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50 CFR Part 17
Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Pacific Walrus as Endangered or Threatened; Proposed Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS–R7–ES–2009–0051; MO 92210–0–0008–B2]

Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to List the Pacific Walrus as Endangered or Threatened

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of 12-month petition finding.

SUMMARY: We, the U.S. Fish and Wildlife Service, announce a 12-month finding on a petition to list the Pacific walrus (*Odobenus rosmarus divergens*) as endangered or threatened and to designate critical habitat under the Endangered Species Act of 1973, as amended. After review of all the available scientific and commercial information, we find that listing the Pacific walrus as endangered or threatened is warranted. Currently, however, listing the Pacific walrus is precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. Upon publication of this 12-month petition finding, we will add Pacific walrus to our candidate species list. We will develop a proposed rule to list the Pacific walrus as our priorities allow. We will make any determination on critical habitat during development of the proposed listing rule. Consistent with section 4(b)(3)(C)(iii) of the Endangered Species Act, we will review the status of the Pacific walrus through our annual Candidate Notice of Review.

DATES: The finding announced in this document was made on February 10, 2011.

ADDRESSES: This finding and supporting documentation are available on the Internet at *http://www.regulations.gov* at Docket Number FWS–R7–ES–2009–0051. A range map of the three walrus subspecies and a more detailed map of the Pacific walrus range are available at the following Web site: *http://alaska.fws.gov/fisheries/mmm/walrus/wmain.htm.* Supporting documentation we used in preparing this finding is available for public inspection, by appointment, during normal business hours at the U.S. Fish and Wildlife Service, Alaska Regional Office, 1011 East Tudor Road, Anchorage, AK 99503. Please submit any new information, materials, comments, or questions concerning this finding to the above address.

FOR FURTHER INFORMATION CONTACT: James MacCracken, Marine Mammals Management, Alaska Regional Office (*see* **ADDRESSES**); by telephone: 800–362–5148; or by facsimile: 907–786–3816. If you use a telecommunications device for the deaf (TDD), please call the Federal Information Relay Service (FIRS) at 800–877–8339.

SUPPLEMENTARY INFORMATION:

Background

Section 4(b)(3)(B) of the Endangered Species Act of 1973, as amended (Act) (16 U.S.C. 1531 *et seq.*), requires that, for any petition to revise the Federal Lists of Endangered and Threatened Wildlife and Plants that contains substantial scientific or commercial information that listing the species may be warranted, we make a finding within 12 months of the date of receipt of the petition. In this finding, we will determine whether the petitioned action is: (a) Not warranted, (b) warranted, or (c) warranted, but the immediate proposal of a regulation implementing the petitioned action is precluded by other pending proposals to determine whether species are endangered or threatened, and expeditious progress is being made to add or remove qualified species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Section 4(b)(3)(C) of the Act requires that we treat a petition for which the requested action is found to be warranted but precluded as though resubmitted on the date of such finding, that is, requiring a subsequent finding to be made within 12 months. We must publish these 12-month findings in the **Federal Register**.

Previous Federal Actions

On February 8, 2008, we received a petition dated February 7, 2008, from the Center for Biological Diversity, requesting that the Pacific walrus be listed as endangered or threatened under the Act and that critical habitat be designated. The petition included supporting information regarding the species' ecology and habitat use patterns, and predicted changes in sea-ice habitats and ocean conditions that may impact the Pacific walrus. We acknowledged receipt of the petition in a letter to the Center for Biological Diversity, dated April 9, 2008. In that letter, we stated that an emergency listing was not warranted and that all remaining available funds in the listing program for Fiscal Year (FY) 2008 had already been allocated to the U.S. Fish and Wildlife Service's (Service) highest priority listing actions and that no listing funds were available to further evaluate the Pacific walrus petition in FY 2008.

On December 3, 2008, the Center for Biological Diversity filed a complaint in U.S. District Court for the District of Alaska for declaratory judgment and injunctive relief challenging the failure of the Service to make a 90-day finding on their petition to list the Pacific walrus, pursuant to section 4(b)(3) of the Endangered Species Act, 16 U.S.C. 1533(b)(3), and the Administrative Procedure Act, 5 U.S.C. 706(1). On May 18, 2009, a settlement agreement was approved in the case of *Center for Biological Diversity* v. *U.S. Fish and Wildlife Service, et al.* (3:08–cv–00265–JWS), requiring us to submit our 90-day finding on the petition to the **Federal Register** by September 10, 2009. On September 10, 2009, we made our 90-day finding that the petition presented substantial scientific information indicating that listing the Pacific walrus may be warranted (74 FR 46548). On August 30, 2010, the Court approved an amended settlement agreement requiring us to submit our 12-month finding to the **Federal Register** by January 31, 2011. This notice constitutes the 12-month finding on the February 7, 2008, petition to list the Pacific walrus as endangered or threatened.

