4 Cumulative Impacts

4 CUMULATIVE IMPACTS

4.1 PRINCIPLES OF CUMULATIVE IMPACTS ANALYSIS

The approach taken herein to analyze cumulative effects[1] meets the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations, and CEQ guidance. CEQ regulations (40 Code of Federal Regulations [C.F.R.] §§ 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 C.F.R. 1508.7).

CEQ provides guidance on cumulative impacts analysis in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 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 CEQ guidance observes that "no universally accepted framework for cumulative effects analysis exists," while noting that certain general principles have gained acceptance. One such principal 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 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, CEQ guidelines observe, "[i]t 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."

For the Proposed Action to have a cumulatively significant impact on 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. Secondly, the Proposed Action must make a substantial contribution to that significant cumulative impact. Finally, if the effects of the Proposed Action alone would have a significant impact on an environmental resource within its Region of Influence, then the impacts of the Proposed Action in combination with all other past, present, and reasonably foreseeable actions would normally be cumulatively significant.

4.1.1 Identifying Geographical Boundaries for Cumulative Impacts Analysis

Geographic boundaries for analyses of cumulative impacts can vary for different resources and environmental media. 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 wide-ranging or migratory wildlife, specifically marine mammals, sea turtles, fish, 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. Due to the relatively remote location of the Proposed Action and limited

[1] CEQ Regulations provide that the terms "cumulative impacts" and "cumulative effects" are synonymous (40 C.F.R. § 1508.8[b]).

Department of Defense (DoD) and commercial project activity, the geographic boundary for the majority of resources analyzed for cumulative impacts in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) is the Gulf of Alaska (GOA). However, migratory wildlife are analyzed for cumulative impacts based on the ecological ranges of their populations.

Activities taking place in areas inland from the coastline, including United States (U.S.) Air Force (Air Force) air ranges and U.S. Army (Army) training lands, are addressed in the *Alaska Military Operations Area EIS* (USAF 1995), *Improvements to Military Training Routes in Alaska Environmental Assessment* (USAF 2007), the *Alaska Army Lands Withdrawal Renewal Final Legislative EIS* (Army 1999), and the *Transformation of U.S. Army Alaska FEIS* (Army 2004). These documents are independent of Navy GOA activities discussed in this EIS/OEIS. The nature and extent of training on Air Force and Army inland training lands has not changed substantially during the past five years, and is not expected to change substantially in the foreseeable future with the exception of the United States Army Alaska [USARAK] Stationing and Training of Increased Aviation Assets. An EIS prepared for the U.S. Army, *Alaska Stationing and Training of Increased Aviation Assets,* analyzed the impact of increasing personnel and aircraft (Army 2009). The result of this analysis is included in the consolidated list of past, present, and reasonably foreseeable future projects in the GOA (Table 4-1).

4.1.2 Projects and Other Activities Analyzed for Cumulative Impacts

4.1.2.1 Past, Present, and Reasonably Foreseeable Future Actions

Identifiable present effects of past actions are analyzed, to the extent they may be additive to impacts of the Proposed Action. In general, the Navy lists and analyzes the effects of individual past actions only where appropriate; cumulative impacts analysis typically focuses on aggregate effects of past actions. This analysis depends on the availability of data and the relevancy of future effects of past, present, and future actions. Although certain data (e.g., extent of forest cover) may be available for extensive periods in the past (i.e., decades), other data (e.g., water quality) may be available only for much shorter periods. Because specific information and data on past projects and actions are usually scarce, the analysis of past effects is often qualitative (CEQ 1997). Analysis will primarily include present and reasonably foreseeable future actions that may have effects additive to the effects of the Proposed Action. These actions include all likely future development of the region even when foreseeable future action is not planned in sufficient detail to permit complete analysis (CEQ 1997). Table 4-1 lists past, present, and reasonably foreseeable projects with the potential to contribute to cumulative impacts.

Table 4-1: Past, Present, and Reasonably Foreseeable Future Projects in the GOA

Project	Project Description	Project Timeframe		
		Past	Present	Future
Alaska Groundfish Harvest Specifications EIS	FEIS to cover the establishment of harvest strategies for the Bering Sea and Aleutian Islands and GOA groundfish fisheries. Final EIS Record of Decision (ROD) signed 2007. The lead agency on this EIS was National Marine Fisheries Service (NMFS).	X	X	X
Alaska Groundfish Fisheries EIS	FEIS for the Fishery Management Plans for groundfish fishery of the GOA and the groundfish fishery of the Bering Sea and Aleutian Islands Area, North Pacific Fishery Management Council. Final Supplemental EIS ROD signed 2004. The lead agency on this EIS was NMFS.	X	X	X

Table 4-1: Past, Present, and Reasonably Foreseeable Future Projects in the GOA (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Alaska Predator Ecosystem Experiment (APEX)	The APEX was initiated under Restoration Project 94163, entitled *Forage Fish Influence on Recovery of Injured Species*. This pilot project was an interdisciplinary and interagency study (from Federal, state, private, and university entities) designed to investigate prey (forage fish) distribution, abundance, and availability. The multi-year project incorporated a group of existing bird and forage fish investigations and proposals within the Prince William Sound, Cook Inlet, and northern Gulf of Alaska to provide an integrated research approach that examined the interactions of seabirds and their prey, the reasons that changes in prey might have occurred, and the consequences for seabirds. The last year in the field for APEX was 1999, followed by a year of data analysis and production of publications.	X		
Amendments to the Alaska Coastal Management Program, Approval, Implementation and Funding, US Army COE 404 Permit, AK	The proposed Federal action is the Office of Ocean and Coastal Resource Management's (OCRM) review and approval of Alaska's request to incorporate Executive Order 106, House Bills 191, 69, and 86, Senate Bill 102, revisions to the statute AS 46, and new implementing regulations at 11 AAC 110, 11 AAC 112, and 11 AAC 114 as amendments to the Alaska Coastal Management Program (ACMP) pursuant to OCRM regulations on Amendments to Approved Management Programs (15 C.F.R. part 923, subpart H). When an amendment is submitted, OCRM must review the request to determine if the federally-approved management program, as changed by the amendment request, will still constitute an approvable program.	X	X	X
Commercially Guided Helicopter Skiing on the Kenai, Peninsula EIS	FEIS issuance of a special use permit allowing guided heli-skiing operations on portions of the Glacier and Seward Ranger Districts, Chugach National Forest, Glacier and Seward Ranger Districts, Kenai Peninsula. Final ROD signed 2002. The lead agency on this EIS was the United States Forest Service.	X	X	
Cook Inlet Beluga Whale Subsistence Harvest-Supplemental EIS	NMFS proposes to implement a long-term plan to manage subsistence harvests of the Cook Inlet, Alaska, beluga whale stock (*Delphinapterus leucas).* Also proposes to implement a Long-Term Harvest Plan and Fulfill the Federal Government's Trust Responsibility, Cook Inlet, AK Final ROD signed 2008. The lead agency on this EIS was NMFS.	X	X	X
EFH Identification and Conservation, Implementation, North Pacific Fishery Management Council, MSFCMA	The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The National Marine Fisheries Service (NMFS) and regional Fishery Management Councils (Councils) have described and identified EFH in fishery management plans (FMPs), minimized the adverse effects of fishing on EFH, and identified other actions to encourage the conservation and enhancement of EFH.	X	X	X

Table 4-1: Past, Present, and Reasonably Foreseeable Future Projects in the GOA (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Exxon Valdez Oil Spill Restoration Plan-Draft Supplemental EIS	NOAA, as a member of the Exxon Valdez Oil Spill Trustee Council, is preparing a supplement to the existing environmental impact statement (EIS) on the Council's restoration efforts. The supplemental EIS assesses the environmental impacts of the Council's proposal to narrow and refine the scope of the Council's restoration efforts to five defined restoration categories: herring; lingering oil; longterm monitoring of marine conditions; harbor protection and marine restoration; and habitat acquisition and protection. Draft published June 2010.			X
Gulf Apex Predator-Prey (GAP) Project	Initiated in 1999 through a NOAA grant, GAP's primary goal is to document trophic relationships between Steller sea lions, their prey, predators, and potential competitors in waters near Kodiak Island, an area of continued sea lion declines and extensive commercial fishing. From 2001-2003 GAP studies indirectly tested the hypothesis that Steller sea lions are prey-limited by documenting a) sea lion prey; b) the abundance, distribution, and quality of those prey species; and c) the productivity and health of other consumers of the same prey. GAP studies also collected baseline data for predation by killer whales or sharks. Additionally, by simultaneously monitoring environmental and oceanographic parameters over time in this area, GAP researchers tested the hypothesis that environmental and oceanographic change affects Steller sea lions, their prey, predators, and potential competitors. Funding from National Marine Fisheries Service (NMFS) in Fiscal Year (FY) 02 provided continued support of GAP's long-term goals and objectives. The final report was published in 2005.	X		
Helicopter Access to Conduct Forest Inventory and Analysis (FIA) in Wilderness FEIS	The USDA Forest Service proposes to authorize the use of helicopters to access FIA plots within the wilderness areas of the Tongass National Forest and a wilderness study area on the Chugach National Forest. This FEIS describes five action alternatives, including the Proposed Action, and the No Action alternative. There are a total of 913 plots that were inventoried over a ten-year period. The Proposed Action authorizes helicopter access to 540 plots. The significant issues identified are effects to wilderness character, wildlife, and employee safety. ROD signed in 2007.	X	X	X
Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar	Final Supplemental Environmental Impact Statement (SEIS) for the employment of the SURTASS LFA system was issued in April 2007, and the Record of Decision (ROD) was issued in August 2007 by the Navy. Under the action, a maximum of four systems would be deployed in the Pacific-Indian ocean area and in the Atlantic-Mediterranean area. Of an estimated maximum 294 underway days per year, the SURTASS LFA sonar would be operated in the active mode about 240 days.	X	X	X

Table 4-1: Past, Present, and Reasonably Foreseeable Future Projects in the GOA (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Naval Special Warfare Maritime Training Activities – Kodiak Island	Navy Special Warfare Command currently conducts training exercises on and around Kodiak Island. Training consists of SEAL Qualification Training (SQT) approximately six times a year, SEAL Team training approximately twice a year; and parachute operations once every two years. The USFWS concluded that the exercises are not likely to adversely affect listed species or adversely modify critical habitat.	X	X	X
Joint Pacific Alaska Range Complex Modernization and Enhancement EIS	The Army and Air Force, through Alaskan Command, are proposing to modernize and enhance the Joint Pacific Alaska Range Complex (JPARC) to enable realistic joint training for the Army, Navy, Marine Corps, and Air Force. The JPARC Modernization and Enhancement EIS will analyze potential environmental consequences associated with expanding and/or establishing new Military Operations Areas, restricted airspace, airspace corridors, ground maneuver training areas, and training complexes. The Notice of Intent to prepare the EIS was published in the Federal Register on December 10, 2010. The EIS is currently in the initial scoping stage.		X	X
Knik Arm Crossing (KAC)	The KAC is a proposed bridge by the Knik Arm Bridge and Toll Authority to enhance access between the Municipality of Anchorage and the Matanuska-Susitna Borough (Mat Su) to the northwest. The project sponsor is the Knik Arm Bridge and Toll Authority, a public corporation established by the Alaska State Legislature in 2003 to undertake the permitting, design, financing, construction, and operation of the KAC as a toll road. The bridge crossing could be 8,000 to 14,000 feet long over Knik Arm. The Federal Highway Administration (FHWA), in coordination with the Alaska Department of Transportation and Public Facilities, prepared an EIS addressing the proposal and alternatives (*Knik Arm Crossing Final EIS: FHWA, Dec. 2007*). A request from the Knik Arm Bridge Toll Authority has been submitted to NOAA (75 FR 54599, September 8, 2010) for authorization to take marine mammals incidental to construction over the course of five construction seasons (spring 2013 through autumn 2017). A Record of Decision (ROD) was issued on December 8, 2010.			X
Kodiak National Wildlife Refuge, Draft Revised Comprehensive Conservation Plan, Implementation	The Comprehensive Conservation Plan and EIS was prepared by U.S. Fish and Wildlife Service Region 7, Anchorage and released in 2004. The plan provides management direction for activities and uses of Kodiak Refuge, goals and objectives for refuge programs, and compatibility determinations for the current uses of the Kodiak National Wildlife Refuge. The revised plan and EIS ROD was signed in 2006.	X	X	X
Port MacKenzie Development	Mat Su Borough has been planning to build a deep-water dock facility in the Point MacKenzie area, to facilitate economic development in the borough, for about 30 years. A barge dock was completed in 2000, and a deep-water dock was completed in 2005. In addition to potentially increasing vessel traffic in the Anchorage area, the project could encourage further economic and land development activity.	X	X	X

