gas structures and the pipelines linking those structures with onshore processing and refining facilities are located off of Louisiana and do not overlap with Navy testing ranges and OPAREAs (Figures 3.11-2 and 3.11-3). Potential impacts associated with Gulf of Mexico 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 Ocean Energy Management, 2016c). These impacts are generally assumed to be negligible due to the dispersed and relative small footprint of normal operations. In the event of small to catastrophic spills, however, impacts grow increasingly detrimental to marine life.				
	State Waters: Gulf of Mexico Outer Continental Shelf, 0 to 10 mi. offshore Texas, 0 to 3 mi. offshore Louisiana, Alabama, and Florida	Texas, Alabama, and Louisiana operate robust oil and gas leasing programs in state offshore waters (Bureau of Ocean Energy Management, 2016d). There are no leases in Mississippi state waters. Activities and potential impacts for these programs are similar as described above for the federal program.		C/O	C/O	C/O
Floating, Production, Storage, and	Gulf of Mexico Outer Continental Shelf, Western	Floating oil and gas production systems occur in deepwater environments, storing crude oil in tanks in the hulls of vessels and periodically offloading the crude oil to shuttle tankers or ocean-going barges for transport to shore	No Floating, Production, Storage, and Offloading	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 X = Other*		
				Past	*Present*	*Future*
Offloading Systems	and Central Planning Areas Deepwater (greater than 650 ft.)	(Minerals Management Service, 2001). At this time two systems occur in the Walker Ridge area of the Gulf of Mexico: (1) Petrobras America, Inc., located 165 mi. from Louisiana in approximately 2,500 m of water, produces oil and gas (gas is transported to shore by pipeline) (Bureau of Safety and Environmental Enforcement, 2011) and (2) Royal Dutch Shell, located 200 mi. southwest of New Orleans in 2,900 m of water (The Times-Picayune, 2015). Resources impacted by Floating, Production, Storage, and Offloading systems include air quality from platform and vessel emissions and water and sediment quality especially in the event of a spill (Minerals Management Service, 2001). Marine mammals, such as the sperm whale, sea turtles, and commercial fisheries may also be impacted due to noise from helicopters, service vessels, and shuttle tankers and vessel and shuttle tanker traffic may also increase collisions with marine mammals. It is anticipated that Floating, Production, Storage, and Offloading systems have similar, negligible anticipated environmental effects and mitigation measures as those expected for other oil development and production systems. Further site-specific, technical and environmental evaluation is required for specific Floating, Production, Storage, and Offloading proposals.	systems permitted within 100 kilometers (km) of the Breton NWA Class 1 Air Quality area; emission restrictions; security and safety controls for spill prevention and damage minimization			
Liquefied Natural Gas Terminals	Atlantic Ocean and Gulf of Mexico, coast and nearshore	Liquefied Natural Gas terminals function to regasify liquid natural gas for distribution via pipeline networks. Liquefied Natural Gas is imported and exported through both offshore and nearshore/ onshore terminals. The following Liquefied Natural Gas terminals are within the Study Area: • 12 Existing Import/Export: 6 Gulf of Mexico, 6 Atlantic (Federal Energy Regulatory Commission, 2017d) • 15 Approved Import/Export: 12 Gulf of Mexico, 3 Atlantic (Federal Energy Regulatory Commission, 2017a) • 14 Proposed Export: 13 Gulf of Mexico, 1 Atlantic (Federal Energy Regulatory Commission, 2017c) • 2 Proposed Import: Atlantic (Federal Energy Regulatory Commission, 2017b) Potential environmental impacts include those associated with additional ship		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 X = Other*		
				Past	*Present*	*Future*
		traffic, underwater noise from construction and operation, seawater intakes and discharges, and potential releases of liquefied natural gas.				
Oil and Gas Structure Removal Operations	Gulf of Mexico 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. Roughly 108 oil and gas structures are removed annually in the Gulf of Mexico. Of these about 66 percent are removed using explosives, which are detonated inside pilings and well conductors at a depth of 15 ft. below the seafloor. 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
Wind Energy Development (Section 3.11.2.1.2, Wind)	Atlantic Ocean Outer Continental Shelf Federal waters (approximately 200 to 350 NM seaward from	Commercial-scale offshore wind facilities are similar to onshore wind facilities, and, depending on rotor size and spacing requirements, can include from 14 (110 m rotor diameter) to 40 (150 m rotor diameter) turbines in one Outer Continental Shelf block (3 statute miles by 3 statute miles) (Bureau of Ocean Energy Management, 2012a). Average leaseholds are 8 blocks and current technology limits development to waters no deeper than 100 m. Development includes installing the substructure, which is typically a large steel tube (up to	Implementation of proper siting and mandatory design criteria; sonic pingers and/or turtle exclusion devices to minimize	C	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 X = Other		
				Past	Present	Future
	state jurisdictional boundary Atlantic Ocean State waters (0 to 3 NM from shoreline of Florida, Georgia, South Carolina, North Carolina, Virginia, Maryland, Delaware, New Jersey, Rhode Island, Maine, New York, and Massachusetts)	20 ft. diameter) driven 80 to 100 ft. below the mudline in 15 to 100 ft. 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. Eleven commercial wind energy leases have been issued in federal waters on the Outer Continental Shelf, including those offshore Delaware, Maryland, Maine, New Jersey, Rhode Island, Virginia, New York, and North Carolina (Bureau of Ocean Energy Management, 2017a). Various state offshore wind energy programs are also under development. 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, 2012b). Most impacts occur during the construction phase, which involves the highest amount of vessel traffic, noise generation, seafloor disturbance (especially from 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 are 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 moderate adverse impacts on sea turtles due to hatchling disorientation from lighting, with possible major	entanglement and entrainment potential; adherence to U.S. Coast Guard oil spill response plans; use of environmentally friendly chemicals.			