This 12-month finding is based on our consideration and evaluation of the best scientific and commercial information available. We reviewed the information provided in the petition submitted to the Service by the Center for Biological Diversity, information available in our files, and other available published and unpublished information. Additionally, in response to our **Federal Register** notice of September 10, 2009, requesting information from the public, as well as our September 10, 2010 press release, and other outreach efforts requesting new information from the public, we received roughly 30,000 submissions, which we have considered in making this finding, including information from the U.S. Marine Mammal Commission, the State of Alaska, the Alaska North Slope Borough, the Eskimo Walrus Commission, the Humane Society of the United States, the Center for Biological Diversity, the American Petroleum Institute, and many interested citizens. We also consulted with recognized Pacific walrus experts and Federal, State, and Tribal agencies.

Species Information

Taxonomy and Species Delineation

The walrus (*Odobenus rosmarus*) is the only living representative of the family Odobenidae, a group of marine carnivores that was highly diversified in the late Miocene and early Pliocene (Kohno 2006, pp. 416–419; Harington 2008, p. 26). Fossil evidence suggests that the genus evolved in the North Pacific Ocean and dispersed throughout the Arctic Ocean and North Atlantic during interglacial phases of the Pleistocene (Harington and Beard 1992, pp. 311–319; Dyke *et al.* 1999, p. 60; Harington 2008, p. 27).

Three modern subspecies of walruses are generally recognized (Wozencraft 2005, p. 525; Integrated Taxonomic Information System, 2010, p. 1): The Atlantic walrus (*O. r. rosmarus*), which ranges from the central Canadian Arctic eastward to the Kara Sea (Reeves 1978, pp. 2–20); the Pacific walrus (*O. r. divergens*), which ranges across the Bering and Chukchi Seas (Fay 1982, pp. 7–21); and the Laptev walrus (*O. r. laptevi*), which is represented by a small, geographically isolated population of walruses in the Laptev Sea (Heptner *et al.* 1976, p. 34; Vishnevskaia and Bychkov 1990, pp. 155–176; Andersen *et al.* 1998, p. 1323; Wozencraft 2005, p. 595; Jefferson *et al.* 2008, p. 376). Atlantic and Pacific walruses are genetically and morphologically distinct from each other (Cronin *et al.* 1994, p. 1035), likely as a result of range fragmentation and differentiation during glacial phases of extensive Arctic sea-ice cover (Harington 2008, p. 27). Although geographically isolated and ecologically distinct, walruses from the Laptev Sea appear to be more closely related to Pacific walruses (Lindqvist *et al.* 2009, pp. 119–121).

Pacific walruses are ecologically distinct from other walrus populations, primarily because they undergo significant seasonal migrations between the Bering and the Chukchi Seas and rely principally on broken pack ice habitat to access offshore breeding and feeding areas (Fay 1982, p. 279) (*see Species Distribution,* below). In contrast, Atlantic walruses, which are represented by several small discrete groups of animals distributed from the central Canadian Arctic eastward to the Kara Sea, exhibit smaller seasonal movements and feed primarily in coastal areas because the continental shelf is narrow over much of their range. The majority of productive feeding areas used by Atlantic walruses are accessible from the coast, and all age classes and gender groups use terrestrial haulouts during ice-free seasons (Born *et al.* 2003, p. 356; COSEWIC 2006, p. 15; Laidre *et al.* 2008, pp. S104, S115).

The Pacific walrus is generally considered a single population, although some heterogeneity has been documented. Jay *et al.* (2008, p. 938) found some differences in the ratio of trace elements in the teeth of Pacific walruses sampled in winter from two breeding areas (southeast Bering Sea and St. Lawrence Island), suggesting that the sampled animals had a history of feeding in different regions. Scribner *et al.* (1997, p. 180), however, found no difference in mitochondrial and nuclear DNA among Pacific walruses sampled from different breeding areas. Pacific walruses are identified and managed in the United States and the Russian Federation (Russia) as a single population (Service 2010, p. 1).