Table 4-1: Past, Present, and Reasonably Foreseeable Future Projects in the GOA (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Port of Anchorage Expansion	The Port of Anchorage plays a major role in the regional economy, accommodating approximately 75 percent of goods shipped into Alaska. The Port is planning a major expansion of its marine terminal capacity, including road and rail service expansion and redevelopment of the marine terminal. The contracts for initial berth expansion were awarded in early 2008, and construction is projected to occur through 2012 (Port of Anchorage 2008). The expansion project could potentially increase vessel traffic to and from the GOA.		X	X
Ferry Service for Knik Arm	The Mat Su Borough is developing a ferry link between Port MacKenzie and the Port of Anchorage. The Cook Inlet Ferry is expected to begin operation in summer 2010, accommodating foot passengers, tractor-trailers, and automobiles. Parking facilities and ferry landings are planned on both sides of Knik Arm. While not directly influencing the GOA, the project could increase vessel traffic in the Cook Inlet/Knik Arm area.			X
Ring of Fire Resource Management Plan, Implementation RMP/EIS	The Bureau of Land Management (BLM) prepared a Proposed Resource Management Plan/Final Environmental Impact Statement (PRMP/FEIS) to provide direction for managing their public lands within the Ring of Fire planning area boundaries, and to analyze the environmental effects that would result from implementing the alternatives presented in the PRMP/FEIS. The ROD was signed in 2008.	X	X	X
USARAK Stationing and Training of Increased Aviation Assets	The U.S. Army, Alaska is proceeding with implementing a proposal to reorganize and augments its aviation assets in Alaska as an Aviation Task Force (ATF). The ATF is permanently stationed at Fort Wainwright. New facilities will be constructed and the total growth will be approximately 2,005 soldiers, family members, and civilian support personnel. The EIS and ROD were completed in 2009.	X	X	X
U.S. Army Alaska Battle Area Complex (BAX) and a Combined Arms Collective Training Facility (CACTF), Construction and Operation	U.S. Army Alaska Battle Area Complex (BAX) and a Combined Arms Collective Training Facility (CACTF), The Army completed an EIS and ROD for construction and operation of a BAX and CACTF to be located at Eddy Drop Zone. The ROD was issued in July 2006. The Eddy site is located almost immediately east of Fort Greely and southeast of Delta Junction. The location is predominately upland habitat but the area where the BAX would be situated also lies within the 100-year floodplain of Jarvis Creek. The CACTF site rests about four miles from Delta Junction, and the BAX approximately five miles. The design of the BAX orients weapons firing to the south, away from Delta Junction.	X	X	X
Other Potential Coastal Development	Various commercial, industrial, transportation, and residential development is possible in the coastal areas of Alaska. Mat Su Borough, for example, has discussed building a road/rail connection to Willow; a 200-megawatt (MW) gas-fired power plant has been discussed for Mat Su Borough; residential development has been proposed near various lakes in Mat Su; and assorted growth and development proposals are regularly raised for the greater Anchorage area. These potential coastal developments may gradually reduce terrestrial habitat acreage and introduce pollutants that are associated with urbanization into the air and water.			X

Table 4-1: Past, Present, and Reasonably Foreseeable Future Projects in the GOA (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Alaska Aerospace Corporation Space Vehicle and Missile Launch Operations at Kodiak Launch Complex	Alaska Aerospace Corporation launches space launch vehicles, long-range ballistic target missiles, and other smaller missile systems at the Kodiak Launch Complex. It is currently seeking authorization from NMFS to take small numbers of marine mammals incidental to the activities for the period of February 2011 through February 2016. This facility occupies 3,717 acres of state-owned lands on the Narrow Cape Peninsula on the eastern side of Kodiak Island, Alaska, approximately 22 miles from the city of Kodiak.		X	X

4.1.3 Other Regional Activities, Processes, and Trends

In addition to analyzing those past, present, and planned future projects listed in Table 4-1, a description follows of other activities that were also considered in the cumulative impact analysis.

4.1.3.1 Fishing

Commercial fishing is by far the predominant human activity in the GOA, although a number of fisheries are at very depressed levels or are closed (Richardson and Erickson 2005). Four major commercial fisheries are located in the GOA and vicinity: the groundfish, Pacific halibut, salmon, and scallop fisheries. Several other fisheries occur in the GOA (e.g., Pacific herring, clam, crab, shrimp, sea cucumber, sea urchin, and abalone) in Alaskan State waters (Ashe et al. 2005, Sagalkin 2005, Berceli and Trowbridge 2006, Trowbridge and Goldman 2006). Commercial fisheries that occur in federal waters off southern Alaska are described below. Some of these fisheries are managed federally (by the NMFS and North Pacific Fishery Management Council [NPFMC]), some have their management activities deferred to the State level (Alaska Department of Fish and Game [ADF&G]), and others are jointly managed at the state, federal, or international levels.

The most important commercial fisheries in the GOA are groundfish fisheries. Groundfish species harvested in the GOA include "target species" such as walleye pollock, Pacific cod, sablefish, Atka mackerel, several species of flatfish and rockfish, and skates. In 2007, the Central regulatory area yielded 71,210 metric tons of groundfish, which equaled approximately 54 percent of the total groundfish catch for the entire GOA. The GOA continental shelf and slope, particularly the wide shelf and banks around Kodiak Island, support a large biomass of groundfish. Groundfish fisheries in the GOA were developed in the late 1970s, and have become a major source of food and income for residents of Alaska, Washington, and Oregon. In addition to groundfish, a number of "other species" are caught, including squids, octopi, sharks, and sculpins. These species are of lesser economic value, and are generally not targeted. Groundfish are often harvested in multispecies complexes, as it is common for several species to be caught at the same time. The groundfish fishery is a complex industry, in that it is conducted across a wide range of habitats using an assortment of fishing gears, including trawls, hook-and-line gear, and pots. In 2002, 824 vessels participated in the groundfish fisheries in the GOA. Of these, 642 were hook-and-line vessels, 131 were pot vessels, and 123 were trawl vessels (NPFMC 2009).

Commercial fisheries for Pacific halibut are managed by a treaty between the United States (U.S.) and Canada, and through recommendations of the International Pacific Halibut Commission (IPHC). Pacific halibut is considered as one large interrelated biological stock, although it is regulated by subareas through catch quotas, time-area closures, and since 1995 in Alaska, by an individual fishing quota (IFQ)

program adopted by the NPFMC and implemented by the NMFS. Commercial catch limits in the GOA, located in IPHC Regulatory Area 3A, are higher than those in other areas of the eastern North Pacific because those waters are believed to be the center of Pacific halibut abundance (United States Department of Commerce, National Oceanic and Atmospheric Administration 2005 [USDC, NOAA]) (See Figure 3.6-1).

Pacific salmon support numerous commercial, recreational, and subsistence fisheries in Alaskan State waters. All five species of Alaska salmon (chinook, chum, coho, pink, and sockeye) are fully utilized, and stocks in most regions of the State generally have been rebuilt to, or beyond, previous high levels (Clark et al. 2006). Pink and sockeye salmon are the most abundant species in catches in the GOA (Eggers 2004).

Scallop fisheries in the GOA are relatively small compared to the region's groundfish, halibut, and salmon fisheries. As discussed in Section 3.12.1.1 (Socioeconomics), a major scallop bed in the GOA is located off the coast of Kodiak Island. Individual catch data for the Kodiak beds are not maintained; however the ADF&G states that, between 1998 and 2002, one of the largest harvests came from the Kodiak area averaging 82 metric tons each year (Woodby et al. 2005). The weathervane scallop is the only commercially exploited scallop stock in the GOA. Weathervane scallop populations were first evaluated for commercial potential in the early 1950s, but it was not until the late 1960s that interest in a fishery off Alaska took shape. Initial commercial fishing effort took place in 1967, when two vessels harvested weathervane scallops from fishing grounds off the east side of Kodiak Island. By the following year, 19 vessels had entered the fishery. Since then, vessel participation and harvests have fluctuated greatly, but have remained below the peak levels experienced in the late 1960s (NPFMC 2005b). All commercial fisheries for scallops take place in the relatively shallow waters of the continental shelf.

Data on recreational and subsistence fishing in the GOA are limited (Richardson and Erickson 2005). Recreational fishing mainly occurs off southeastern Alaska and along the northern Gulf of Alaska coast, including Prince William Sound, Kenai Peninsula, Cook Inlet, and Kodiak Island (Squire and Smith 1977). Fishing derbies for salmon and halibut are regularly held in Seward, Cordova, Homer, and Valdez. Sportfishing charters also routinely operate out of each of these ports. Subsistence fishing primarily occurs in coastal areas to the west and north that are relatively inaccessible to most recreational anglers. Nearly all recreational and subsistence fishing activities occur in State waters, as rough waters are a limiting factor further offshore (Squire and Smith 1977; NPFMC 1990, 2005b; USDC, NOAA 2005). As a result, minimal recreational and subsistence fishing activities are expected within the TMAA.

Commercial fishing can affect fish habitat and managed species. Potential effects of commercial fishing include over-fishing of targeted species and by-catch, both of which affect fish stocks. Mobile fishing gears such as bottom trawls disturb the seafloor and reduce structural complexity. Indirect effects of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats. Recreational fishing could affect fish habitats because of the large number of participants and the intense, concentrated use of specific habitats. Other indirect environmental effects of fishing include water pollution, air pollution from vessel engine exhaust, vessel transit noise, and vessel maintenance, which generates solid and hazardous wastes.

Commercial fishing in Alaska, including the GOA, appears to be a mature industry, with year-to-year variations in total landings of particular species, but no substantial increases in overall landings of commercial fish and other seafood (NMFS 2004, NOAA 2009). The overall numbers of fishing vessels engaged in major commercial fisheries and commercial fishing licenses in Alaska both have declined substantially in the past 8 years (State of Alaska Commercial Fisheries Entry Commission 2008). On the

basis of these trends, the level of commercial fishing in the GOA is not expected to increase substantially in the foreseeable future.

4.1.3.2 Commercial and Recreational Marine Traffic

A substantial amount of ocean traffic, consisting of both large and small vessels, transits through the GOA. Vessel traffic in the GOA includes tankers, container ships, roll-on roll-off cargo ships, ferries, fishing boats, cruise ships, military and scientific vessels, whale-watching boats, and recreational watercraft of various sizes and uses. A substantial volume of small craft traffic, primarily recreational, occurs throughout the inland waters of the GOA. Inland waters surrounding the GOA offer other recreational activities, such as kayaking and rafting. Sportfishing is also popular (Outdoor Directory 2008).

Cruise travel along the GOA is a popular recreational activity, and is the fastest growing tourist trade (City Data 2008). With excellent fishing and stunning coastal scenery, many visitors to the GOA choose to tour the area by boat and can choose from single-day to multiday cruises (Travel Alaska 2008).

In addition to large commercial vessels traversing the GOA, the Alaska Marine Highway System (AMHS) provides ferry service for passengers and vehicles between coastal communities (AMHS 2007). The Southwest Alaska route services Prince William Sound, Kodiak Island, the Alaska Peninsula, and the Aleutian Islands. The ferry route closest to the GOA is in Chenega Bay in the Prince William Sound and the town of Kodiak on Kodiak Island. The route is one of the least busy routes, with only 12 sailings in 2007 (AMHS 2007).

Two major ports close to the GOA, Anchorage and Valdez, were ranked in the top 150 U.S. ports by tonnage in 2000 (Research and Innovative Technology Administration/Bureau of Transportation Statistics [RITA/BTS] 2001). Commercially used waterways traverse the GOA, but are controlled by the use of directional shipping lanes for large vessels (cargo, container ships, and tankers). Ships traveling from major ports to the Lower 48 states and Hawaii, as well as marine traffic between coastal ports, enter the GOA briefly, but Navy activities are communicated to all vessels and operators by use of Notices to Mariners (NOTMARs).