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 X = Other		
				Past	Present	Future
		impacts if turtle nests or aggregates of hatchings are destroyed. Proper siting and design and other mitigation measures would minimize potential impacts on coastal sediment transport processes, marine navigation, commercial shipping, fishing activities, seafloor habitats, marine mammals, sea turtles, areas of special concern, archaeological sites, and U.S. Department of Defense (DoD) training and exercise activities.				
		Other Commercial Industries				
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, 2016a).		C/O	O	O
Marine Mineral Extraction (Section 3.11.2.2, Mineral Extraction)	U.S. Outer Continental Shelf and shoreline, including Florida, Louisiana, Mississippi, New Jersey, North Carolina, South Carolina,	Marine minerals, primarily sand and gravel, are dredged from leased marine areas and applied to coastal restoration projects, including beach nourishment and coastal habitat restoration (Bureau of Ocean Energy Management, 2016b). Marine mammals, fish, and sea turtles may be impacted directly by dredge operations (including vessel strikes or dredge entrainment) or indirectly by noise, turbidity, water quality, and benthic habitat alteration produced by such (Bureau of Ocean Energy Management, 2013). Beach nourishment activities may impact nearshore habitat, including estuaries and bird and turtle nesting	Dredge timing and location constraints; lighting protocols; specialized equipment requirements; monitoring; buffer establishment surrounding cultural	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 X = Other*		
				Past	*Present*	*Future*
	Maryland, and Virginia	areas; however, site/project-specific NEPA analysis, mitigation measures, and other stipulations are established for each project that are specifically protective of local sensitive physical, biological, and cultural resources.	resources and hard-bottom habitat (Bureau of Ocean Energy Management, 2017b).			
Commercial Fishing (Section 3.11.2.4, Commercial Fishing)	Greater Atlantic region (Main through Cape Hatteras, North Carolina) Southeast Region (North Carolina to Texas)	There are 48 different fisheries in the Greater Atlantic region (National Marine Fisheries Service, 2016c). In the Southeast Region there are 21 separate fisheries. The National Oceanic and Atmospheric Administration provides bycatch data for 50 percent of the Greater Atlantic fisheries and 48 percent of those that occur in the Southeast. Figure 3.11-5 illustrates the decline of total fish caught in the Atlantic since 1956; Figure 3.11-6 shows a similar decline in the Gulf of Mexico. The NMFS issues fishing vessel, dealer, and commercial operator permits and fishing authorizations as required under the various Federal Fishery Regulations. Ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems (Jackson et al., 2001). Approximately 30 percent of the U.S. managed stocks are overfished (National Marine Fisheries Service, 2009b). 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	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 X = Other*		
				Past	*Present*	*Future*
		removal. Lost gear fouls and disrupts bottom habitats and has the potential to entangle or be ingested by marine animals.				
Recreational Fishing (Section 3.11.2.4.2, Recreational Fishing)		In 2014, more than 6.1 million residents of Atlantic coast states participated in marine recreational fishing. All participants, including visitors, took nearly 39 million trips and caught approximately 217 million fish (National Marine Fisheries Service, 2015c). In the Gulf of Mexico in 2014, nearly 2.9 million residents of Gulf Coast states participated in marine recreational fishing, taking 22 million trips and catching almost 155 million fish. Figure 3.11-7 through 3.11.9 show fishing locations and dive sites throughout the Study Area. 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.		O	O	O
Aquaculture (Section 3.11.2.5, 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, 2015d). 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 per year globally. Species are typically farmed in U.S. state waters and include mollusks (oysters, clams, mussels) and Atlantic Salmon (National Marine Fisheries Service, 2015c). 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		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 X = Other*		
				Past	*Present*	*Future*
		Aquaculture Policy provides direction to enable the development of sustainable marine aquaculture (National Marine Fisheries Service, 2015d).				
Coastal Land Development and Tourism (Section 3.11.2.6, Tourism)	States bordering Atlantic Ocean and Gulf of Mexico	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). 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 and snorkeling has the potential to degrade reef systems through disturbance and collecting, and collisions between whale watching ships and whales are common.	Site-specific mitigation often determined during Coastal Consistency Review by the respective state's Coastal Zone Management Program	C	C	C
Maritime Traffic (Section 3.11.2.3.1, Ocean Transportation)	U.S. East Coast	The east coast of the U.S. is heavily traveled by commercial, recreational, and government marine vessels with several commercial ports near Navy OPAREAs (see Figure 3.11-4 for commercially used waterways in the Study Area). 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 2011, 7,836 oceangoing vessels made 68,036 calls at U.S. ports; the average number of calls from 2006 to 2011 was 60,899 (Maritime Administration, 2013). Primary environmental concerns regarding increased maritime traffic include vessels striking marine mammals and sea turtles, introduction of non-native		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 X = Other*		
				Past	*Present*	*Future*
		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 maintenance of port infrastructure, which often include dredging requirements to maintain channel depths.				
	Panama Canal	A project to widen and expand the capacity of the Panama Canal was completed in June 2016 that allows larger vessels access to the east coast ports of the U.S. (The Canal Connection, 2017). Ports of Charleston, Philadelphia, Savannah, Virginia, and Baltimore have experienced record growth in cargo volume as the larger ships were expedited through the Canal in 2016. Port Miami and the Port of New York and New Jersey are significantly investing in infrastructure to accommodate big ships, including deep dredging projects. (Impacts are similar to those discussed for U.S. East Coast Maritime traffic.)		C	O	O
	Atlantic Coast Port Access Study	The Atlantic Coast Port Access Route Study is an ongoing endeavor intended to enhance navigational safety and reduce vessel collisions (U.S. Coast Guard, 2016). The Study focuses on shipping routes and near coast users between U.S. Atlantic coastal ports, approaches to coastal ports, and future uses of those ports. Establishing specific lanes and safety zones concentrates traffic, which decreases the extent of disturbance across the landscape but can increase the incidence of vessel strike, underwater noise, and air and water pollution in the concentrated traffic areas.				X
Research						
Geological and Geophysical Oil and Gas Survey Activities	Atlantic Ocean Outer Continental Shelf, Delaware Bay to south of Cape Canaveral, Florida, seaward from State jurisdictional	Offshore geological and geophysical activities includes seismic airgun surveys and high resolution geophysical surveys supporting oil and gas, renewable energy, and marine minerals exploration (Bureau of Ocean Energy Management, 2014a). 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 (dB) re 1 µPa for the large air gun array and 210.3 dB re 1 µPa for the small array (Bureau of Ocean Energy	Establishing and monitoring (visual, passive acoustic, and active acoustic) safety and acoustic exclusion zones and enforcing delay/ suspension and	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 X = Other*		
				Past	*Present*	*Future*
	boundary to 403 mi. offshore	Management, 2014a). 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). Since Between May 2012 and April 2015, the Bureau of Ocean Energy Management received 14 applications from 6 different permittees for Atlantic Outer Continental Shelf seismic survey activities (Bureau of Safety and Environmental Enforcement, 2015). Vessel strikes and especially seismic sound production in excess of 180 dB could cause adverse impacts on marine mammals, including North Atlantic right whales, dolphins, and sea turtles (Bureau of Ocean Energy Management, 2014b). 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 authorizations.	spacing protocols. Seasonal management includes avoidance of North Atlantic right whale and sea turtle breeding season and critical habitat. Maximum sound level thresholds established and enforced.			
Academic Research		Wide-scale academic research is conducted in the region of influence by federal entities, such as both the Navy and National Oceanic and Atmospheric Administration/NMFS, as well as state and private entities and other partnerships. Academic geologists use seismic surveys/air gun arrays to study the ocean floor and beyond, including plate tectonics and volcanic activity. For example, research vessel Marcus G. Langseth is owned by the National Science Foundation and operated by the Lamont-Doherty Earth Observatory at Columbia University for use by academic researchers from universities around the world. Although academic research aims to capture data without disturbing the ambient conditions of the ocean environment, vessels contribute traffic, 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.	NMFS and states manage scientific research permits for certain activities.	O	O	O
Ocean Pollution and Ecosystem Alteration						

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 X = Other*		
				Past	*Present*	*Future*
Hypoxic Zones (Section 3.6.2.1.5, 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, 2017c).		X	X	
	Gulf of Mexico	The northern Gulf of Mexico adjacent to the Mississippi River has the largest hypoxic zone in the U.S. and the second largest hypoxic zone worldwide. The average size of the hypoxic zone in the northern Gulf of Mexico varies year to year but from 1985 to 2014 was an average of about 5,300 square miles ($mi.^2$); in 2016 the hypoxic zone was 5,898 $mi.^2$ an area about the size of Connecticut (National Oceanic and Atmospheric Administration, 2016).				
Harmful Algal Blooms (Section 3.6.2.1.5, Water Quality)	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, 2017c). 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 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, 2017c).		X	X	
	Gulf of Mexico	In Florida, the deaths of 107 bottlenose dolphins in 2004 and 277 manatees in 2013 were linked to Harmful Algal Blooms (Edwards, 2013; Flewelling et al., 2005). With the projection of warming ocean waters, these harmful blooms				