Species Description

Walruses are readily distinguished from other Arctic pinnipeds (aquatic carnivorous mammals with all four limbs modified into flippers, this group includes seals, sea lions, and walruses) by their enlarged upper canine teeth, which form prominent tusks. The family name Odobenidae (tooth walker), is based on observations of walruses using their tusks to pull themselves out of the water. Males, which have relatively larger tusks than females, also tend to have broader skulls (Fay 1982, pp. 104–108). Walrus tusks are used as offensive and defensive weapons (Kastelein 2002, p. 1298). Adult males use their tusks in threat displays and fighting to establish dominance during mating (Fay *et al.* 1984, p. 93), and animals of both sexes use threat displays to establish and defend positions on land or ice haulouts (Fay 1982, pp. 134–138). Walruses also use their tusks to anchor themselves to ice floes when resting in the water during inclement weather (Fay 1982, pp. 134–138; Kastelein 2002, p. 1298).

The Pacific walrus is the largest pinniped species in the Arctic. At birth, calves are approximately 65 kilograms (kg) (143 pounds (lb)) and 113 centimeters (cm) (44.5 inches (in)) long (Fay 1982, p. 32). After the first 7 years of life, the growth rate of female walruses declines rapidly, and they reach a maximum body size by approximately 10 years of age. Adult females can reach lengths of up to 3 meters (m) (9.8 feet (ft)) and weigh up to 1,100 kg (2,425 lb). Male walrus tend to grow faster and for a longer period of time than females. They usually do not reach full adult body size until they are 15 to 16 years of age. Adult males can reach lengths of 3.5 m (11.5 ft) and can weigh more than 2,000 kg (4,409 lb) (Fay 1982, p. 33).

Behavior

Walruses are social and gregarious animals. They tend to travel in groups and haul out of the water to rest on ice or land in densely packed groups. On land or ice, in any season, walruses tend to lie in close physical contact with each other. Young animals often lie on top of adults. Group size can range from a few individuals up to several thousand animals (Gilbert 1999, p. 80; Kastelein 2002, p. 1298; Jefferson *et al.* 2008, p. 378). At any time of the year, when groups are disturbed, stampedes from a haulout can result in injuries and mortalities. Calves and young animals are particularly vulnerable to trampling injuries (Fay 1980, pp. 227–227; Fay and Kelly 1980, p. 226).

The reaction of walruses to disturbance ranges from no reaction to escape into the water, depending on the circumstances (Fay *et al.* 1984, pp. 13–14). Many factors play into the severity of the response, including the age and sex of the animals, the size and location of the group (on ice, in water, on land), their distance from the disturbance, and the nature and intensity of the disturbance (Fay *et al.* 1984, pp. 14, 114–119). Females with calves appear to be most sensitive to disturbance, and animals on shore are more sensitive than those on ice (Fay *et al.* 1984, p. 114). A fright response caused by disturbance can cause stampedes on a haulout, resulting in injuries and mortalities (Fay and Kelly 1980, pp. 241–244).

Mating occurs primarily in January and February in broken pack ice habitat in the Bering Sea. Breeding bulls follow herds of females and compete for access to groups of females hauled out onto sea ice (Fay 1982, pp. 193–194). Males perform visual and acoustical displays in the water to attract females and defend a breeding territory. Subdominant males remain on the periphery of these aggregations and apparently do not display. Intruders into display areas are met with threat displays and physical attacks. Individual females leave the resting herd to join a male in the water where copulation occurs (Fay *et al.* 1984, pp. 89–99; Sjare and Stirling 1996, p. 900). Gestation lasts 15 to 16 months (Fay 1982, p. 197) and pregnancies are spaced at least 2 years apart (Fay 1982, p. 206). Calving occurs on sea ice, most typically in May, before the northward spring migration (Fay 1982, pp. 199–200). Mothers and newborn calves stay mostly on ice floes during the first few weeks of life (Fay *et al.* 1984, p. 12).

The social bond between the mother and calf is very strong, and it is unusual for a cow to become separated from her calf (Fay 1982, p. 203). The calf normally remains with its mother for at least 2 years, sometimes longer, if not supplanted by a new calf (Fay 1982, pp. 206–211). After separation from their mother, young females tend to remain with groups of adult females, whereas young males gradually separate from the females and begin to associate with groups of other males. Individual social status appears to be based on a combination of body size, tusk size, and aggressiveness. Individuals do not necessarily associate with the same group of animals and must continually reaffirm their social status in each new aggregation (Fay 1982, p. 135; NAMMCO 2004, p. 43).