Commercial vessels are sources of pollutants introduced into the water and air of the GOA. Additionally, commercial vessels are a source of transient noise, affecting the acoustic environment. Finally, commercial vessels are a source of ship strikes to marine mammals, and are implicated in many ship strikes in the GOA. Pleasure boats are sources of fuel leaks and toxins from antifouling paints (National Marine Manufacturers Association [no date], Nichols 1988).

The volumes of commercial and recreational vessel traffic in the GOA are closely tied to conditions in mainland Alaska. The population of Alaska is growing (Western Rural Development Center 2008); ferry services and private recreational fishing and boating are likely to grow in proportion to the increase in population. Additionally, cruise ship traffic and other tourism activities such as whale-watching, fishing charters, and other commercial recreational activities in the GOA are expected to increase in response to increasing demand for outdoor recreational experiences in Alaska (U.S. Fish and Wildlife Service 2009). Based on projections for freight shipments through the Port of Anchorage, freight shipments through Alaskan waters, and thus cargo vessel traffic, are expected to grow about 10 percent every five years (Port of Anchorage 2005). Further energy development in Alaska, such as expansion of Arctic oil fields or new oil and gas developments on the outer continental shelf, by encouraging population and economic growth (Institute of Social and Economic Research 2009), will indirectly increase commercial and recreational vessel traffic. On the basis of the trends mentioned above in population, recreation, and industry, the volume of commercial and recreational vessel traffic in the GOA is expected to increase substantially in the future.

4.1.3.3 Ocean Pollution

Water quality in the GOA is generally considered to be pristine because of the low population densities found in the region compared to the large amount of shoreline. Water pollution could result from onshore and offshore oil and gas exploration and production, municipal discharges, mining wastes, timber harvesting, vessel traffic, and fish-processing discharges.

Inland contaminated sites may contribute pollutants to coastal waters through surface water. Possible sources include solid and industrial waste landfills, the open burning of solid waste, active and formerly-used defense sites, and federal, state, and privately owned contamination sites. These sites contain a variety of pollutants, with possible contaminants including persistent organic pollutants (POPs), dioxins, petroleum products, heavy metals, pesticides, and radionuclides. Inland pollutants do not substantially affect the quality of offshore waters in the GOA, however, because pollutants flushed into the ocean are rapidly buried in coastal benthic sediments and upwelling of deep oceanic water in the central GOA diverts surface waters away from this area (Sheppard 2000).

POPs are common at low concentrations in the GOA because their physical and chemical properties allow them to persist for long periods in the Arctic environment. POPs in offshore areas of the GOA result primarily from distant sources because POPs can travel large distances in ocean currents and on surface winds (Sheppard 2000). They persist for long periods in the environment, and bioaccumulate in the food chain, causing health effects in humans and wildlife. Recent sampling of fish in Alaska by ADEC, including from the GOA, however, indicate that concentrations of organic and inorganic contaminants are generally substantially lower than concentrations in fish from other areas (ADEC, no date, Fish Monitoring Program: Analysis of Organic Contaminants; accessed in May 2009). Concentrations of POPs from distant sources are likely to increase in the GOA in the future in response to long-term trends in Pacific Ocean pollution.

Petroleum hydrocarbons may enter the marine environment during exploration, extraction, and transportation of crude oil, natural gas, coal, and coal bed methane resources. Oil may be discharged when it is discovered, during accidental blowouts, and during transportation. Low volumes of oil are continually discharged during the drilling process; drill cuttings and mud, which contain heavy metals and lubricants, are contained in process water that is deposited directly into the marine environment, estuaries, land, or deep injection wells. Process water also may include heavy metals, such as mercury, cadmium, zinc, chromium, and copper. Benthic infauna can be impacted within 15 square kilometers (km^2) of an oil rig due to disposal of water-based muds. The State of Alaska and the federal government are expanding their oil and gas leasing program in Alaska for exploration and extraction to meet the nation's energy demands, but there are no planned leases in either GOA or Kodiak planning areas (Minerals Management Service 2009). After the 20 April 2010 Deepwater Horizon oil rig explosion in the Gulf of Mexico a ban on deepwater drilling was reinstated for six months. The Department of the Interior has stated that it will not decide whether to allow exploration drilling for oil and gas in the Alaska Arctic outer continental shelf until it has completed a review of safety issues relating to offshore drilling activities (DOI 2010).

Marine water quality in the GOA is also affected by air pollution and emissions of greenhouse gases (GHGs). Air pollutants adhere to or are absorbed by water droplets, and are rained out of the atmosphere during precipitation events, which transport these pollutants into the GOA. GHGs, especially CO_2, are absorbed into ocean surface waters and, through downwelling, mixed into deeper waters. Marine waters near the poles have a greater capacity for dissolving carbon dioxide than do waters in the tropics, making them more susceptible to ocean acidification (Congressional Research Service 2009). A study of ocean acidification released in September 2009 indicates, based on monitoring data collected by instrumented buoys, that the acidity of GOA marine waters has increased by about 25 percent from its pre-industrial level (University of Alaska, Fairbanks 2009). Based on current trends in atmospheric GHG concentrations

and the known characteristics of arctic marine waters, the quantities of GHGs absorbed by ocean waters and ocean acidity are expected to increase in the foreseeable future.

Cruise ships are a substantial source of water pollutants because of the large number of passengers and the hazardous wastes generated. For example, a typical cruise ship produces 15 tons of garbage, 170,000 gallons of gray water, 21,000 gallons of sewage, and 5,000 gallons of oil-contaminated water per day (USEPA 2008). The amount of pollutants is similar to a small city, and the cruise industry is expanding. The cruise ship industry in North America has been growing at an annual rate of about five percent, and the future outlook for the industry in Alaska is for continued slow long-term growth.

In 1990, Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 which established a federal program to prevent the introduction and to control the spread of unintentionally introduced aquatic nuisance species and gave the U.S Coast Guard jurisdiction over ballast water management (see Section 3.3). The National Invasive Species Act amended the Nonindigenous Aquatic Nuisance Prevention and Control Act in 1996, which indicated that the DoD was to establish its own ballast water management program for seagoing vessels of the Department of Defense. Additionally, the Clean Water Act was amended in 1996 to allow for the Secretary of the Defense and Administrator of the USEPA to work in consultation with the U.S. Coast Guard and interested states to determine discharges incidental to the normal operation of a vessel of the Armed Forces for which it is reasonable and practicable to require use of a marine pollution control device. The Navy has chosen to voluntarily adopt the intent of the U.S. Coast Guard with respect to ballast water management as it works with USEPA to finalize Uniform National Discharge Standards. Other cruise ships, freighters, and tankers that frequent the GOA are required to comply with the regulations as well.

4.1.3.4 Scientific Research

There are currently scientific research permits and General Authorizations for research issued by the NMFS for cetacean work in the wild in the North Pacific. The most invasive research involves tagging or biopsy, while the remainder focuses on vessel and aerial surveys and close approach for photo-identification. NMFS has also issued General Authorizations for commercial photography of non-listed marine mammals, provided that the activity does not rise to Level A harassment of the animals. These authorizations are usually issued for no more than 1 or 2 years, depending on the project.

The impacts of this type of research are largely unmeasured. However, given the analysis and scrutiny given to permit applications, it is assumed that any adverse effects are largely transitory (e.g., inadvertent harassment, biopsy effects). Data to assess population level effects from research are not available. Even if data were available, it is uncertain that research effects could be separately identified from other adverse effects on cetacean populations. Levels of research-related vessel and aircraft activities in the GOA are assumed to remain relatively unchanged for the foreseeable future.

4.1.3.5 Commercial and General Aviation

Ted Stevens Anchorage International Airport is the primary airport that services the GOA region. Other primary airports in Alaska, but outside of the GOA region, include Fairbanks International Airport, Juneau International Airport, and Ketchikan International Airport. Numerous other commercial and smaller general aviation airports are located throughout the GOA region, and add to the increase in low-altitude traffic.

Private aviation is an important and basic mode of transportation in Alaska because approximately 90 percent of Alaska is not served by roads. Alaska has six times as many pilots per capita and 16 times as many aircraft per capita as the rest of the United States. Aircraft operating under visual flight rules (VFR) can fly along the Alaska coast, largely unconstrained, except by safety requirements and mandated traffic

flow requirements. Aircraft operating under instrument flight rules (IFR) clearances authorized by the FAA normally fly on the airway route structures. These routes include both high- and low-altitude routes between neighboring airports. When Warning Area (W)-612 is active, aircraft on IFR clearances are precluded from entering the Warning Area by the FAA. However, since W-612 is located entirely over international waters, nonparticipating aircraft operating under VFR are not prohibited from entering the area. Examples of aircraft flights of this nature include light aircraft, fish spotters, and whale watchers.

The intensity of commercial air traffic and private aviation in Alaska is expected to increase somewhat in the future (ADEC 2008), due to increases in the resident population (Western Rural Development Center 2008), increased summer tourism (U.S. Fish and Wildlife Service 2009), and increased air cargo shipments (Alaska Department of Labor and Workforce Development 2005).

4.1.3.6 Naval Special Warfare Maritime Training Activities Around Kodiak Island

As part of its training curriculum, the Navy Special Warfare Command currently conducts the following training exercises on and around Kodiak Island:

- SEAL Qualification Training (SQT) approximately six times a year;
- SEAL Team training approximately twice a year; and
- Parachute operations once every two years.

The specific timing of training events varies depending on operational requirements. These training exercises have been reviewed by the USFWS Anchorage Field Office. On January 25th, 2010, the USFWS concurred that the exercises are not likely to adversely affect listed species or adversely modify critical habitat. Training activities conducted as part of the Proposed Action and NSW training around Kodiak Island will not occur together but could coincide in terms of timeframe. Even if these activities did coincide, the potential for cumulative impacts is very low due to the type of activities conducted around Kodiak Island and the lack of spatial overlap (Kodiak Island is over 20 nm from the TMAA) between Kodiak training and Fleet training in the TMAA. Due to the type of activities, their location, and the limited and infrequent nature of NSW activities, these activities would not add cumulatively to the impacts of the Proposed Action.

4.1.4 Habitats of Migratory Marine Animals and Sea Turtles

Migratory or wide-ranging marine mammals and sea turtles that may be present in the GOA may be affected by natural events and anthropogenic activities that occur in areas far removed from Alaska waters, on breeding grounds, migration routes, wintering areas, or other habitats within a species' range. Events and activities that affect the habitats and populations of these marine species outside the GOA include the following:

- Disease
- Natural toxins
- Weather and climatic influences including climate change impacts
- Navigational errors
- Natural predation
- Fishing
- Hunting (including sea turtle egg predation)

- Ocean pollution
- Habitat modification or destruction
- Commercial shipping, fishing, and other vessel traffic
- Scientific whaling

These stressors on marine habitats in migratory wintering areas and on marine mammals and sea turtles when those animals are outside the GOA are discussed in detail in Section 3.8. In general, both natural and anthropogenic factors affect the health of marine mammal populations.

4.2 CUMULATIVE IMPACTS ANALYSIS

The cumulative impacts of training activities over land were previously analyzed in Section 1.6.2.1 and Appendix L of the *Alaska MOA EIS* (USAF 1995); Section 3.0 and Appendix C of the *Improvements to Military Training Routes in Alaska Environmental Assessment* (USAF 2007); Sections 3.18, 4.18, and 4.23 of the *Alaska Army Lands Withdrawal Renewal Final Legislative EIS* (Army 1999); and Sections 3.12, 4.12, and 9.3 of the *Transformation of U.S. Army Alaska FEIS* (Army 2004). The nature and extent of training on Air Force and Army inland training lands has not changed substantially during the past five years, and is not expected to change substantially in the foreseeable future (with the exception of the USARAK Stationing and Training of Increased Aviation Assets included in Table 4-1). No activities conducted within the TMAA have been analyzed in the previous documents but are analyzed for cumulative impacts in individual sections below.

4.2.1 Air Quality

4.2.1.1 Air Pollution

The offshore area of the GOA has few sources of air pollutants and good atmospheric ventilation. The intensity of ocean uses, and correspondingly the density of air pollutant sources, generally declines with increasing distance from the coast. Air pollutant sources affecting air quality in the GOA are primarily mobile sources such as vessels and aircraft. Commercial ocean industries, such as fishing and ocean transport, are dispersed over broad areas. Typical air pollutants include engine exhaust gases and process emissions from fishing vessels or other ocean vessels. Local meteorological conditions and atmospheric transport processes disperse these emissions over a large area. Because most of the GOA (that portion more than 3 nautical miles [nm] from the coast) is beyond the jurisdiction of the State of Alaska, no emissions inventory for the GOA is available. The air quality of Pacific Ocean offshore waters generally is relatively high, however, indicating that current air pollutant emissions in the region are generally not causing substantial adverse effects.