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 X = Other*		
				Past	*Present*	*Future*
		may become more prevalent - beginning earlier, lasting longer, and covering larger geographic areas (Edwards, 2013; Moore et al., 2008)				
Major Spill Events	Global	Oil and other chemical spills related to oil and gas production activities are common throughout the Gulf of Mexico and Atlantic.		X	X	X
	Gulf of Mexico	In the Gulf of Mexico from 2009 to 2016 there were a total of 5,084 spills, 50 of which were over 50 barrels (2,100 gallons) of oil (Bureau of Safety and Environmental Enforcement, 2017c). The biggest of these was in April 2010 when the Deepwater Horizon offshore drill rig, 41 mi. southeast of the Louisiana coast, exploded and sank during exploratory well drilling. This was the largest accidental marine oil spill in U.S. history releasing 4.9 million barrels (210 million gallons) of crude oil into the Gulf of Mexico (National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling, 2011). Environmental impacts continue to be observed, including those arising from direct exposure of marine life to oil and dispersants, habitat degradation, and disturbances caused by cleanup activities. There has been extensive documentation of negative effects of the spill to deep sea corals and benthos, fish, marine mammals, sargassum, sea turtles, and other shoreline species and habitats (National Oceanic and Atmospheric Administration, 2017a). In particular, the spill has caused an ongoing unusual mortality event killing over 1,000 marine mammals, mostly bottlenose dolphins, off the coasts of Louisiana, Alabama, and Mississippi since the spill occurred (National Oceanic and Atmospheric Administration, 2017a).				
Marine Debris (Section 3.2.2.6 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 (National Marine Fisheries Service, 2006). An estimated 75 percent or more of marine debris consists of plastic (Derraik, 2002; Hardesty & Wilcox, 2017). Approximately 80 percent of marine debris originates onshore and 20 percent from offshore sources. Marine debris degrades marine habitat and water		X	X	X

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 X = Other*		
				Past	*Present*	*Future*
		quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service, 2006). Marine debris has been discovered to be accumulating in gyres throughout the oceans, two major accumulation zones exist in the Pacific Ocean and in the Atlantic east of Bermuda. 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.				
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 airgun, 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).		X	X	X
Climate Change (Section 3.1, Air Quality)	Global	Predictions of long-term negative environmental impacts due to climate change include sea level rise; changes in ocean surface temperature, pH, 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, carbon dioxide absorption, decreased pH, and altering carbonate		X	X	X

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 X = Other*		
				Past	*Present*	*Future*
		chemistry, decline in dissolved oxygen, and alteration 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.				

[1] Some projects/activities did not list specific impacts minimization measures (such as avoidance techniques, standard operating procedures, or industry best management practices) or mitigation requirements; either official documentation of project descriptions could not be obtained or did not specify these actions. In most cases, site-specific actions are to be developed as specific projects are developed.

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 interacting in the ocean environment (Table 4.2-1), 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 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). 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 will have an insignificant contribution to the cumulative stress experienced by these resources.

Cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the Proposed Action in combination with past, present, and reasonably foreseeable future actions. 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 will implement the mitigation detailed in Chapter 5 (Mitigation) to avoid 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) and/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 and reptiles. Rationale is also provided for an abbreviated analysis of the following resources: air quality, sediments and water quality, vegetation, invertebrates, habitat, fishes, birds and bats, 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. 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. 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 of the Study Area is very good with a small proportion of nonattainment and maintenance areas generally concentrated in the inland, urban, industrialized areas of northeastern states and a few isolated areas in the other regions (Figure 3.1-1 through Figure 3.1-4). The good quality of the ocean atmosphere 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. 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, 2016d). Air emissions from vessel operations within territorial waters are not regulated and contribute air emissions to adjacent air basins.

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 alternatives would result in localized and temporarily elevated emissions, but overall, criteria pollutant emissions in nonattainment or maintenance areas would not exceed *de minimis* thresholds. A few areas where ongoing training activities routinely occur are locations with greater emissions. These primarily include the lower Chesapeake Bay and surrounding tributaries where riverine training occurs. They are all attainment areas and the training in state waters is not anticipated to result in significant impacts to air quality. Hazardous air pollutant emissions are anticipated to be so minute that they were dismissed as a stressor of impact.

It is anticipated that the majority of emissions resulting from the Proposed Action would be released outside of state waters and would quickly disperse in the ocean environment. These emissions would largely degrade rather than concentrate due to meteorological and air chemistry processes, but under various scenarios these emissions could intermix with emissions from other vessel traffic and oil and gas production activities. Additionally, activities occurring in state waters would likely impact onshore areas to a greater extent than more distant activities. The incremental additive impacts from 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 (Tables 2.6-2 through 2.6-5), and the small quantities of expected emissions, 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 will not result in measurable additional impacts on air quality in the Study Area or beyond.

Activities occurring within state waters can be considered as localized with greater frequency and higher probability of combining with past, present and reasonably foreseeable future actions in and adjacent to the areas where the training and/or testing activity is occurring. With the exception of areas around Jacksonville, Florida where training would occur on the St. Johns River and Naval Station Mayport, these areas are all in attainment. An analysis of the emissions from the Proposed Action activities occurring in the Jacksonville, Florida area demonstrated that emissions are well below General Conformity thresholds (Section 3.1 Air Quality). It is anticipated that the incremental contribution of the Proposed Action in the state waters in the Jacksonville, Florida area, when added to the impacts of all other past,

present and reasonably foreseeable future actions, would not result in measurable additional impacts on air quality in the Jacksonville (Florida)-Brunswick (Georgia) Interstate Air Quality Control Region, which currently contains a small area designated as nonattainment for sulfur dioxide.

The area of greatest emissions in state waters is near the Virginia Capes Operational Area, specifically in the lower Chesapeake Bay, the York River, the James River, and their attendant tributaries. Training activities using small riverine boats and other vessels in this area were not analyzed in prior NEPA documents and account for approximately 2,600 tons per year of nitrogen oxide emissions. This represents about 21% of nitrogen oxide emissions for non-road and miscellaneous area sources in the Hampton Roads Intrastate Air Quality Control Region, which covers Isle of Wight, James City, Nansemond, Southampton, and York counties and the cities of Chesapeake, Franklin, Hampton, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach, and Williamsburg (U.S. Environmental Protection Agency, 2016). While the riverine training activities account for a substantial percentage of nonroad emissions in the region, the area is in attainment for all criteria pollutants and the level of activity has not changed appreciably over time. It is anticipated that these emissions, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on 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 into the offshore ocean environment due to transport through currents, storms, and persistent winds as well as vertical mixing in the water column. The environmental 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 to degrade or dilute, it can also concentrate materials in areas of the seafloor or water column where predictable currents, eddies, or gyres result in convergence zones (such as the “garbage patch” in the North Pacific Ocean or east of Bermuda where debris, particularly plastics, has accumulated and persists in the marine environment).

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 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 (see Section Table 3.2.2.1, Water Pollution and 3.2.2.2, Marine Debris for further discussion of sediment and water quality trends and impacts; Section 3.2.1.2, Methods lists applicable standards, regulations, and guidelines).

Threats to water quality are detailed in Section 3.3.2.1.5.1 (Water Quality). Sediment quality of the Study Area is generally rated as very good with most instances of lower quality in nearshore waters adjacent to population centers or areas with concentrated past or present industrial activities (Table 3.2-1; Figures 3.2-2 through 3.2-4). Water quality in the open ocean portion of the Study Area tends to be rated as good, but in the nearshore areas water quality is generally fair or compromised due to increased use and development in coastal waters (see Figures 3.2-6 through 3.2-8). Turbidity, dissolved oxygen, solids, and chemical components from land-based urban, agricultural, and industrial point and nonpoint sources in the coastal watershed are typical stressors to sediment and water quality. Persistent organic pollutants such as polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and pesticides; nutrients; bacteria; and some metals are typical components of discharge. 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 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 AFTT Study Area as part of normal operations. Shipboard waste-handling procedures governing the discharge of nonhazardous waste streams have been established for commercial and Navy vessels. These categories of wastes include liquids: “black water” (sewage); “grey water” (water from deck drains, showers, dishwashers, laundries, etc.); and oily wastes (oil-water mixtures) and solids (garbage). Global climate change is linked with 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 and a higher rate as water temperatures rise and become more widely dispersed. 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 3.0-9 and 3.0-10).