Species Distribution

Pacific walruses range across the shallow continental shelf waters of the northern Bering Sea and Chukchi Sea, occasionally ranging into the East Siberian Sea and Beaufort Sea (Fay 1982, pp. 7–21; Figure 1 in Garlich-Miller *et al.* 2011). Waters deeper than 100 m (328 ft) and the extent of the pack ice are factors that limit distribution to the north (Fay 1982, p. 23). Walruses are rarely spotted south of the Alaska Peninsula and Aleutian archipelago; however, migrant animals (mostly males) are occasionally reported in the North Pacific (Service 2010, unpublished data).

Pacific walruses are highly mobile, and their distribution varies markedly in response to seasonal and interannual variations in sea-ice cover. During the January to March breeding season, walruses congregate in the Bering Sea pack ice in areas where open leads (fractures in sea ice caused by wind drift or ocean currents), polynyas (enclosed areas of unfrozen water surrounded by ice) or thin ice allow access to water (Fay 1982, p. 21; Fay *et al.* 1984, pp. 89–99). The specific location of winter breeding aggregations varies annually depending upon the distribution and extent of ice. Breeding aggregations have been reported southwest of St. Lawrence Island, Alaska; south of Nunivak Island, Alaska; and south of the Chukotka Peninsula in the Gulf of Anadyr, Russia (Fay 1982, p. 21; Mymrin *et al.* 1990, pp. 105–113; Figure 1 in Garlich-Miller *et al.* 2011).

In spring, as the Bering Sea pack ice deteriorates, most of the population migrates northward through the Bering Strait to summer feeding areas over the continental shelf in the Chukchi Sea. However, several thousand animals, primarily adult males, remain in the Bering Sea during the summer months, foraging from coastal haulouts in the Gulf of Anadyr, Russia, and in Bristol Bay, Alaska (Figure 1 in Garlich-Miller *et al.* 2011).

Summer distributions (both males and females) in the Chukchi Sea vary annually, depending upon the extent of sea ice. When broken sea ice is abundant, walruses are typically found in patchy aggregations over continental shelf waters. Individual groups may range from less than 10 to more than 1,000 animals (Gilbert 1999, pp. 75–84; Ray *et al.* 2006, p. 405). Summer concentrations have been reported in loose pack ice off the northwestern coast of Alaska, between Icy Cape and Point Barrow, and along the coast of Chukotka, Russia, as far west as Wrangel Island (Fay 1982, pp. 16–17; Gilbert *et al.* 1992, pp. 1–33; Belikov *et al.* 1996, pp. 267–269). In years of low ice concentrations in the Chukchi Sea, some animals range east of Point Barrow into the Beaufort Sea; walruses have also been observed in the Eastern Siberian Sea in late summer (Fay 1982, pp. 16–17; Belikov *et al.* 1996, pp. 267–269). The pack ice of the Chukchi Sea usually reaches its minimum extent in September. In years when the sea ice retreats north beyond the continental shelf, walruses congregate in large numbers (up to several tens of thousands of animals in some locations) at terrestrial haulouts on Wrangel Island and other sites along the northern coast of the Chukotka Peninsula, Russia, and northwestern Alaska (Fay 1982, p. 17; Belikov *et al.* 1996, pp. 267–269; Kochnev 2004, pp. 284–288; Ovsyanikov *et al.* 2007, pp. 1–4; Kavry *et al.* 2008, pp. 248–251).

In late September and October, walruses that summered in the Chukchi Sea typically begin moving south in advance of the developing sea ice. Satellite telemetry data indicate that male walruses that summered at coastal haulouts in the Bering Sea also begin to move northward towards winter breeding areas in November (Jay and Hills 2005, p. 197). The male walruses' northward movement appears to be driven primarily by the presence of females at that time of year (Freitas *et al.* 2009, pp. 248–260).