Air pollutant concentrations in the GOA will likely increase in the future. Some of the projects listed in Table 4-1 (bridge and port projects) are expected to increase vessel traffic, with attendant increases in air pollutant emissions. The expected regional trends in fishing (Section 4.1.3.1), marine traffic (Section 4.1.3.2), and commercial aviation (Section 4.1.3.3) are also expected to increase air pollutant emissions. New coastal development (see Table 4-1), especially large point sources such as power plants or extractive industries could – depending upon their locations relative to the GOA – contribute to increased levels of air pollutants. The degree to which these activities will cumulatively increase regional air pollutant concentrations is not known; current aircraft and vessels are more fuel-efficient than in the past, and these design trends are expected to continue due both to the increased cost of fossil fuels and to the imperative to reduce emissions of GHG. Under any foreseeable scenario, however, increases in air pollutant emissions in the GOA region would not be sufficient to measurably degrade air quality within the GOA. Therefore, past, present, and reasonably foreseeable activities in the GOA, including the Proposed Action, would not have a cumulatively significant impact on regional air quality.

4.2.1.2 Greenhouse Gases

Greenhouse Gases

It has been generally accepted in the scientific community that anthropogenic emissions of GHG over the past century, in the aggregate, have led to increasing global air temperatures. GHG, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases, have a propensity to trap heat in the atmosphere. CO_2 is the predominant greenhouse gas emitted by human activities, primarily from the combustion of fossil fuels such as coal, oil, and natural gas. The observed increase in average global air temperatures since the mid-20th Century is very likely a result of increased atmospheric concentrations of GHG (Intergovernmental Panel for Climate Change [IPCC] 2007). This phenomenon is commonly referred to as "global warming." Global warming due to GHG emissions induces climate change through the complex interaction of increased temperature with various natural processes such as ocean and atmospheric circulation. Effects of climate change in turn create complex feedback loops, such as loss of reflective snow and ice cover, that increase the rate of climate change. Scientists are now in general agreement that climate change is occurring (American Meteorological Society 2007, Alaska State Legislature 2008), and that current trends are very likely to continue unless worldwide emissions and atmospheric concentrations of CO_2 and other GHG are substantially reduced (Ledley et al 1999, Energy Information Agency 2008).

Climate Change

As noted by the IPCC, climate change in the Arctic over the last half-century has been well documented. Alaska's climate has warmed by about 4°F (2.2°C) since the 1950s, and about 7°F (3.9°C) in interior Alaska during the winter. The State experienced a 30-percent average increase in precipitation between 1968 and 1990. The growing season has lengthened by about two weeks. Changes in the climate of Alaska have had several direct and indirect effects on animals, indigenous peoples, and coastal communities. Among the effects are rising air and ground temperatures, loss of sea ice, loss of protection from fall storms, and retreat of the permafrost boundaries. Sea ice has retreated by about 14 percent since 1978, and thinned by 60 percent since the 1960s, resulting in widespread effects on marine ecosystems, coastal climates, and human settlements. Permafrost has melted, causing erosion, landslides, and damaged infrastructure in central and southern Alaska. Recent warming has been accompanied by increases in forest disturbances, including insect infestations. A sustained infestation of spruce bark beetles, limited in the past by low temperatures, has caused widespread tree mortality over 2.3 million acres (906,000 hectares) on Kenai Peninsula since 1992, the largest loss of trees to insects ever recorded in North America (IPCC 2007).

Effects of climate change on Arctic marine mammals are poorly understood, due to lack of integrated baseline data (Burek et al. 2008). This lack of data on health, diseases, and toxic effects in Arctic marine mammals severely limits our ability to predict the effects of climate change on marine mammal health. The overall health of an individual animal is the result of complex interactions among immune status, body condition, pathogens and their pathogenicity, toxicant exposure, and the various environmental conditions that interact with these factors. Climate change could affect these interactions in several ways. There may be direct effects of loss of the sea ice habitat, elevations of water and air temperature, and increased occurrence of severe weather. Some of the indirect effects of climate change on animal health will likely include alterations in pathogen transmission due to a variety of factors, effects on body condition due to shifts in the prey base/food web, changes in toxicant exposures, and factors associated with increased human habitation in the Arctic (e.g., chemical and pathogen pollution in the runoff due to human and domestic-animal wastes and chemicals and increased ship traffic with the attendant increased risks of ship strike, oil spills, ballast pollution, and possibly acoustic injury). The extent to which climate change will impact marine mammal health will also vary among species, with some species more sensitive to these factors than others. Baseline data on marine mammal health parameters along with

matched data on the population and climate change trends are needed to document these changes (Burek et al. 2008).

Ocean Acidity

It has been posited that the continued emission of CO_2 is resulting in seawater becoming more acidic as CO_2 from the atmosphere dissolves in the oceans. Ocean acidification from the invasion of CO_2 is a recognized phenomenon (Cicerone et al. 2004, Feely et al. 2004, Sabine et al. 2004). Scientists estimate that the oceans are now about 25 percent more acidic than they were at the start of the industrial revolution about 300 years ago.

The negative effects of ocean acidification are likely to be felt on biological processes such as calcification (Orr et al. 2005, Kleypas et al. 2006). Ocean acidification from CO_2 invasion and reduced ventilation also may result in decreases in sound absorption for frequencies lower than 10 kHz (Hester et al. 2008). This would result in increases in ambient noise levels in ocean environments, and enhanced propagation of anthropogenic sound. The scale of potential acidification is presently unknown, due to lack of data and challenges associated with sampling on a basin-wide or regional scale. While this phenomenon is under study (cf. Hester et al. 2008), the effects of CO_2 emissions on ocean acidity and the resultant potential for enhanced sound propagation remain indeterminate due to incomplete information.

The cold water and broad, shallow continental shelves bordering the GOA could make this area more susceptible to acidification than warmer portions of the ocean. The colder the water, the higher its dissolved gases content; cold water absorbs more CO_2 than warm water. The vast shallow continental margins around the GOA also could maintain higher concentrations of CO_2 because there is less mixing of surface layers with deeper ocean waters (University of Alaska 2009). Atmospheric CO_2 concentrations are expected to increase, at least in the near-term, and increases in ocean acidity are expected to generally reflect those increases.

Cumulative Effects

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, an appreciable impact on global climate change would only occur when proposed GHG emissions combine with GHG emissions from other man-made activities on a global scale.

Currently, there are no formally adopted or published NEPA thresholds of significance for GHG emissions. Formulating such thresholds is problematic, as it is difficult to determine what level of proposed emissions would substantially contribute to global climate change. Therefore, in the absence of an adopted or science-based NEPA significance threshold for GHGs, this EIS compares GHG emissions that would occur from the Preferred Alternative to the U.S. GHG baseline inventory of 2006 to determine the relative increase in proposed GHG emissions.

CO_2, N_2O, and CH_4 are generated during Navy training activities primarily through combustion of fossil fuels by vessels, aircraft, and energetic or powered training items (e.g., missiles, bombs). For purposes of determining the project contribution to global climate change, all GHG emitted during a training exercise are included. For ease of expression, the amounts of GHG other than CO_2 are added to the total amount of CO_2 to produce a single CO_2-equivalent ($CO_{2\text{-}e}$) value.

On a per-molecule basis, N_2O and CH_4 have more effect on global climate change than CO_2. Therefore, these values are weighted based on their Global Warming Potential (GWP) relative to CO_2. The GWP of N_2O is 310 and the GWP of CH_4 is 21. Thus, the calculation of $CO_{2\text{-}e}$ is:

$$CO_{2\text{-}e} = CO_2 + 310*N_2O + 21*CH_4$$

Navy training activities in the TMAA under the No Action Alternative will generate an estimated 22,000 TPY of $CO_{2\text{-}e}$. This amount is approximately 0.0003 percent of the nationwide GHG emissions in 2006 (USEPA 2008).

Navy training activities in the TMAA under Alternative 1 would generate an estimated 23,171 TPY of $CO_{2\text{-}e}$, an increase of about 1,200 TPY over that generated under the No Action Alternative. The amounts of GHG emitted under Alternative 1 are approximately 0.0003 percent of the nationwide GHG emissions in 2006 (USEPA 2008).

Navy training activities in the TMAA under Alternative 2 would generate an estimated 48,530 TPY of $CO_{2\text{-}e}$, an increase of 26,530 TPY over that generated under the No Action Alternative. This amount is approximately 0.0007 percent of the nationwide GHG emissions in 2006 (USEPA 2008).

Table 4-2 summarizes the annual GHG emissions associated with implementation of the Preferred Alternative. Under any of the alternatives, the contribution of the Proposed Action to national GHG emissions, and thus to climate change and ocean acidity, would be insignificant.

Table 4-2: Annual GHG Emissions

Scenario	Emissions, tons/year[1]			
	CO_2	N_2O	CH_4	$CO_{2\text{-}e}$
No-Action Alternative	21,708	0.7	3.6	22,003
Alternative 2 (Preferred Alternative)	47,881	1.6	7.9	48,530
Increase	26,173	0.9	4.3	26,527
U.S. 2006 Baseline Emissions (10^6 metric tons)[2]	-	-	-	7,054.2
Preferred Alternative Emissions as a % of U.S. Emissions	-	-	-	0.0007

Notes:
1 $CO_{2\text{-}e} = (CO_2 * 1) + (CH_4 * 21) + (N_2O * 310)$.
2 (USEPA 2008)

Navy Stewardship

In response to concerns over climate change, Department of the Navy leadership has initiated broad programs to reduce energy consumption and shift energy demand to renewable and alternative fuels to the extent consistent with its national security mission, thereby reducing emissions of CO_2 and other GHG. The Navy has implemented a number of shore installation and fleet programs that have substantially reduced the generation of GHG, primarily through conservation of fossil fuels and electricity.

Ashore, the Navy has aggressively encouraged its installations to reduce energy use, both through facility competitions and through investments in solar, wind, and geothermal technologies. Since 1985, the Navy has sponsored a world-wide energy management program that has reduced its energy use by more than 29 percent (Naval Facilities Engineering Command [NAVFAC] Public Affairs, 10/26/2005). At Pearl Harbor, for example, the installation of approximately 2,800 energy-efficient light fixtures has reduced electricity use by about 758 megawatt-hours (MWh) per year, equal to 448 tons per year (TPY) of CO_2 emissions (NAVFAC Public Affairs, 3/18/2008). New air conditioning chillers also installed at this installation will save another 252 MWh of electricity per year, equal to about 149 TPY of CO_2 emissions. Implementing similar energy conservation measures at Navy shore installations world-wide has substantially decreased the Navy's carbon footprint, and the Navy continues to identify new energy conservation measures.

Energy conservation aboard Navy vessels at sea also has achieved substantial reductions in fuel consumption, and thus emissions of GHG. Naval Sea Systems Command has established an Energy Conservation Awards Program to reward leading fuel conservers among underway surface ships with special recognition and cash incentives. During the first half of 2009, this program reduced the Navy's fuel consumption by about 682,000 barrels, or about 346,000 tons of CO_2 emissions (Navy News Service 5/14/2009).

The Navy also is researching and implementing new technologies that may result in substantial additional fuel savings. The new amphibious assault ship Makin Island, using a new hybrid power propulsion system, saved an estimated 900,000 gallons of fuel (equal to about 11,000 tons of CO_2) on its initial voyage from the Gulf of Mexico to San Diego. As new Navy ships are placed into service and older ships are retired, the overall fuel efficiency of the Navy's fleet will substantially increase.

The Navy also is investigating new hull-cleaning technologies that could substantially reduce drag from fouling of vessel hulls by marine organisms, potentially saving millions of gallons of fuel per year. Finally, the Navy has successfully tested the use of biofuels with camelina oil to power aircraft. The Green Hornet biofuel program is the first aviation test program to test and evaluate the performance of a 50/50 biofuel blend in supersonic (above mach 1) operations – a critical test point to successfully clear the F/A-18 E/F for biofuel operations through its entire flight envelope (NAVAIR 2010). Camelina jet biofuel produces 80 percent less carbon emissions than conventional jet fuels (Scientific American 2009).