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 explosion 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. Explosion byproducts are expected to disperse rapidly near the water’s surface after detonation. Explosive materials and metal corrosion products 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 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. 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 and water temperate 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. Plastic and other 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) and discharge of shipboard black and grey water, oily wastes, and solids. Most explosion constituents are fully consumed in detonation, and chemical, physical, or biological changes to sediments or water quality 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 (such as pesticides). 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 oilrig 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 nearshore areas and bays, such as Narragansett Bay or the Lower Chesapeake Bay, to exacerbate already impacted sediments and water quality. Although impacts may temporarily intermingle with other inputs in areas with degraded existing conditions, most of the Navy impacts to water quality and turbidity are expected to be negligible, 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 persistent metal and plastic materials primarily to the offshore ocean ecosystems. However, these relatively minute concentrations of Navy stressors are not likely to combine with other past, present, or reasonably foreseeable activities in a way that would cumulatively threaten the water and sediment quality within the Study Area.

4.4.3 VEGETATION

The region of influence for vegetation includes the sunlit portions of the open-ocean, coastal, and inland waters, including the surface, water column and benthic habitat to a maximum depth of roughly 200 m. 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.

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, and water temperature and physical damage. Section 3.3.2.1.5 (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, 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).

Although Navy mitigation measures would help avoid impacts of the Proposed Action on vegetation in the Study Area, including species that are associated with shallow-water coral reefs and live hard bottom and *Sargassum*, 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 most 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 inland waters and are associated with coastal development, maritime commerce, 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 the open ocean and other areas where seagrasses and other attached marine vegetation do not grow; impacts would be localized; recovery would occur quickly; and none of the alternatives would 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

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. Invertebrates 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). Deep-water corals occur at depths below 50 m (164 ft) where there is no or low sunlight penetration and do not form biogenic reefs, but rather form mounds of intermediate substrate over hard bottom areas. Seven shallow-water coral species are listed as threatened under the ESA, and one deep-water coral species is designated as a Species of Concern under the ESA. NMFS maintains a website that provides additional information on the biology, life history, species distribution (including maps), and conservation of invertebrates in the Study Area.

Section 3.4.2.1.5 (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, and global climate change and ocean acidification. 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, hydrocarbon exploration and extraction, petroleum contamination, cable and pipeline placement, installation, 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 have the potential to impact marine invertebrates due to their ubiquitous presence and relative vulnerability.

The analysis presented in Section 3.4 (Invertebrates) indicates that the proposed alternatives could impact marine invertebrates through acoustic stressors (sonar and other transducers, air guns, pile driving, vessel noise, weapons noise), explosives, 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 corals (Table 3.4-1) would be avoided by mitigation designed to avoid locations where shallow-water corals are present. For example, the Navy will not conduct certain activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks (Chapter 5, Mitigation).

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), few individuals would likely be affected repeatedly by the same event.
- Invertebrates generally have high reproductive rates, short reproductive cycles, and resilient dispersal mechanisms; thus, with the exception of some species such as deep-water corals, 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.

- The Navy will not conduct, certain activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, or shipwrecks. All these features that have been identified are included in Chapter 5.0 (Mitigation).

Although marine invertebrates are impacted by other stressors in the ocean environment, the Proposed Action is not likely to incrementally contribute to population-level stress and decline of the resource. 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 l 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. 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 and 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 13,000 square km of designated National Marine Sanctuaries in the total AFTT Study Area (0.12% of total study Area), and 2,600 square km or 0.22% of Study Area 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 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, and 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).

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 alternatives 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 3.5.3.2.2 (Impacts from Explosives) and Appendix F (Military Expended Materials and Direct Strike Calculations), the area of hard bottom potentially impacted represents a negligible percentage (less than 0.01 percent) of the total hard bottom habitat in the Study Area (Figures 3.5-1 through 3.5-4). The Navy will implement mitigation to avoid 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 (Other Regulatory Considerations). 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 areas of soft, intermediate, and hard bottom habitat and National Marine Sanctuaries within the AFTT 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. 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. 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).

Fishes are the most numerous and diverse of the major vertebrate groups (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. As discussed in Section 3.6.1 (Introduction), approximately 78 percent of all marine fish species occur in waters less than 200 m deep and in close association with land, while 13 percent are associated with the open ocean (Moyle & Cech, 2004). 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; 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. 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.

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 inland waters such as pile-driving, sonar, seismic activity, shipping, and offshore construction projects, may contribute to cumulative stress as experienced by 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 exposed to sonar and other transducers or vessel or weapons noise may experience brief masking or behavioral reactions, such as startle or avoidance responses, or no reaction. 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. Some ESA-listed fish species, such as Atlantic sturgeon, would be at higher risk for impact during training and testing activities that occur within inland water areas. These activities include the use of vessels and in-water devices where proposed critical habitat for Atlantic sturgeon occurs along the southeast and northeast portions of the Study Area and would overlap with vessel use, especially in the James River and tributaries and York River in Virginia and the St. Mary's River in Georgia. Since Atlantic sturgeon are a large, slow moving species and typically occur near the surface in these areas, they are at higher risk of a vessel strike. Higher risks of impacts to this species from training and testing activities within inland waters may also occur from vessel movements, the use of seafloor devices, and when military expended materials are released into these inland waters.

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 quickly recover 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. 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 will 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 over a small spatial scale relative to the entire Study Area, have few participants, and are of a short duration. Thus, 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 already in significant decline. 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

Four main types of marine mammals are generally recognized: cetaceans (whales, dolphins, and porpoises), pinnipeds (seals, sea lions, and walruses), sirenians (manatees, and dugongs), and other marine carnivores (sea otters, marine otters, and polar bears). 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. Populations are varied; whereas the average population of certain dolphin and some whale populations can exceed the hundreds of thousands, other stock populations are unknown or estimated to be in the hundreds. As with other marine resources, distribution is patchy and can be temporarily concentrated in specific areas depending on the species. The size and structures of these groups are dynamic, and based on the species, and can range from several to several thousand individuals.

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' ranges during their lifecycle. Most of the baleen whales migrate great distances, while the toothed whales and dolphins have a smaller-scale, seasonal dispersal. Pinnipeds occur mostly in coastal habitats or over continental shelves. Manatees and polar bears are strongly associated with coastal waters as habitat for reproducing, resting, and, in some cases, feeding though polar bears can also range far offshore. 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.

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 AFTT 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. A general summary in this regard is presented in Section 3.7.2.1.5 (General Threats). Other populations, such as the humpback whale, are increasing in abundance in much of their range (National Marine Fisheries Service, 2015a). All marine mammals in the

U.S. are protected under the Marine Mammal Protection Act (MMPA), and some species receive additional protection under the ESA. Of the 48 species of marine mammals known to exist within the Study Area, there are 10 populations listed as endangered under ESA and classified as strategic stocks under MMPA (North Atlantic right whale, bowhead whale, humpback whale, minke whale, Bryde's whale, sei whale, fin whale, blue whale, and sperm whale), two are listed as threatened under ESA and classified as strategic stocks under the MMPA (West Indian manatee and polar bear), and one is proposed for listing under ESA (Arctic subspecies of ringed seal). In addition, the pygmy sperm whale and some bottlenose dolphin stocks are classified as MMPA strategic stocks. Polar bears and Arctic ringed seals occur in a very limited portion of the Study Area and the locations where the majority of activities are proposed to occur do not overlap with those areas; thus, it is anticipated that the Proposed Action would have no effect on polar bears or the Arctic ringed seal and they are not discussed further in this cumulative effects analysis.