Foraging and Prey

Walruses consume mostly benthic (region at the bottom of a body of water) invertebrates and are highly adapted to obtain bivalves (Fay 1982, p. 139; Bowen and Siniff 1999, p. 457; Born *et al.* 2003, p. 348; Dehn *et al.* 2007, p. 176; Boveng *et al.* 2008, pp. 17–19; Sheffield and Grebmeier 2009, pp. 766–767). Fish and other vertebrates have occasionally been found in their stomachs (Fay 1982, p. 153; Sheffield and Grebmeier 2009, p. 767). Walruses root in the bottom sediment with their muzzles and use their whiskers to locate prey items. They use their fore-flippers, nose, and jets of water to extract prey buried up to 32 cm (12.6 in) (Fay 1982, p. 163; Oliver *et al.* 1983, p. 504; Kastelein 2002, p. 1298; Levermann *et al.* 2003, p. 8). The foraging behavior of walruses is thought to have a major impact on benthic communities in the Bering and Chukchi Seas (Oliver *et al.* 1983, pp. 507–509; Klaus *et al.* 1990, p. 480). Ray *et al.* (2006, pp. 411–413) estimate that walruses consume approximately 3 million metric tons (3,307 tons) of benthic biomass annually, and that the area affected by walrus foraging is in the order of thousands of square kilometers (sq km) (thousands of square miles (sq mi)) annually. Consequently, walruses play a major role in benthic ecosystem structure and function, which Ray *et al.* (2006, p. 415) suggested increased nutrient flux and productivity.

The earliest studies of food habits were based on examination of stomachs from walruses killed by hunters. These reports indicated that walruses were primarily feeding on bivalves (clams), and that non-bivalve prey was only incidentally ingested (Fay 1982, p. 145; Sheffield *et al.* 2001, p. 311). However, these early studies did not take into account the differential rate of digestion of prey items (Sheffield *et al.* 2001, p. 311). Additional research indicates that stomach contents include over 100 taxa of benthic invertebrates from all major phyla (Fay 1982, p. 145; Sheffield and Grebmeier 2009, p. 764), and while bivalves remain the primary component, walruses are not adapted to a diet solely of clams. Other prey items have similar energetic benefits (Wacasey and Atkinson 1987, pp. 245–247). Based on analysis of the contents from fresh stomachs of Pacific walruses collected between 1975 and 1985 in the Bering Sea and Chukchi Sea, prey consumption likely reflects benthic invertebrate composition (Sheffield and Grebmeier 2009, pp. 764–768). Of the large number of different types of prey, statistically significant differences between males and females from the Bering Sea were found in the occurrence of only two prey items, and there were no statistically significant differences in results for males and females from the Chukchi Sea (Sheffield and Grebmeier 2009, pp. 765). Although these data are for Pacific walrus stomachs collected 25–35 years ago, we have no reason to believe there has been a change in the general pattern of prey use described here.

Walruses typically swallow invertebrates without shells in their entirety (Fay 1982, p. 165). Walruses remove the soft parts of mollusks from their shells by suction, and discard the shells (Fay 1982, pp. 166–167). Born *et al.* (2003, p. 348) reported that Atlantic walruses consumed an average of 53.2 bivalves (range 34 to 89) per dive. Based on caloric need and observations of captive walruses, walruses require approximately 29 to 74 kg (64 to 174 lbs) of food per day (Fay 1982, p. 160). Adult males forage little during the breeding period (Fay 1982, pp. 142, 159–161; Ray *et al.* 2006, p. 411), while lactating females may eat two to three times that of nonpregant, nonlactating females (Fay 1982, p.159). Calves up to 1 year of age depend primarily on their mother's milk (Fay 1982, p. 138) and are gradually weaned in their second year (Fisher and Stewart 1997, pp. 1165–1175).

Although walruses are capable of diving to depths of more than 250 m (820 ft) (Born *et al.* 2005, p. 30), they usually forage in waters of 80 m (262 ft) or less (Fay and Burns 1988, p. 239; Born *et al.* 2003, p. 348; Kovacs and Lydersen 2008, p. 138), presumably because of higher productivity of their benthic foods in shallow waters (Fay and Burns 1988, pp. 239–240; Carey 1991, p. 869; Jay *et al.* 2001, p. 621; Grebmeier *et al.* 2006b, pp. 334–346; Grebmeier *et al.* 2006a, p. 1461). Walruses make foraging trips from land or ice haulouts that range from a few hours up to several days and up to 100 kilometers (km) (60 miles (mi)) (Jay *et al.* 2001, p. 626; Born *et al.* 2003, p. 349; Ray *et al.* 2006, p. 406; Udevitz *et al.* 2009, p. 1122). Walruses tend to make shorter and more frequent foraging trips when sea ice is used as a foraging platform compared to terrestrial haulouts (Udevitz *et al.* 2009, p. 1122). Satellite telemetry data for walruses in the Bering Sea in April of 2004, 2005, and 2006 showed they spent an average of 46 hours in the water between resting bouts on ice, which averaged 9 hours (Udevitz *et al.* 2009, p. 1122). Because females and young travel with the retreating pack ice in the spring and summer, they are passively transported northward over feeding grounds across the continental shelves of the Bering and Chukchi Seas. Male walruses appear to have greater endurance than females, with foraging excursions from land haulouts that can last up to 142 hours (about 6 days) (Jay *et al.* 2001, p. 630).