These examples illustrate the Navy's leadership role in achieving large-scale energy reductions that will substantially contribute to a long-term national effort to mitigate global climate change.

4.2.2 Expended Materials

Cumulative impacts of expended materials on ocean resources would consist of the effects of the Proposed Action in combination with the other past, present, and future actions and activities listed in Sections 4.1.2 and 4.1.3 that would expend hazardous and nonhazardous materials in offshore areas of the GOA, or that would affect the regional hazardous waste management system.

4.2.2.1 Materials Expended in the GOA

The international waters offshore of the GOA are considered to be relatively pristine. Overall, the quality of offshore Pacific Ocean waters and bottom sediments offshore are relatively high, indicating that local releases of hazardous materials are generally not causing substantial adverse effects. There is no central point of contaminant discharge, but the intensity of ocean uses, and correspondingly the density of hazardous materials discharges, generally declines with increasing distance from the coast. Commercial ocean industries, such as fishing and ocean transport, are dispersed over broad areas of the Pacific Ocean. Ocean currents and sediment transport processes disperse the released materials over a large area.

Quantities of solid wastes and other manmade materials deposited in the GOA each year are expected to remain at about current levels. Fishing gear is likely the largest component of expended materials, and the intensity, duration, and geographic range of fishing activity in the GOA are unlikely to substantially increase, as discussed in Section 4.1.3. Commercial, scientific, and recreational vessel traffic are expected to increase substantially as a result of the projects described in Section 4.12 (e.g., port expansion, ferry service) and the regional processes and trends described in Section 4.13, but these ocean users typically do not discard large quantities of materials in the ocean. Coastal development (see Table 4-1) could increase deposition of manmade materials in coastal areas, but such materials are not likely to be transported into the GOA in substantial quantities. No hazardous materials or wastes are expected to be deposited in State or federal waters, in the absence of upset conditions such as a natural disaster, and deposition of hazardous materials or wastes in international waters of the GOA is expected to be

negligible. Most of the expended materials deposited in the GOA are denser than seawater and inert, and thus persist for long periods on the ocean bottom, but because of their inert character they have little effect on benthic organisms or resources. Entanglement from expended materials would not be likely and would not contribute to cumulative impact. Overall, the impacts on GOA ocean resources of manmade materials expended by past, present, and reasonably foreseeable actions, projects, and activities, including the Proposed Action, would not amount to a significant cumulative impact.

4.2.2.2 Hazardous Materials Management

The current and reasonably foreseeable projects and activities described in Sections 4.1.2 and 4.1.3 will result in increased numbers of aircraft and vessels in the GOA. The quantities of hazardous materials used and hazardous wastes generated by these activities, and subsequently sent to hazardous waste management facilities in the region, are anticipated to be relatively small. Construction of new infrastructure in coastal areas and expansion of port facilities (see Table 4-1) likely will generate substantial quantities of hazardous wastes requiring disposal. While the regional costs for hazardous waste transport, treatment, storage, and disposal could increase substantially in response to increased cumulative demand, the hazardous waste management industry generally has sufficient physical capacity to respond to this increased demand.

Navy vessels engaged in training activities under the Proposed Action would offload used hazardous materials to the Navy shore facilities at their home ports, where the used materials would become part of the overall hazardous waste stream managed by the appropriate Navy facility. Increased levels of training would result in increased throughput of hazardous wastes, but likely would not require additional storage, transport, or disposal facilities ashore for these materials. The Navy's hazardous waste management system and procedures are adequate to accommodate an increase in hazardous waste volumes. While the costs for hazardous waste transport, treatment, storage, and disposal could increase substantially in response to increased cumulative demand, the hazardous waste management industry generally has sufficient capacity to respond to this increased demand. Overall, the impacts on the GOA from release of hazardous wastes expended by past, present, and reasonably foreseeable actions, projects, and activities, including the Proposed Action, would not amount to a significant cumulative impact.

4.2.3 Water Resources

Cumulative impacts on water resources would consist of the effects of the Proposed Action in combination with other past, present, and reasonably foreseeable actions (as listed in Sections 4.1.2 and 4.1.3). Marine hydrology, marine water quality, deposition of sediment or debris, or public uses of State or federal waters could be affected by these actions and continuing activities, possibly to a significant degree.

Some of the major infrastructure projects planned for the region, such as the Knik Arm Crossing, Port MacKenzie development, Port of Anchorage expansion, and new ferry service (see Table 4-1) could affect ocean water quality near the coast. New coastal development could release urban pollutants, such as oils and grease, that would be flushed into coastal waters. As discussed in Section 4.1.3.3, however, such pollutants do not substantially affect the quality of ocean waters in the GOA because they are rapidly buried in coastal benthic sediments and upwelling of deep oceanic water diverts surface waters away from the GOA.

Anticipated future activities within the GOA, however, could affect water quality there. Expansion of oil and gas leases in the GOA could increase releases of petroleum products, heavy metals, and drilling muds. Increased commercial, scientific, and recreational vessel traffic, especially cruise ships, would increase releases of gray water and oil and grease. Compliance with federal and state regulations, where they apply, would limit the release of such pollutants to *de minimis* amounts. Concentrations of POPs originating from outside the GOA also would increase. These activities and processes are expected to

have cumulative but non-significant effects on ocean water quality. The degree of degradation in the foreseeable future is not anticipated to be substantial, except perhaps for ocean acidification (see Section 4.2.1.2), and GOA waters are expected to continue to be relatively pristine. The amounts of materials expended in the ocean by the Proposed Action would not alter these conditions, as described in Section 3.3.2. Therefore, impacts on ocean water resources from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.4 Acoustic Environment (Airborne)

Cumulative impacts on the acoustic environment would consist of the effects of the Proposed Action in combination with other past, present, and reasonably foreseeable actions (as listed in Sections 4.1.2 and 4.1.3). To the extent that the aggregate effects of these actions and activities increased long-term average or short-term peak sound levels in the GOA or otherwise resulted in long-term degradation of the acoustic environment of the GOA, those cumulative effects could be significant.

Environmental noise in the GOA primarily results from transportation and resource extraction activities. Aircraft noise that exceeds background sound levels typically occurs under airport approach / departure corridors and under air traffic patterns near an airfield. As aircraft gain altitude, their noise contribution at ground level decreases, eventually merging with the background noise level. Commercial airliners and private planes traversing the GOA at a cruise altitude generally are not audible at the surface. Therefore, these sources can be excluded from the cumulative acoustic environment analysis.

Commercial ship traffic and fishing activities contribute occasional, short-term noise in the GOA. The airborne sounds they generate include steady low- to moderate-level passby noise, which from the standpoint of a fixed observer is a short-term event, and occasional short-term intrusive noise events in different locations at different times. In a region as large as the GOA, vessels do not often pass near each other, so these noise events seldom overlap in time or location. Thus, these discrete noise events generally are not additive, and produce no cumulative effect.

The intensity and geographical extent of fishing activities are expected to remain about the same for the foreseeable future, as discussed in Section 4.1.3. The projects described in Section 4.1.2 (e.g., port development and expansion); however, are expected to increase vessel traffic in the GOA, and commercial vessel traffic is generally expected to increase over time (see Section 4.1.3.2). Numbers of low-flying commercial and private aircraft (e.g., small planes, fish spotters, whale watchers) are expected to increase, as described in Section 4.1.3.5. The Proposed Action also would increase the numbers of intrusive noise events in the GOA. This generally more-intense use of the GOA during the six-week window for the Proposed Action is expected to increase the number of intrusive noise events during each three-week event and the potential for two or more sound events to overlap. Because the GOA is a very large geographic area and vessels and aircraft are not often near each other, the potential for overlapping sound events would remain low. Peak and average noise levels at a specific location would remain largely unchanged. Therefore, impacts on marine noise environment from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.5 Marine Plants and Invertebrates

The GOA is among the world's most productive marine regions, supporting large and relatively healthy populations of phytoplankton, zooplankton, and commercially valuable pelagic and benthic invertebrates. At present, water quality is relatively high which supports the productivity of the GOA region.

Cumulative projects and processes affecting future marine conditions in the GOA (see Sections 4.1.2 and 4.1.3) include increased vessel traffic as a result of port development (see Table 4-1) and increased resident populations; increased runoff of sediments and urban pollutants from new coastal development (see Table 4-1); and continuing seabed damage, water pollution, deposition of debris, and underwater noise from fishing and other vessel operations. Future climate change is expected to increase average ocean water temperature, increase CO_2 concentrations, and increase acidity. Potential effects on marine plants and invertebrates in the GOA include long-term changes in species abundance or diversity, loss or degradation of sensitive habitats, and adverse effects to rare species. In addition, marine invertebrates may experience direct mortality or injury from commercial fishing operations or other resource extraction industries (e.g., oil and gas development). Plant and invertebrate populations may both experience long-term changes in abundance and diversity as a result of climate change and ocean acidification. Cumulative effects on marine plants and invertebrates are expected to be less than significant in the foreseeable future.

The Proposed Action was evaluated for long-term effects on marine communities that would result from explosions based on their force, location, and proximity to the bottom. Based on the short duration of annual training activities and the analysis presented in Section 3.5, the Proposed Action would not result in long-term changes in species abundance or diversity, loss or degradation of sensitive habitats, or effects on threatened and endangered species. The Proposed Action would not affect the sustainability of marine resources, the regional ecosystem, or the human community. Therefore, impacts on marine plants and invertebrates from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.6 Fish

The GOA is a highly productive region for various fish populations, largely as a result of a rich population of microscopic organisms that form the basis of the food chain. The GOA also is an important spawning area for many fish species, supporting a diverse array of fish larvae. The fish fauna in offshore portions of the GOA is dominated by large epipelagic species, and offshore areas provide the principal feeding habitat for many species.

Current and anticipated future projects and ongoing processes in the GOA region, particularly port development and new coastal development, as described in Table 4-1, and general population growth in Alaska, would increase vessel traffic through the GOA. Increased vessel traffic would, in turn, incrementally increase marine pollution, including the frequency and extent of underwater noise. Coastal development could increase the amount of sediments and urban pollutants released into coastal waters but, due to the circulation patterns of the GOA, such releases probably would not affect water quality in the GOA. Ongoing commercial fishing operations would affect commercially valuable fish species and ongoing recreational fishing could affect populations of game fish, although proper management of these industries would prevent any substantial declines in fish populations. Ocean bottom disturbance and damage from fish trawls would continue; recovery of these areas is very gradual, so degradation of the ocean floor and attendant loss of habitat for some fish species is cumulative within the foreseeable future. Climate change and ocean acidification (see Section 4.2.1.2) may alter prey abundance and distribution, or alter the distribution and abundance of competitors and predators. With the possible exception of climate change and ocean acidification, the long-term effects of which are not well understood, the cumulative impacts of past, present, and reasonably foreseeable projects and processes in the GOA would be less than significant.

Potential contributions of Navy training exercises to cumulative impacts on fish include releases of chemicals into the ocean, introduction of military expended materials into the water column and onto the seafloor, mortality and injury of marine organisms and fish near the detonation or impact point of ordnance or explosives, and physical and acoustic impacts of vessel activity (disturbance and collisions).

Based on the short duration of the Proposed Action and the analysis provided in Section 3.6 of the EIS/OEIS, impacts on fish from explosions may result in injury or mortality to individual fish but would not result in significant impacts to fish populations.

Disturbance of the water column would be short-term and local, while disturbance of benthic habitats would be unlikely due to the water depths where training activities occur. As described in Section 3.6, habitat disturbance, fish injury, and mortality from explosions are reduced by Navy mitigation measures. For this reason, there would be no adverse effects to Habitat Areas of Particular Concern (HAPC) by avoidance with these areas for SINKEX activities. Activities would not adversely affect fish populations or EFH as defined under the MSFCMA. However, activities may affect threatened and endangered species. The overall contribution of the Proposed Action to cumulative impacts on fish stocks in the GOA would not be a significant cumulative impact because no long-term changes in species abundance or diversity and no loss or degradation of sensitive or critical habitats are anticipated.