4.4.7.3 Impacts of Other Actions

4.4.7.3.1 Overview

Section 3.7.2.1.5 (General Threats to Marine Mammals) 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 and other interactions), noise, hunting, vessel strike, marine debris, disease and parasites, 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. The abundance of the species in large part determines whether a fatality from any stressor would have population-level impacts on that species, and for species with small populations such as the North Atlantic right whale, individual fatalities could have considerable population-level impacts (Laist et al., 2001).

The activities as described in Table 4-1 each potentially contribute multiple stressors in the Study Area experienced by marine mammals, including vessel traffic, underwater noise, and water pollution. 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 other military operations. Bycatch and entanglement, the main threats to marine mammal populations, are chiefly associated with fishing. While Table 4-1 discusses these stressors for individual actions, their aggregate impacts specific to marine mammals are detailed in Section 3.7.2.1.5 (General Threats to Marine Mammals) 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);. This mortality could result in or contribute to continued population declines for some species, including ESA-listed species such as the North Atlantic right whale.

4.4.7.3.2.1 Bycatch

Potential impacts from commercial fishing activities include marine mammal injury and mortality from bycatch, when animals are caught in commercial fishing operations targeting a different species. Although marine mammal bycatch has generally declined since the implementation of take reduction measures, and new management practices and regulatory oversight could result in future reductions, bycatch is expected to remain a leading cause of mortality for the reasonably foreseeable future (Geijer & Read, 2013; Hamer et al., 2010; Northridge, 2008; Read et al., 2006; Read, 2008).

Sixty-nine commercial fisheries, divided into groups defined by the type of gear, location, and/or target species for reporting purposes, operate in the Study Area (National Marine Fisheries Service, 2016c). In the Northern Atlantic Region (Maine to North Carolina) 6 fishery groups impact 13 marine mammal stocks. From 2011-2013 the average total marine mammal bycatch estimate in this region was 2,960 animals per year. Gillnet gear continues to be the largest contributor to total marine mammal bycatch, taking an average 2,102 and 386 animals annually in the New England and Mid-Atlantic fisheries, respectively. In 2013 these effects were as follows:

- Western North Atlantic gray seal (1,086 animals)
- Gulf of Maine/Bay of Fundy stock of harbor porpoise (640 animals)
- Western North Atlantic harbor seal (442 animals)
- Short-beaked common dolphin (287 animals)
- Western North Atlantic white-sided dolphin (116 animals).

In the Southeast Region (North Carolina through the Gulf of Mexico) one fishery (HMS pelagic longline) impacts two main species, short-finned pilot whales (Western North Atlantic) and bottlenose dolphins (National Marine Fisheries Service, 2016a). From 2011-2013 the total marine mammal bycatch estimates were 350, 293, and 145, respectively. In 2013 the total bycatch included 124 short-finned pilot whales and 62 bottlenose dolphins. Although not historically reported, the shrimp otter trawl fishery is also suspected of impacting marine mammal through bycatch.

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.

The operations of fisheries 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 and Ingestion

As discussed in Section 3.7.2.1.5 (General Threats to Marine Mammals), interactions between marine mammals and marine debris, including derelict fishing gear 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. Manatee rescue records from 1993 to 2007 found that 27 percent of the cases were directly or indirectly associated with entanglement in or ingestion of marine debris, making entanglement and ingestion the top reason for rescuing manatees (Reinert et al., 2011). Table 4.4-1 provides entanglement data specific to baleen whales in the region of influence from 2010 through 2014 (Henry et al., 2016).

Table 4.4-1: Entanglements by Year: Summary of the Confirmed Human-Caused Mortality and Serious Injury Events Involving Baleen Whale Stocks along the Gulf of Mexico Coast, United States East Coast and Atlantic Canadian Provinces, 2010–2014

Stock	*Annual Injury and Mortality Rate (U.S. Waters / Canadian Waters / Unassigned Waters)*	*Confirmed Mortalities (2010, 2011, 2012, 2013, 2014)*	*Confirmed Injury Events (2010, 2011, 2012, 2013, 2014)*
Western North Atlantic Fin Whale	2.0 / 0 / 0	10 (2, 1, 4, 1, 2)	2 (1, 0, 0, 0, 1)
Gulf of Maine Humpback Whale[1]	1.8 / 0 / 0	9 (3, 3, 0, 2, 1)	13 (1, 4, 0, 3, 5)
Canadian East Coast Minke Whale	1.2 / 0.4 / 0	8 (1, 3, 1, 0, 3)	0
Western North Atlantic Right Whale	0.81 / 0 / 0.2	2 (1, 2, 0, 0, 0)	21 (4, 7, 6, 3, 1)
Nova Scotian Sei Whale	0.8 / 0 / 0	4 (0, 1, 0, 0, 3)	0
Unidentified Whale spp.	0.2 / 0.2 / 0	1 (1, 0, 0, 0, 0)	2 (0, 0, 1, 1, 0)
Northern Gulf of Mexico Bryde's Whale	0 / 0 / 0	0	0
Western North Atlantic Blue Whale	0 / 0 / 0	0	0

[1] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock

[2] Opportunistic reports were provided by members of the US and Canadian regional stranding networks, whale survey and disentanglement teams, the US and Canadian Coast Guards, and the general public. With the exception of minke whales, the incidental takes of baleen whales recorded by fisheries observer programs are also included here as opportunistic reports because the numbers of observed takes were not sufficient to calculate bycatch rate estimates. All available information for each reported injury or mortality was collected by the NMFS Greater Atlantic Regional Fisheries Office, Southeast Regional Office, and Northeast Fisheries Science Center.

Source: Henry et al. (2016)

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 in response 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 (e.g., Atlantic Coast Port Access Study (U.S. Coast Guard, 2016)). Within the AFTT Study Area, commercial traffic is heaviest along the entire United States East Coast and along the northern coast of the Gulf of Mexico while Navy vessel traffic is primarily concentrated along the United States East Coast between the mouth of the Chesapeake Bay and Jacksonville, Florida (Mintz, 2012). An examination of vessel traffic within the AFTT 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 usage is episodic, based on specific exercises being conducted at different times of the year (Mintz, 2012) , however Navy vessel use within inland 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). However, West Indian manatees are very susceptible to vessel strikes within inland and coastal waters due to the overlap with their distribution and high levels of small vessel traffic, making it the leading anthropogenic cause of manatee mortality (Rommel et al., 2007). 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.

The following percentage of strikes by species were observed during the period from 1995 through 2011 (National Marine Fisheries Service, 2011b): humpback whale (28 percent), North Atlantic right whale (19 percent), fin whale (17 percent), unknown species (16 percent), sei whale (6 percent), minke whale (5 percent), Cuvier's beaked whale (3 percent), Bryde's whale (2 percent), sperm whale (2 percent), Blainville's beaked whale (1 percent), and Gervais' beaked whale (1 percent). West Indian manatees are also highly susceptible to boat strikes, but the data were not readily available to calculate a comparable percentage. Vessel strike data for tracked baleen whale stocks in the region of influence from 2010 to 2014 are provided in Table 4.4-2.