4.2.7 Sea Turtles

The only species of sea turtle expected to occur regularly in the GOA is the leatherback turtle, which is globally distributed, although likely low in number in the GOA. Adult leatherbacks can tolerate a wide range of water temperatures, and have been sighted along the west coast of the United States as far north as the GOA. Leatherback turtles appear to forage in the GOA in limited numbers, but no nesting grounds are located in the region. Leatherback turtles are endangered throughout their range (National Oceanic and Atmospheric Administration [NOAA] 2007).

Leatherback turtle populations can be affected both directly and indirectly by human activities. Incidental "take" in fishing operations, or bycatch, is one of the most serious direct threats to sea turtle populations. In the Pacific, NMFS requires measures (e.g., gear modifications, changes to fishing practices, and time/area closures) to reduce sea turtle bycatch in the Hawaii- and California-based pelagic longline fisheries and the California/Oregon drift gillnet fishery. In 2000, an estimated 50,000 leatherbacks were incidentally taken worldwide as pelagic longline bycatch (Lewison et al. 2004).

Sea turtles also can ingest marine debris or become entangled in debris (e.g., tar balls, plastic bags, plastic pellets, balloons, and ghost fishing gear). Marine pollution from coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased underwater noise, and boat traffic can also degrade marine habitats used by sea turtles. In addition, sea turtles swimming or feeding at or just beneath the surface of the water are vulnerable to boat and vessel strikes, which can result in serious propeller injuries and death. Global warming could affect all aspects of a leatherback turtle's life cycle, as well as the abundance and distribution of its prey.

Current and anticipated future projects that increased the volume of vessel traffic (see Table 4-1) and ongoing processes that increased the volume of marine vessel traffic (see Sections 4.1.3.1, 4.1.3.2, and 4.1.3.4) would increase the potential for vessel strikes and increase the volume of marine debris. Bycatch from fishing operations would not change substantially because the intensity and extent of fishing operations in the GOA are not expected to change, as discussed in Section 4.1.3.1. Marine pollution, including the frequency and intensity of underwater noise, is expected to increase in response to increased vessel traffic and increased coastal development. The effects of the Exxon Valdez spill are still ongoing and are continually being restored through work with the Exxon Valdez Oil Spill Trustee Council (Table 4-1). Climate change (see Section 4.2.1.2) may alter prey abundance and distribution, or alter the distribution and abundance of competitors and predators. These anticipated future conditions are generally not expected to substantially affect the level of foraging by leatherback turtles in the GOA, although climate change may result in a northward expansion of sea turtle foraging activity. Therefore, impacts on sea turtles from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.8 Marine Mammals

During the past few decades, marine mammal mortalities have increased in association with a variety of human activities (Geraci et al. 1999, NMFS 2007a) (Figure 4-1). These activities include fisheries interactions (bycatch, directed catch), ship strikes (Laist et al., 2001) pollution (marine debris, toxic compounds), habitat modification (degradation, prey reduction), and gunshots. Other concerns include entanglement, underwater noise, and climate change, and associated changes in the physical characteristics and chemistry of marine waters, and other environmental factors. Potential cumulative impacts of past, present, and reasonably foreseeable future projects and activities (Sections 4.1.2 and 4.1.3) on marine mammals would result primarily from increased commercial and recreational vessel traffic (underwater noise, ship strikes, air and water pollutants), as discussed in Table 4.1 and Section 4.1.3.2, and ongoing commercial fishing (bycatch, entanglement, prey reduction, marine debris, and habitat degradation), as discussed in Section 4.1.3.1.

4.2.8.1 Fisheries Interaction: By-Catch, Directed Catch, and Entanglement

The incidental catch of marine mammals in commercial fisheries is a significant threat to the survival and recovery of many populations of marine mammals (Geraci et al. 1999, Baird et al. 2002, Culik 2002, Carretta et al. 2004, Geraci and Lounsbury 2005, NMFS 2007a). Interactions with fisheries and entanglement in discarded or lost gear continue to be a major factor in marine mammal deaths worldwide (Geraci et al. 1999, Nieri et al. 1999, Geraci and Lounsbury 2005, Read et al. 2006, Zeeberg et al. 2006). For instance, baleen whales and pinnipeds have been found entangled in nets, ropes, monofilament line, and other fishing gear that has been discarded out at sea (Geraci et al. 1999, Campagna et al. 2007).

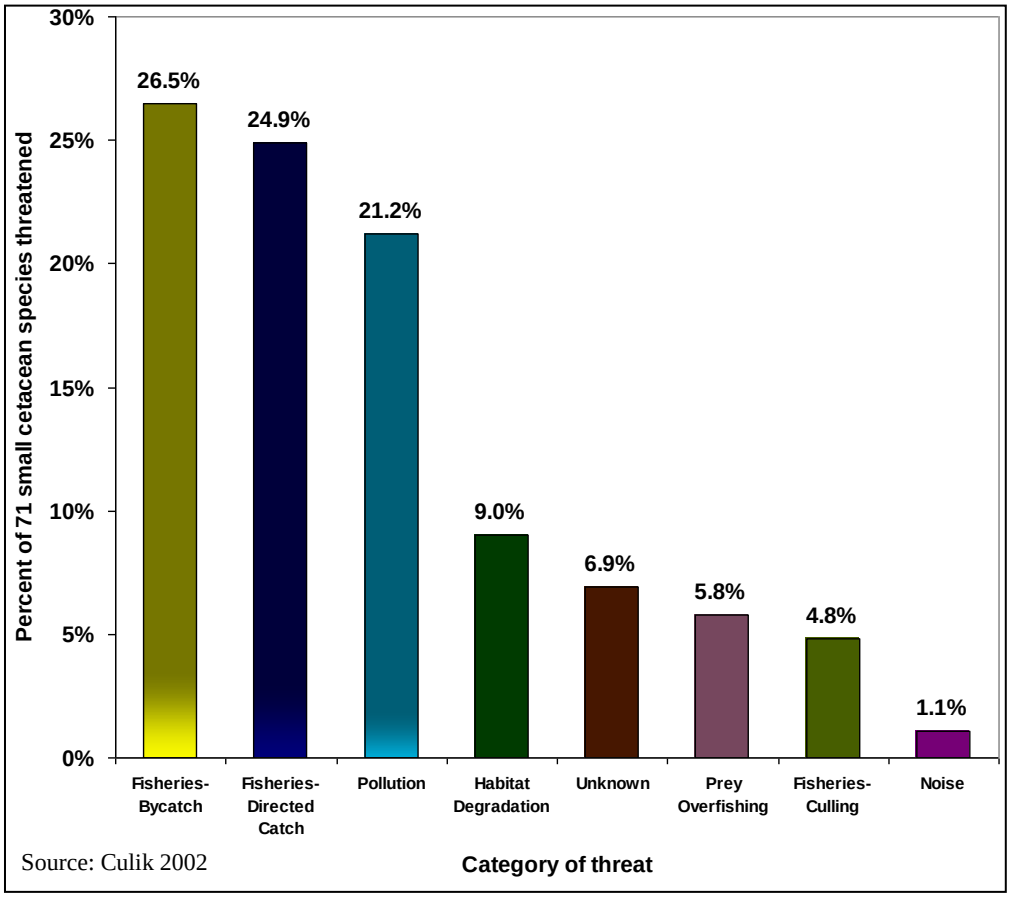

Figure 4-1: Human Threats to World-wide Small Cetacean Populations

Bycatch- Bycatch is the catching of non-target species within a given fishing operation and can include non-commercially used invertebrates, fish, sea turtles, birds, and marine mammals (NRC 2006). Read et al. (2006) attempted to estimate the magnitude of marine mammal bycatch in U.S. and global fisheries. Within U.S. fisheries, between 1990 and 1999, the mean annual bycatch of marine mammals was 6,215 animals. Eighty-four percent of cetacean bycatch occurred in gill-net fisheries, with dolphins and porpoises constituting most of the cetacean bycatch (Read et al. 2006). Over the last decade marine mammal bycatch declined by 40 percent, primarily in response to conservation measures that were implemented during this period. Based on the mature state (minimal growth) of the Alaskan fishing industry and the continuing implementation of conservation measures, the amount of marine mammal bycatch associated with commercial fishing in the GOA is expected to remain steady or decline slightly in the future. The Proposed Action would have no direct or indirect effects on the level of fisheries bycatch in the GOA.

Entanglement- Entanglement in active fishing gear is a major cause of death or severe injury among the whale species in the GOA. Entangled marine mammals may drown, escape with pieces of gear still attached to their bodies, or be set free either by their own efforts or by fishermen. Many large whales carry off fishing gear after becoming entangled (Read et al. 2006). When a marine mammal swims off with gear attached, the result can be fatal. The gear may be too cumbersome for the animal or it may be wrapped around a crucial body part and tighten over time. Stranded marine mammals frequently exhibit signs of previous fishery interaction, such as scarring or gear attached to their bodies. Deaths of stranded marine mammals often are attributed to such interactions (Baird and Gorgone 2005). Marine mammals that die from fisheries interactions may not wash ashore and not all animals that do wash ashore exhibit clear signs of interactions, so data probably underestimate fishery-related mortality and serious injury (NMFS 2005).

From 1998-2005, based on observer records, five fin whales (CA/OR/WA stock), 12 humpback whales (ENP stock), and six sperm whales (CA/OR/WA stock) were either seriously injured or killed in fisheries off the west coast of the United States (California Marine Mammal Stranding Network Database 2006). Reported entanglements thus average about three whales per year for the entire west coast. As discussed in Section 3.8.3.3, according to the July 2007 NMFS Pacific Islands Region Marine Mammal Response Network Activity Update, there were reports of 26 distressed marine mammals in Hawaii found entangled in fishing gear for the 6-month period from November to April 2007. Based on the type of fishing gear, some of these animals were entangled during the Alaska portion of their annual migration cycle. Additional information on fishery interactions in Alaska specific to each species is presented in Section 3.8 (for general information see http://www.fakr.noaa.gov/protectedresources/strandings.htm and Appendix F).

Fishing practices are unlikely to change substantially in the foreseeable future, so this source of whale injury and mortality is expected to remain about the same for the foreseeable future. The Proposed Action would have no direct or indirect effects on the level of marine mammal entanglements in the GOA.

As discussed in Section 3.8, parachutes associated with expendable materials, such as sonobuoys, are weighted and designed to sink after landing in the water; therefore, the period of time in which entanglement is possible is limited. They do not create the type of entanglement hazard resulting from the use of fishing gear involving a line connected to a recovery float at the surface. Entanglement from parachutes would not be likely and would not contribute to cumulative impacts.

4.2.8.2 Ship Strikes

Ship strikes of marine mammals are another cause of mortality and stranding (Laist et al. 2001, Geraci and Lounsbury 2005, de Stephanis and Urquiola 2006). An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or an animal just below the surface could

be cut by a vessel's propeller. The severity of injuries typically depends on the size and speed of the vessel and the size of the animal (Knowlton and Kraus 2001, Laist et al. 2001, Vanderlaan and Taggart 2007).

While there are reports and statistics of whales struck by vessels in U.S. waters, the magnitude of the risks that commercial ship traffic poses to marine mammal populations is difficult to quantify or estimate. In addition, information on vessel strike interactions between ships and marine mammals outside of U.S. waters is limited (de Stephanis and Urquiola 2006). Laist et al. (2001) concluded that ship collisions may have a negligible effect on marine mammal populations, except for small regional populations or population segments where the relative significance of a few collisions would be greater.

Commercial ports and associated commercial vessel traffic have grown as a result of the globalization of trade. The Final Report of the NOAA International Symposium on "Shipping Noise and Marine Mammals: A Forum for Science, Management, and Technology" stated that the worldwide commercial fleet has grown from approximately 30,000 vessels in 1950 to over 85,000 vessels in 1998 (NRC 2003, Southall 2005). Current statistics support the prediction that the international shipping fleet will continue to grow at the current rate or at greater rates in the future. Shipping densities in specific areas and trends in routing and vessel design are as significant, or more significant, than the total number of vessels. Densities along existing domestic and international coastal routes are expected to increase. New routes are also expected to develop as new ports are opened and existing ports are expanded. New vessel propulsion systems are also advancing toward faster ships operating in higher sea states at lower costs; and container ships are expected to become larger along certain routes (Southall 2005).

Among the regional projects identified in Section 4.1.2 are developments at Port MacKenzie and at the Port of Anchorage, both of which are expected to increase the amount of commercial vessel traffic in the GOA. Ferry service and cruise ship traffic also are expected to increase, and new oil and gas developments also may encourage additional vessel traffic in the GOA. The numbers and sizes of fishing vessels operating in the GOA are expected to remain about the same as at present. The cumulative effect of these projects and trends is expected to be a moderate increase in large commercial vessel traffic in the GOA in the foreseeable future.