Table 4.4-2: Vessel Collisions by Year: Summary of the Confirmed Human-Caused Mortality and Serious Injury Events Involving Baleen Whale Stocks along the Gulf of Mexico Coast, United States East Coast and Atlantic Canadian Provinces, 2010–2014[2]

Stock	*Annual Injury and Mortality Rate (U.S. Waters /Canadian Waters / Unassigned Waters)*	*Confirmed Mortalities (2010, 2011, 2012, 2013, 2014)*	*Confirmed Injury Events (2010, 2011, 2012, 2013, 2014)*
Western North Atlantic Fin Whale	2.0 / 0 / 0	10 (2, 1, 4, 1, 2)	2 (1, 0, 0, 0, 1)
Gulf of Maine Humpback Whale[1]	1.8 / 0 / 0	9 (3, 3, 0, 2, 1)	13 (1, 4, 0, 3, 5)
Canadian East Coast Minke Whale	1.2 / 0.4 / 0	8 (1, 3, 1, 0, 3)	0
Western North Atlantic Right Whale	0.81 / 0 / 0.2	2 (1, 2, 0, 0, 0)	21 (4, 7, 6, 3, 1)
Nova Scotian Sei Whale	0.8 / 0 / 0	4 (0, 1, 0, 0, 3)	0

Table 4.4-3: Vessel Collisions by Year: Summary of the Confirmed Human-Caused Mortality and Serious Injury Events Involving Baleen Whale Stocks along the Gulf of Mexico Coast, United States East Coast and Atlantic Canadian Provinces, 2010–2014[2] (continued)

Stock	*Annual Injury and Mortality Rate (U.S. Waters /Canadian Waters / Unassigned Waters)*	*Confirmed Mortalities (2010, 2011, 2012, 2013, 2014)*	*Confirmed Injury Events (2010, 2011, 2012, 2013, 2014)*
Unidentified Whale spp.	0.2 / 0.2 / 0	1 (1, 0, 0, 0, 0)	2 (0, 0, 1, 1, 0)
Northern Gulf of Mexico Bryde's Whale	0 / 0 / 0	0	0
Western North Atlantic Blue Whale	0 / 0 / 0	0	0

[1] Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock

[2] Opportunistic reports were provided by members of the US and Canadian regional stranding networks, whale survey and disentanglement teams, the US and Canadian Coast Guards, and the general public. With the exception of minke whales, the incidental takes of baleen whales recorded by fisheries observer programs are also included here as opportunistic reports because the numbers of observed takes were not sufficient to calculate bycatch rate estimates. All available information for each reported injury or mortality was collected by the NMFS Greater Atlantic Regional Fisheries Office, Southeast Regional Office, and Northeast Fisheries Science Center.

Source: Henry et al. (2016)

4.4.7.3.4 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-1 and specific 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), may result in injury, including hearing loss in the form of temporary threshold shift (TTS) or permanent threshold shift (PTS) 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 airgun, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and 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).

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. Although sonar activity has historically had various negative impacts on marine mammals, with the implementation of required mitigation measures, the operations associated with the Surveillance Towed Array Sensor System Low Frequency Active Sonar 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; in particular, in-water construction at naval piers 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 Ocean Pollution

As discussed in Table 4.2-1, multiple pollutants from multiple sources are present in, and continue to be released into, the oceans. Section 3.7.2.1.5 (General Threats to Marine Mammals) 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., 2008). 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 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). 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 Marine Mammal Protection Act), and behavioral responses and TTS (Level B harassment under the Marine Mammal Protection Act). 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 including the common dolphin, Atlantic spotted dolphin, striped dolphin, bottlenose dolphin, clymene dolphin, harbor porpoise, Atlantic white-sided dolphin, Risso's dolphin, pantropical spotted dolphin, and pilot whale that have stocks with tens to hundreds of thousands of animals. From a cumulative perspective, any potential impacts on species with small populations, especially ESA-listed species such as the North American right whale, are of particular concern, and the Navy will consult with the National Marine Fisheries Service, as required by Section 7(a)(2) of the Endangered Species Act, in that regard. The Navy will implement mitigation to avoid 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 significant impacts to marine mammals. 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 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, 2015b; National Oceanic and Atmospheric Administration, 2013) are that 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 marine mammals

4.4.7.3.6 Mortality

NMFS has previously concluded that the use of sonar and other transducers under the Proposed Action is possible but not expected to result in marine mammal mortality (National Marine Fisheries Service, 2015b; National Oceanic and Atmospheric Administration, 2013). Mitigation measures discussed in Chapter 5 (Mitigation) are designed to avoid 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 from explosive detonations that may lead to mortality (Tables 3.4-26 through 3.4-33). The protections afforded by mitigation measures cannot be fully quantified.

Abundant species including the common dolphin, Atlantic spotted dolphin, striped dolphin, bottlenose dolphin, clymene dolphin, harbor porpoise, Atlantic white-sided dolphin, Risso's dolphin, pantropical spotted dolphin, and pilot whale could have the highest chance of being killed by an explosion. The acoustic analysis also suggests that small numbers (three or less) of minke whales, melon-headed whales, white-beaked dolphins, spinner dolphins, and the ESA-listed sperm whale could be exposed to pressure waves from explosive detonations that may lead to mortality (Tables 3.4-22 through 3.4-29). Potentially lethal impacts were not predicted for other ESA-listed marine mammals.

Aircraft carrier ship shock trials occurring once per five-year period and guided missile destroyer/littoral combat ship shock trials occurring three times per five-year period represent the greatest risk for marine mammal mortality based on the high net explosive weight charges used during these testing activities (up to 58,000 lb. net explosive weight). These testing events may occur in either the Virginia Capes OPAREA or the Jacksonville OPAREA in waters deeper than 650 ft. Specific mitigation measures discussed in Chapter 5 (Mitigation) would be applied during shock trials and would greatly lower the likelihood of killing or injuring any marine mammals. If mortality were to occur, it is likely that the affected individuals would be from delphinid stocks or populations that number in the tens of thousands of animals.

Vessel strikes could also result in mortality of certain marine mammal species under the Proposed Action. 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 the following species: fin whale, minke whale, sei whale, sperm whale, blue whale, or beaked whales. The Navy does not anticipate it would strike a North Atlantic right whale or West Indian manatee. For small vessel use within inland waters, there have been zero reported strikes; therefore the Navy predicts that no marine mammals would be struck by small vessels.

4.4.7.4 Cumulative Impacts on Marine Mammals

Throughout the region of influence for marine mammals, in general, bycatch, vessel strikes, and entanglement are leading causes of direct mortality to marine mammals, 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 and vessel strikes. Implementation of 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. 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 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 construction and operation of liquefied natural gas terminals; 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, injury, or even mortality. 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, TPS, 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 available at this time 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 both further compound effects on a given individual already experiencing stress and in turn have the potential to further stress populations, some of which may already be in significant decline or in the midst of stabilization and recovery. 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, as well as 5-year reviews 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 the minimization of adverse effects and are explicitly limited to small numbers, with no more than a negligible impact on species and stocks of marine mammals. 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. These processes help to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Actions would 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 is the open-ocean and coastal regions throughout the tropical to temperate latitudes of the Study Area. Reptiles that occur within the boundaries of the Study Area include sea turtles (green turtles [*Chelonia mydas*], hawksbill turtle [*Eretmochelys imbricate]*, Kemp's ridley turtle [*Lepidochelys kempii*], leatherback turtle [*Dermochelys coriacea]*, and loggerhead turtle [*Caretta caretta*]) and crocodilians (the American crocodile [*Crocodylus acutus*] and the American alligator [*Alligator mississippiensis*]). 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. Alligators and crocodiles spend most of their time in fresh or brackish water, with individuals occasionally briefly sighted in nearshore marine waters. 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. Other reptiles were considered for inclusion in the analysis, such as various subspecies of diamondback terrapin (*Malaclemys terrapin*) that occupy brackish and inland swamps along the Atlantic and Gulf coasts; however, the Navy determined that terrapins would not be impacted by stressors analyzed in this EIS/OEIS.