As discussed in Section 3.8, regulations governing the approach to humpback whales in Alaska were promulgated in 2001 to manage the threat caused by whale watching activities (NOAA 2001). Available data on ship strikes in Alaska waters presented in an unpublished preliminary summary indicates 60 recorded collisions between vessels and humpback whales (two additional involved a sperm and a gray whale; Gabriele et al., manuscript on file). None of these recorded collisions involved Navy vessels. Nine ship strikes were implicated in mortality or serious injuries of humpback whales between 2001 and 2005; seven of these ship strikes occurred in Southeast Alaska and two occurred in the northern portion of the Central North Pacific's range (Angliss and Allen 2008). Additional information on ship strikes in Alaska specific to each species is presented in Section 3.8. For general information involving ship strikes in Alaska, see http://www.fakr.noaa.gov/protectedresources/strandings.htm and Appendix F.

Ship strikes on marine mammals in the future are expected to increase in rough proportion to the increased volume of ship traffic and an increase in the average speed of these vessels. Based on the most recent scientific information, however, the cumulative impact of ship strikes on marine mammal populations in the GOA is unlikely to be significant (Laist et al. 2001).

U.S. Navy vessel traffic is a small fraction of the commercial and recreational vessel traffic in the GOA. While U.S. Navy vessel movements may incrementally contribute to the ship strike threat, given the lookout and mitigation measures adopted by the U.S. Navy, the probability of vessel strikes is greatly reduced. Furthermore, actions to avoid close interaction of U.S. Navy ships and marine mammals, such as maneuvering to avoid any observed marine mammal are part of existing at-sea protocols and standard

operating procedures. Navy ships have up to three or more dedicated and trained lookouts as well as two to three bridge watchstanders during at-sea movements who would be searching for any whales or other obstacles on the water surface. Such lookouts are expected to further reduce the chances of a collision. Accordingly, impacts on marine mammals by ship strikes from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

Ingestion of Plastic Objects and Other Marine Debris and Toxic Pollution Exposure

Ingestion. For many marine mammals, debris is a great hazard. Not only is debris a hazard because of possible entanglement, but animals may mistake plastics and other debris for food (NMFS 2007b). Sperm whales have been known to ingest plastic debris, such as plastic bags (Evans et al. 2003, Whitehead 2003). While ingestion has led to mortality, the scale on which ingestion affects sperm whale populations is unknown, but Whitehead (2003) suspects it is not substantial at this time. The cumulative effect of the projects identified in Section 4.1.2 and the trends and processes described in Section 4.1.3 probably would be a minor increase in the levels of marine debris present in the GOA, and thus a minor increase in the instances of ingestion of marine debris by marine mammals. Given that this source of marine mammal mortality is not now substantial, and assuming a minor increase, then ingestion of marine debris is not expected to be a substantial source of marine mammal mortality in the future. Furthermore, the limited annual duration of Navy training activities in the GOA under the Proposed Action and Navy afloat procedures would assure that the Navy's contribution to cumulative marine debris pollution would be negligible (see Section 3.3.1.2 and Table 3.3-1 in Water Resources).

Toxic Pollution. High concentrations of potentially toxic substances within marine mammals, along with an increase in new diseases, have been documented in recent years. Scientists are considering possible links between pollutants and marine mammal mortality. The manmade chemicals called polychlorinated biphenyls (PCBs) and the pesticide dichlorodiphyenyltrichloroethane (DDT), for example, are both considered persistent organic pollutants; they are banned in the United States because of their harmful effects in wildlife and humans (NMFS 2007c). Despite having been banned for decades, the levels of these compounds in marine mammal tissue samples taken along U.S. coasts are still high (Hickie et al. 2007, Krahn et al. 2007, NMFS 2007c). Both compounds are long-lasting, reside in marine mammal fat tissues (especially in the blubber), are carcinogenic, and can have toxic effects such as reproductive impairment and immunosuppression (NMFS 2007c).

The effects of toxic pollutants on marine mammals are difficult to measure. However, some researchers have correlated contaminant exposure with possible adverse health effects in marine mammals (Borell 1993, O'Shea and Brownell 1994, O'Hara and Rice 1996, O'Hara et al. 1999). In addition to direct effects, marine mammals are indirectly affected by habitat contamination that degrades prey species availability or that increases disease susceptibility (Geraci et al. 1999). Vessel traffic and commercial fishing both contribute incrementally to marine pollution in the GOA through deliberate discharges of allowable wastes and byproducts, incidental and accidental discharges of petroleum products, and equipment and materials losses. Based on the projects and processes identified in Sections 4.1.2 and 4.1.3, a moderate increase is anticipated in the levels of toxic pollutants in the GOA in the foreseeable future. Thus, the cumulative impact would be less than significant.

U.S. Navy vessel operations in the GOA could release small amounts of pollutants into the water column. U.S. Navy vessels are not a typical source, however, of contaminants with bioaccumulation potential such as pesticides and PCBs. Before engaging in a SINKEX activity, the Navy must conduct an inventory of each SINKEX vessel to ascertain the presence of PCBs. This inventory and list of items removed prior to sinking must be provided to USEPA in the annual report that is required by the MPRSA permit. Furthermore, any vessel discharges associated with the vessels, such as bilge water and deck runoff, would be in accordance with international and U.S. requirements for eliminating or minimizing

discharges of oil, garbage, and other substances. Therefore, impacts on marine mammals by ingestion of plastic, military expended materials, marine debris, or toxic exposure from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.8.3 Anthropogenic Sound

Many marine mammals use sound to communicate, navigate, locate prey, and sense their environment. Underwater anthropogenic sound may interfere with these functions, although comprehension of the type and magnitude of any behavioral or physiological responses resulting from man-made sound, and how these responses may contribute to strandings, is rudimentary at best (NMFS 2007d). Marine mammals may respond both behaviorally and physiologically to anthropogenic sound exposure (e.g., Richardson et al. 1995, Finneran et al. 2000, Finneran et al. 2003, Finneran et al. 2005). However, the range and magnitude of the behavioral responses of marine mammals to various sound sources is highly variable (Richardson et al.,1995), and appears to depend on the species involved, the experience of the animal with the sound source, the motivation of the animal (e.g., feeding, mating), and the context of the exposure.

Marine mammals are regularly exposed to several sources of natural and anthropogenic sounds. Anthropogenic noise sources that could affect ambient noise levels arise from several types of activities in or near the ocean, any combination of which can contribute to the total noise level at any one place and time. These noise sources include: transportation; dredging; construction; oil, gas, and mineral exploration; geophysical (seismic) surveys; sonar; explosions; and ocean research (Richardson et al. 1995). Commercial fishing vessels, cruise ships, transport and recreational boats, and aircraft all generate underwater sound in the ocean (NRC 2003; NRC 2006). Several investigators have argued that anthropogenic sources of noise have increased ambient noise levels in the ocean over the last 50 years (NRC 1994, 2003, 2005; Richardson et al. 1995; Jasny et al. 2005; McDonald et al. 2006). Much of this increase is due to increased shipping because ships are becoming more numerous and of larger tonnage (NRC 2003, McDonald et al. 2006). Andrew et al. (2002) compared ocean ambient sound levels from the 1960s with those from the 1990s for a receiver off the California coast. The data showed an increase in ambient noise of approximately 10 decibel (dB) in the frequency range of 20 to 80 Hertz (Hz) and 200 and 300 Hz, and about 3 dB at 100 Hz over a 33-year period.

Sound emitted by large vessels, particularly during transit, is the principal source of noise in the ocean today, primarily due to the properties of sound emitted by civilian cargo vessels (Richardson et al. 1995, Arveson and Vendittis 2000). Ship propulsion and electric generation engines, engine gearing, compressors, bilge and ballast pumps, as well as hydrodynamic flow around a ship's hull and any hull protrusions, contribute to a large vessels' underwater noise emissions. Propeller-driven vessels also generate noise through cavitation, which accounts for much of the noise emitted by a large vessel and which is related to its speed. Military vessels underway or involved in naval activities or exercises also generate anthropogenic noise in the marine environment. Noise emitted by large vessels is low-frequency, continuous, and tonal. The sound pressure levels around the vessel vary according to its speed, burden, capacity, and length (Richardson et al. 1995, Arveson and Vendittis,2000). Vessels ranging from 135 to 337 meters generate peak sound levels of 169 - 200 dB between 8 Hz and 430 Hz, although Arveson and Vendittis (2000) documented components of higher frequencies (10-30 kHz) as a function of newer merchant ship engines and higher speeds. Given the propagation of low-frequency sounds, a large vessel in this sound range can be heard 139-463 kilometers away (Ross 1976 in Polefka 2004). U.S. Navy vessels, however, have incorporated significant underwater ship-quieting technology to reduce their acoustic signature, compared to a vessel of similar size, thus reducing their vulnerability to detection by enemy passive acoustics (Southall 2005).

As noted in Section 4.1.3.2, commercial and recreational vessel traffic in the GOA are expected to increase moderately in the foreseeable future, and underwater noise levels associated with vessel transits are expected to increase in rough proportion to this increase. Fishing vessel traffic in the GOA is expected to remain about the same as at present, although the average size and speed of fishing vessels may change over time. Oil and gas development, especially exploration, could be a substantial new source of underwater noise in the GOA, but this activity is expected to occur primarily along the northern and western margins of the GOA on the continental shelf. Overall, the level and geographic range of underwater noise in the GOA are expected to increase in the future in response to past, present, and reasonably foreseeable projects and processes, including the Proposed Action, but this cumulative increase would be less than significant.

Navy vessels would be present in the GOA for a small portion of the year under the Proposed Action, and thus their contribution to cumulative ship noise would be insignificant. As noted above, U.S. Navy vessels have underwater ship-quieting technology that reduces their acoustic signature compared to vessels of similar size, further reducing their contribution to cumulative underwater noise impacts. Naval sonars would operate in a limited number of areas, as discussed in Section 3.8, and most likely would not contribute substantially to underwater noise levels in the GOA. Modeling of atmospheric and underwater ordnance detonations for the Proposed Action (Section 3.8) indicated that few marine mammals, if any, would be exposed to underwater noise from these sources. In summary, impacts of underwater sound from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.8.4 Climate Change

The effect of large-scale climatic changes on the world's oceans, and how these changes impact marine mammals and influence strandings, are difficult to quantify, given the broad spatial and temporal scales involved and the cryptic movement patterns of marine mammals (Moore 2005; Learmonth et al. 2006). The most immediate, although indirect, effect would be decreased prey availability during unusual conditions. This, in turn, would result in increased search effort required by marine mammals (Crocker et al. 2006), potential starvation, and corresponding stranding due directly to starvation, disease, or predation while in a weakened or stressed state (Selzer and Payne 1988, Geraci et al. 1999, Moore 2005, Learmonth et al. 2006, Weise et al. 2006). Future changes in climate and ocean acidification resulting from human development and natural processes are likely to be cumulatively significant, based on current projections by the U.S. government. As discussed in Section 3.1, however, the contribution of the Proposed Action to this cumulative impact would be negligible.

4.2.8.5 Summary

Cumulative impacts on marine mammals from past, present, and reasonably foreseeable projects, processes, and trends would result primarily from climate change and fisheries interactions, with ship strikes, ingestion of and entanglement by marine debris, military expended materials, effects of toxic pollutants, and underwater noise all minor sources of impacts. The Proposed Action would not contribute to fisheries interactions, and its contributions to future ship strikes, ingestion of marine debris, military expended materials, health effects of marine pollutants, and climate change would be negligible. The Proposed Action would contribute minimally to cumulative increases in underwater sound in the GOA. Overall, impacts on marine mammals from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.9 Seabirds

Seabird populations within the GOA are affected by direct and indirect perturbations of breeding and foraging habitat on the coastal mainland and inshore islands. The single greatest concern is the loss of

suitable habitat for nesting and roosting seabirds throughout the coastal northwest due to land development and human encroachment. Historically, seabird populations have sustained numerous impacts from pollution and human activities within the GOA from a variety of sources, including the discharge of hazardous chemicals and sewage. Seabird populations in the GOA have become more susceptible to impacts due to their increased concentration. Large-scale effects on seabird populations such as global warming, reduced fish populations, and development in other regions or countries are not well defined for individual species but have been cited as contributing to the overall decline of seabirds.