4.4.8.2 Resource Trends

All reptiles 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 turtles are so long-lived, and because reliable data is 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 within the Study Area. Since listing, alligator and crocodile populations are recovering in the U.S. and distributions

have expanded; alligator populations have largely rebounded but are still protected under the ESA due to their similarity in appearance to crocodiles.

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 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 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. Crocodiles are largely impacted by habitat loss, specifically coastal development in Florida that restricts breeding areas as well as freshwater flow into swamps and estuaries. Car collisions and competition and predation pressure from introduced species are also threats. Alligators are sensitive to water quality parameters, including metal and pharmaceutical contamination, and prey availability.

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 locations (e.g., Kemp's ridley nesting in the Gulf of Mexico), and individual fatalities could have considerable impacts in localized populations.

The activities as described in Table 4-1 each potentially contribute multiple stressors in the Study Area experienced by reptiles, including vessel traffic, underwater noise, and water pollution. 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, 1990; Wallace et al., 2010). One comprehensive study estimated that worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al., 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. NMFS has instituted fishery observer and documentation programs to record bycatch events and implements regulations to reduce sea turtle bycatch in the Pacific and Atlantic Oceans and the Gulf of Mexico. In the Atlantic, NMFS requires gear modifications, changes to fishing practices, and time/area closures to reduce sea turtle bycatch in pelagic longline, mid-Atlantic gillnet, Chesapeake Bay pound net, and Southeast shrimp and flounder trawl fisheries (National Marine Fisheries Service, 2016b). In the

southeast U.S. Atlantic and Gulf of Mexico, NMFS has worked closely with the trawl fishing industry (e.g. shrimp trawl) to develop and require the use of turtle excluder devices. NMFS is currently involved in cooperative gear research projects designed to reduce sea turtle bycatch in the Gulf of Mexico and Atlantic pelagic longline fisheries, the Atlantic sea scallop dredge fishery, the Chesapeake Bay pound net fishery, and non-shrimp trawl fisheries in the Atlantic and Gulf of Mexico.

In the region of influence for sea turtles three fishery groups comprised of 13 individual fisheries impact loggerhead, leatherback, green, and Kemp's Ridley (National Marine Fisheries Service, 2016a). Fisheries that result in sea turtle bycatch in the Study Area include pelagic fisheries for swordfish, tuna, shark, and billfish; purse seine fisheries for tuna; commercial and recreational rod and reel fisheries; gillnet fisheries for shark; driftnet fisheries; bottom longline fisheries; and sea scallop fisheries (National Marine Fisheries Service, 2009a). Formal Section 7 consultations have been conducted and Southeast shrimp trawl fisheries, Atlantic HMS pelagic longline, HMS directed shark, reef fish, and coastal migratory pelagic resources fisheries have been found likely to adversely affect threatened and endangered sea turtles (National Marine Fisheries Service, 2014c).

However, the fisheries that have the most significant demographic effect on sea turtles are the shrimp trawl fisheries conducted off the southeast U.S. (from North Carolina to the Atlantic coast of Florida) and Gulf of Mexico (from the Gulf coast of Florida to Texas). Since 1994 all shrimp trawling participants are required to use Turtle Exclusion Devices, which when used, are estimated to reduce the number of sea turtles trawlers capture by as much as 94-97 percent (National Marine Fisheries Service, 2014c). However, from 2012 to 2013 use ranged from 58 to 83 percent on vessels boarded (National Marine Fisheries Service, 2014c). Interactions between Southeastern shrimp fisheries and sea turtles are estimated to effect 663,636 individual sea turtles, including 527,842 interactions and 43,622 mortalities, and the majority of the species affected are Kemp's Ridley.

Globally, large-scale commercial exploitation also contributes to global decline in sea 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 turtles (Humber et al., 2014). Illegal fishing for sea 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., 2012; Maison et al., 2010). For example, Humber et al. (2014) estimated that in Mexico 65,000 sea turtles have been illegally harvested since 2000. 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, widening of the Panama Canal, and 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 had been 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.

The Sea Turtle Stranding and Salvage Network includes federal, state and private partners who document sea turtle strandings along the U.S. Gulf of Mexico and Atlantic coasts from Maine to Texas and portions of the U.S. Caribbean (National Oceanic and Atmospheric Administration, 2017b). Network participants compile records of vessel interactions (propeller injury) from their respective areas and contribute those data to the centralized Sea Turtle Stranding and Salvage Network database on a weekly basis (National Oceanic and Atmospheric Administration, 2017b). For the Gulf of Mexico and Atlantic Regions in the region of influence, the Sea Turtle Stranding and Salvage Network recorded 2,055 total nearshore and offshore strandings in 2016. (Louisiana had minimal participation in this program.)

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 (e.g. Atlantic Coast Port Access Study (U.S. Coast Guard, 2016)).

4.4.8.3.3 Coastal Land Development

The population along the U.S. coastline grew from 47 million in 1960 to 87 million in 2008, and human communities now occur in an almost unbroken band throughout the coast (U.S. Census Bureau, 2010). During this timeframe, the Atlantic Coast grew by 15 million people and the Gulf of Mexico about 8 million. Although this represents 56 percent growth for the Atlantic region, the Gulf of Mexico, which prior to the 1960s was more rural, grew 150 percent during that timeframe. The limited space for development in coastal areas results in greater population density in these locations. In the U.S. (excluding Alaska), non-coastal counties average 98 persons per square mile while coastal counties average 300 persons per square mile.

Upon reaching sexual maturity, sea turtles generally return to the same beaches where they were hatched to lay eggs, but pervasive coastal land development often restricts or prevents this process. The human alteration of coastlines forces nesting females to use other beaches, changes the properties of nesting beaches, and contributes to the pollution of sea turtle habitat from runoff and wastewater discharge. Coastal development includes the beachfront construction of homes, hotels, restaurants, and roads, beach replenishment, seawall construction, operation of ports and marinas, nearshore dredging, and oil platform construction. Half of the world's population lives on or within 100 miles of a coastline, and increased coastal populations result in increased recreation and beach-going vehicles, abandoned debris and equipment, and lighting that confuses hatchlings' instincts to orient toward the moon over the ocean. Objects left on beaches, like beach chairs, create obstacles for nesting females that may result in failed nesting attempts or act as hazards to hatchlings as they get trapped in depressions and are unable to make it to the ocean. Seawall construction creates impenetrable barriers to nesting females and causes unnatural erosion of beaches. Along the Atlantic coast, development can also lead to secondary impacts, such as barrier island migration induced by altering sediment loads into coastal environments. For example, landward barrier island migration is occurring at about 1–6 meters per year,

which is leading to back barrier area reduction and large-scale salt marsh loss (0.45 km2 per year) (Deaton et al., 2017). This process is responsible for 51 percent of the marsh loss in the Atlantic coastal region.

Likewise, human development along coastal zones is a major threat to crocodilian species as it diminishes available habitat and restricts the species' breeding range. In addition to direct habitat loss, alteration of habitat is a concern; typically, residential and urban development restricts freshwater flow into swamps and estuaries, which may limit crocodilian growth, survival, and abundance (Mazzotti et al., 2007).

4.4.8.3.4 Ocean Pollution

As discussed in Table 4-1, multiple pollutants from multiple 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.

A total of 1,146 sea turtle mortalities were recorded during the 2010 Deepwater Horizon Oil Spill, most of which were Kemp's Ridley (National Marine Fisheries Service, 2011a, 2014a). The available data on sea turtle strandings and response collections during the time of the spill are expected to represent a fraction (currently unknown) of the actual losses to the species, as most individuals likely were not recovered. Indirect effects from the spill include loss of seagrass foraging habitat and other food species. Long-term effects of oil spills can persist for decades (National Marine Fisheries Service, 2011a, 2014a; Ortmann et al., 2012).

4.4.8.3.5 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-1. 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 guns, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and 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). 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, the Surveillance Towed Array Sensor System Low Frequency Active Sonar operations are not expected to result in mortality to any sea turtles and minimal injury or behavioral changes are anticipated. Although various other military training and testing activities involve surface or underwater detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones, and are infrequent, and isolated events.

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 & Lohmann, 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

Off-shore energy development including oil and natural gas extraction in coastal and deep waters on the continental shelf, as well as renewable energy projects, can degrade sea turtle habitats during pre-construction and operation phases. Prior to drilling operations, vessel traffic and seismic disturbances through exploration activities can degrade sea turtle coastal and open ocean foraging habitats. Oil and gas exploration and development in the Gulf of Mexico are a particular threat to Kemp's Ridley sea turtles.

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

Although susceptible to nearshore vessel strikes and entanglement hazards, most activities associated with the Proposed Action would not occur in crocodilian habitat and the probability of impacts on these species is anticipated to be extremely low.

The cumulative impacts analysis is generally focused on green, hawksbill, Kemp's ridley, leatherback, and loggerhead turtles, all of which are ESA-listed species. The analysis presented in Section 3.5 (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 ESA-listed species are of particular concern, and mitigation measures designed to avoid 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, TTS, PTS, injury (modeled as slight lung injury), and mortality. As summarized below, these impacts would be associated with certain acoustic and physical strike stressors:

- The use of sonar and transducers may result in behavioral responses, TTS, and PTS in sea turtles (Tables 3.5-6 through 3.5-8) including ESA-listed sea turtles (Table 3.5-18).
- Explosives may result in behavioral responses, TTS, PTS, injury, and mortality in sea turtles (Tables 3.5-10 through 3.5-16), including ESA-listed sea turtles (Table 3.5-18).
- Vessel strikes may cause injury or mortality in sea turtles, including ESA-listed sea turtles (Section 3.5.3.3.1, Impacts from Vessels).

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

The remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft overflight, and vessels), energy stressors (electromagnetic and high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, and seafloor devices), entanglement stressors (cables, wires, and decelerators/parachutes), ingestion stressors (munitions and military expended materials other than munitions), and secondary stressors are not expected to result in TTS, 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 the Navy's training and testing activities do not co-occur with nesting activities, it is unlikely that stressors presented to sea turtles will 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 impact 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 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 widely spaced, allowing exposed individuals to recover. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

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, speed of the platforms, and general dynamic movement of many training and testing activities, it is very unlikely that a sea turtle 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 are conducted in the open ocean. Unit level exercises 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 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, 2015b; National Oceanic and Atmospheric Administration, 2013) are that 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 also result in stress, injury, and mortality to individuals of some sea turtle species from underwater explosions and vessel strikes. Implementation of observation and delay measures discussed in Chapter 5.0 (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 safety, security and operational standard operating procedures 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 quickly recover 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 will not affect turtle nesting or crocodilian habitat, and contaminants and debris discharged into the marine environment are expected to be negligible and not persistent (Section 4.4.1.2, Sediment and Water Quality). Affects from the Proposed Action to sea turtle food sources are avoided or insignificant (Section 4.4.1.4, Invertebrates and Section 4.4.1.3, 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 of time.

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 impacts from the Proposed Action could make an individual more susceptible to other stressors. For example, if a Navy vessel were to strike and injure 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, a sea turtle in the vicinity of 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 both further compound effects on a given individual already experiencing stress and in turn has the potential to further stress populations in significant decline or recovery efforts thereof. 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 population 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 processes helps to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Action would not have a measurable effect on the resource.

4.4.9 BIRDS AND BATS

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. Bats are also present in marine environments, although they do not utilize water column and shallow bottom habitat. The majority of species encountered in the Study Area are waterbirds, including seabirds, wading birds, shorebirds, and waterfowl that use Study Area habitat for breeding, foraging, roosting, and migration. Many bat species occur in coastal (nearshore) waters, offshore waters (continental shelf), or open ocean areas while migrating or foraging. Bats almost exclusively use echolocation to navigate and feed, and they will use islands, ships, and other offshore structures as opportunistic or deliberate stopover sites for resting or roosting.

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 Birds of Conservation Concern are subject to regulatory processes and permitting that gives 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). Bat populations are also in precipitous decline, impacted chiefly by disease (Section 3.9.2.1.5.3, Disease and Parasites).

Birds and bats 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 and bat populations in the Study Area, and all activities listed in Table 4-1 contribute one or more of these stressors. Other activities in the Study Area that could have direct impacts on birds and bats include wind energy development (strike mortality); 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 (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 and Bats) indicates that birds and bats (to a lesser extent) 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 by-products, 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 the injury or mortality of birds or bats 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.

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 bats are infrequent, bird distribution is patchy, and concentrations of individuals are often low; therefore, the potential for interactions between bats, 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 and bat 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 significant impacts on birds and bats 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, consultation with the appropriate State Historic Preservation Office will continue, as needed, for cultural resources located within state territorial waters (within 3 NM, with the exception of Texas, Puerto Rico, and Florida [Gulf Coast only], which have a 9 NM limit). 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 Socioeconomics

The analysis in Section 3.11 (Socioeconomics) indicates that the Proposed Action is not expected to result in long-term impacts to socioeconomic resources in the Study Area, including energy production and distribution, mineral extraction, commercial transportation and shipping, commercial and recreational fishing, aquaculture, and tourism. Minimal temporary and short-term (hours) impacts may occur from limits on accessibility to marine areas used by the public (e.g., commercial and recreational fishing and tourism); however, accessibility restrictions would be lifted upon completion of training and testing activities and conditions would return to normal within hours of being initiated. The public may intermittently hear noise from transiting ships or aircraft overflights if they are in the general vicinity of a training or testing activity, but these occurrences would be infrequent, and other than transiting, most

Navy training and testing occurs farther from shore than most recreational and tourism 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. No impacts on sources for energy production and distribution, mineral extraction, and aquaculture are anticipated. Short-term impacts, should they occur, would not contribute incrementally to cumulative socioeconomic impacts. 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 likewise 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 Action Alternatives 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 meaningful contribution to the ongoing stress or cause significant collapse of any particular marine resource, but it would further cause 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 interfere with the recovery efforts thereof due to the implementation of standard operating procedures that reduce the likelihood of overlap in time and space and mitigation measures as described in Chapter 5 (Mitigation) that reduce the likelihood of impacts to both resources.

The aggregate impacts of past, present, and other reasonably foreseeable future actions (Table 4.2-1) 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, and coastal zone development. The analysis presented in this Chapter 4 (Cumulative Impacts) and Chapter 3 (Affected Environment and Environmental Consequences) indicate that the incremental contribution of the Proposed Action to cumulative impacts on air quality, sediments and water quality, vegetation, invertebrates, marine habitats, fishes, birds and bats, cultural and socioeconomic resources, and public health and safety would not significantly contribute to cumulative stress on those resources.

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