Past, present and reasonably foreseeable future actions discussed in Section 4.1.2 (vessel traffic from port development, coastal development) and other activities described in Section 4.1.3 (increased commercial and recreational vessel traffic), together with the Proposed Action, would elevate the potential for direct and indirect impacts on seabirds, including the short-tailed albatross (a species listed under the federal Endangered Species Act). Increased vessel and low-flying aircraft traffic would result in a greater level of day-to-day disturbance of seabirds and interference with foraging activities. Increased ocean pollution could degrade the health of seabirds through direct exposure and through ingestion of trash or contaminated prey. New coastal development (see Table 4-1) would decrease lands available for seabird nesting and roosting. The cumulative effects of increased disturbance, decreased health, and decreased terrestrial habitat on seabird populations would be adverse, but less than significant. Therefore, impacts on seabird habitat from implementation of the Proposed Action (the Proposed Action would not directly affect land areas), in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.10 Cultural Resources

Consultation with the Alaska SHPO was conducted during the preparation of the *Alaska MOA EIS* and the *Transformation of U.S. Army Alaska FEIS*. Based on the previous consultations, no further analysis of prehistoric and historic archaeological resources on land is required.

Underwater archaeological resources are submerged sites that may have a cultural affiliation. This type of site includes shallow water or nearshore prehistoric or historic sites or isolated artifacts, historic shipwrecks, airplanes, or pieces of ship components, such as cannons or guns. Ship and aircraft wrecks are the only potential cultural resource of concern in the open ocean portions of the GOA. There are no known prehistoric or historic archaeological resources, architectural resources, or traditional cultural properties within the GOA.

Cumulative impacts on cultural resources would consist of the effects of the Proposed Action in combination with other cumulative actions and processes (as listed in Sections 4.1.2 and 4.1.3), that would affect shipwrecks and associated open ocean-bottom resources. Of the cumulative projects and activities identified in the GOA, only fish trawling could have such an effect. Trawling for bottom fish and invertebrates in the GOA is a widespread and long-standing practice. Bottom trawling and anchoring can damage benthic habitat and therefore disturb shipwrecks on the ocean floor (USDC, NOAA 2005; NOAA, NMFS 2006). Bottom trawling is conducted in many unprotected areas within the GOA and will continue for the foreseeable future.

The analysis presented determined that the Proposed Action would have no potential to affect underwater cultural resources on the floor of the ocean. In accordance with Section 106 of the NHPA, the Navy entered into consultation with the Alaska SHPO. On May 18, 2010, the Alaska SHPO signed a letter indicating concurrence with the Navy's analysis that the Proposed Action would not affect submerged cultural resources (see correspondence in Appendix C). Therefore, impacts on cultural resources from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.11 Transportation and Circulation

Cumulative impacts on airspace and marine traffic would consist of the effects of the Proposed Action in combination with other past, present, and reasonably foreseeable actions and processes (Sections 4.1.2 and 4.1.3) that would increase air and marine traffic volumes or conflicts within the GOA region. As discussed in Section 4.1.3.2, marine vessel traffic is expected to increase. As discussed in Section 4.1.3.5, commercial air traffic is expected to increase. Specific projects that would contribute to these general processes include port development, new ferry service, helicopter transits, and new bridge crossings (see Table 4-1).

At present, commercial air traffic through the TMAA is minimal, and this situation is not expected to change substantially in the future as a result of other projects and processes (e.g., growth in commercial airliner traffic, fish spotting aircraft, and oil and gas development. Airspace within the TMAA is only restricted by the Navy during hazardous training activities (a maximum of 42 days per year); these activities are coordinated with the FAA, and Notices to Airmen (NOTAMs) are issued. Aircraft in the vicinity are required to detour around the training area, and adjacent air corridors may experience more intense use. When hazardous activities occur on the inland ranges, military flight plans are coordinated with Anchorage and Fairbanks Air Route Traffic Control Center (ARTCC). Coordination with the FAA on matters affecting airspace and adherence to established operating rules within and around Special Use Airspace reduces or eliminates the possibility of indirect adverse impacts and associated cumulative impacts on civil aviation and airspace use. Thus, cumulative impacts on air transportation are expected to be less than significant.

Vessel traffic through the TMAA (other than fishing boats, which are addressed in Sections 3.6 and 3.11 Fish and Transportation and Circulation respectively) consists primarily of cargo vessels and tankers; whale-watching boats, cruise ships, and other vessel traffic in the GOA mostly use coastal areas outside of the TMAA. For hazardous training activities in the TMAA or W-612, the Navy issues a NOTMAR to notify non-participants to avoid the affected area. Regarding the PUTR, the installation is temporary (to be recovered once training is complete); therefore, no formal restricted areas would be designated and no limitations would be placed on commercial or civilian use of the area, thus limiting impacts to marine traffic. Although the resultant detours for cargo or tanker vessels traversing the TMAA may be inconvenient, they do not preclude the affected vessels from reaching their destinations.

Other current, planned, and reasonably foreseeable projects and processes in the GOA are not expected to have a substantial effect on vessel traffic and circulation. The volume of cargo vessels traversing the GOA is expected to increase moderately, while the volume of tanker traffic is not expected to change substantially. For hazardous training activities in the TMAA or W-612, the Navy would continue to issue NOTMARs. With cumulative increases in vessel traffic, the numbers of vessels detouring around the TMAA would increase, but the affected vessels would not be prevented from reaching their destinations. Thus, impacts on marine transportation from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.12 Socioeconomics

The economy of the coastal communities is based on commercial fishing of pink and red salmon, fish processing, timber, minerals, agriculture and tourism. Current socioeconomic conditions in the GOA primarily are associated with fishing. Several native communities in Alaska rely on the harvesting of marine resources (fish, shellfish, marine mammals, birds) for subsistence. Tourism also is a socioeconomic factor in the area, but tourism activities mostly occur in coastal waters. Vessels and aircraft transiting across the GOA value it as a relatively short, unimpeded route between source and destination; disruption or displacement of this traffic would incrementally increase operating costs for the

transportation industry. The area has some potential for oil and gas development, primarily on the continental shelves on its northern and western margins. Fishing in the GOA is a mature industry with little remaining potential for substantial growth, and the possibility exists that one or more major fisheries will be further restricted in the future to protect fish stocks from overfishing.

Several native communities in Alaska rely for their subsistence on the harvesting of marine resources (fish, shellfish, marine mammals, birds). The economy of the coastal communities is based on commercial fishing of pink and red salmon, fish processing, timber, minerals, agriculture and tourism. Shellfish fisheries developed in the 1960s in the Gulf of Alaska (see Our Living Oceans [NMFS 1999]).

Cumulative impacts on socioeconomics would consist of the effects of the Proposed Action in combination with other past, present, and reasonably foreseeable future actions and processes that would significantly affect regional employment, income, housing, or infrastructure. Port development and coastal development (see Table 4-1) would contribute to long-term economic growth. Increased marine vessel traffic (Section 4.1.3.2) and commercial air traffic (Section 4.1.3.5) would incrementally increase regional employment. Employment and income could be substantially affected by changes in fishing or tourism activities, or development of other resource extraction industries (e.g., oil and gas). Based on the socioeconomic resources available and sectors represented in the GOA, no direct cumulative impacts on housing or infrastructure are expected, although declines in employment and income could indirectly affect housing demand or funding for infrastructure projects.

Implementation of the Proposed Action alone would not produce any significant regional employment, income, housing, or infrastructure impacts. Effects on commercial and recreational fishermen, and boaters would be short-term and would produce some temporary access limitations. Some activities in the TMAA, especially if coincident with peak fishing locations and periods, could cause temporary displacement of and potential economic loss to individual fishermen. However, most activities within the TMAA are short in duration and have a small operational footprint. Effects on fishermen are mitigated by a series of Navy initiatives, including public notification of scheduled activities, near-real time schedule updates, prompt notification of schedule changes, and adjustment of hazardous activities areas. In selected instances where safety requires exclusive use of a specific area, fishermen may be asked to relocate to a safer nearby area for the duration of the activity. These measures would not have a noticeable effect on any individual fisherman, overall commercial revenue, or public recreational opportunities.

Implementation of the PUTR under the Proposed Action would require the Navy to issue a NOTMAR to limit the possibility of any interactions with fishing activities that could damage or disturb the sensors. If, as a part of complying with the NOTMAR, fishing activities are voluntarily shifted to a different area, this could place an economic hardship on commercial fishing enterprises if the range is deployed in a viable fishing area. However, the Navy will, to the maximum extent practicable, avoid commercially viable fishing areas when placing the PUTR.

Other current, planned, and reasonably foreseeable projects and processes would have little effect on socioeconomic conditions in the GOA. The fishing industry is not expected to change substantially (see Section 4.1.3.1). An expected moderate increase in cargo vessels (see Table 4-1 and Section 4.1.3.2) would have a small, but positive effect on socioeconomic conditions in the region, as would development of oil and gas resources on the outer continental shelf. Moderate growth in the tourism industry, especially in cruise ship traffic, as well as the local economic stimulus of planned infrastructure projects in coastal areas (see Table 4-1) would have a moderate, beneficial economic effect in communities on the northern and western margins of the GOA.

The aggregate effects of cumulative projects and processes on socioeconomic factors in the GOA region are expected to be moderately beneficial, but not significant. The Proposed Action, as noted above, would

not contribute to these cumulative impacts. Therefore, impacts on socioeconomics from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.13 Environmental Justice and Protection of Children

No permanent human population exists in the GOA, and no cumulative effects on environmental justice or protection of children are possible without resident populations. Populations within the greater GOA region are not affected by Navy training activities because of the rare and inconsistent nature of these activities. Based on these factors, no disproportionately high and adverse human health or environmental effects on minority or low-income populations would occur from implementation of the Proposed Action. Therefore, impacts on environmental justice and children from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.

4.2.14 Public Safety

Despite the size of the GOA, the frequently severe weather, and the large number of vessels and aircraft that operate in or traverse the area, substantial accidents posing a safety risk to the public are rare. Most reported accidents involve commercial vessels. Of these, on-board fires appear to be the most common type of accident, followed by groundings. Vessel sinkings and collisions and aircraft accidents are very rare. The potentials for vessel groundings and collisions, moreover, are much higher in coastal waters where vessel traffic is substantially more congested than in the open GOA and obstacles to navigation are much more common. Thus, current risks to public safety in the GOA from past and present activities are very low.

Cumulative impacts on public safety would consist of the combined effects of the Proposed Action and other past, present, and reasonably foreseeable future actions and processes (as listed in Sections 4.1.2 and 4.1.3) on public safety conditions in the GOA. Navy training poses potential risks to the public in the GOA primarily through aircraft and vessel movements, live ordnance fire, and explosive ordnance, in combination with the accidental presence of non-participants in a designated temporary training area. Aircraft and ship collisions would be the primary public safety concern. These risks are minimized through standard Navy practices and procedures. The incremental increase in public safety risk from temporary Navy operations in the GOA probably is offset by the availability of substantial Navy physical assets and communications systems to assist in search-and-rescue operations in the event of an accident involving a commercial or private aircraft or vessel.

Other projects and activities that would increase the number aircraft or vessels in the GOA, or the duration of their presence there, such as additional cruise ship and marine cargo traffic (see Section 4.1.3.2) and increased commercial airliner traffic (see Section 4.1.3.5), could increase public safety risks in the future. Projects that increased the number of individuals present in the GOA also could increase the public safety risk by increasing the population exposed to such risks. Other proposed or operational commercial, industrial, and recreational activities in the GOA would not substantially affect public safety. Based on the existing low incidence of vessel and aircraft accidents and an anticipated moderate increase in aircraft and vessel activities in the GOA in the foreseeable future, the overall public safety risk in the GOA is expected to remain less than significant.

The Proposed Action would not contribute substantially to the public safety risks in the GOA resulting from other past, present, and reasonably foreseeable future actions. As noted above, the Proposed Action could have a beneficial effect on cumulative public safety risk in this remote region of the GOA because Navy assets could assist commercial or private aircraft or vessels in distress. Therefore, impacts on public safety from implementation of the Proposed Action, in combination with past, present, or planned projects and other activities within the GOA, would not be cumulatively significant.