Sea-Ice Habitats

The Pacific walrus is an ice-dependent species that relies on sea ice for many aspects of its life history. Unlike other pinnipeds, walruses are not adapted for a pelagic existence and must haul out on ice or land regularly. Floating pack ice serves as a substrate for resting between feeding bouts (Ray *et al.* 2006, p. 404), breeding behavior (Fay *et al.* 1984, pp. 89–99), giving birth (Fay 1982, p. 199), and nursing and care of young (Kelly 2001, pp. 43–55). Sea ice provides access to offshore feeding areas over the continental shelf of the Bering and Chukchi Seas, passive transportation to new feeding areas (Richard 1990, p. 21; Ray *et al.* 2006, pp. 403–419), and isolation from terrestrial predators (Richard 1990, p. 23; Kochnev 2004, p. 286; Ovsyanikov *et al.* 2007, pp. 1–4). Sea ice provides an extensive substrate upon which the risk of predation and hunting is greatly reduced (Kelly 2001, pp. 43–55; Fay 1982, p. 26).

Sea ice in the Northern Hemisphere is comprised of first-year sea ice that formed in the most recent autumn-winter period, and multi-year ice that has survived at least one summer melt season. Sea-ice habitats for walruses include openings or leads that provide access to the water and to food resources. Walruses generally do not use multi-year ice or highly compacted first-year ice in which there is an absence of persistent leads or polynyas (Richard 1990, p. 21). Expansive areas of heavy ice cover are thought to play a restrictive role in walrus distributions across the Arctic and serve as a barrier to the mixing of populations (Fay 1982, p. 23; Dyke *et al.* 1999, pp. 161–163; Harington 2008, p. 35). Walruses generally do not occur farther south than the maximum extent of the winter pack ice, possibly due to their reliance on sea ice for breeding and rearing young (Fay *et al.* 1984, pp. 89–99) and isolation from terrestrial predators (Kochnev 2004, p. 286; Ovsyanikov *et al.* 2007, pp. 1–4), or because of the higher densities of benthic invertebrates in northern waters (Grebmeier *et al.* 2006a, pp. 1461–1463).

Walruses generally occupy first-year ice that is greater than 20 cm (7.9 in) thick and are not found in areas of extensive, unbroken ice (Fay 1982, pp. 21, 26; Richard 1990, p. 23). Thus, in winter they concentrate in areas of broken pack ice associated with divergent ice flow or along the margins of persistent polynyas (Burns *et al.* 1981, pp. 781–797; Fay *et al.* 1984, pp. 89–99; Richard 1990, p. 23) in areas with abundant food resources (Ray *et al.* 2006, p. 406). Females with young generally spend the summer months in pack ice habitats of the Chukchi Sea, where they feed intensively between bouts of resting and suckling their young. Some authors have suggested that the size and topography of individual ice floes are important features in the selection of ice haulouts, noting that some animals have been observed returning to the same ice floe between feeding bouts (Ray *et al.* 2006, p. 406). However, it has also been noted that walruses can and will exploit a fairly broad range of ice types and ice concentrations in order to stay in preferred foraging or breeding areas (Freitas *et al.* 2009, p. 247; Jay *et al.* 2010a, p. 300). Walruses tend to make shorter foraging excursions when they are using sea ice rather than land haulouts (Udevitz *et al.* 2009, p. 1122), presumably because it is more energetically efficient for them to haulout on ice near productive feeding areas than forage from shore. Fay (1982, p. 25) notes that several authors reported that when walruses had the choice of ice or land for a resting place, ice was always selected.

Terrestrial Habitats (Coastal Haulouts)

When suitable sea ice is not available, walruses haul out on land to rest. A wide variety of substrates, ranging from sand to boulders, are used. Isolated islands, points, spits, and headlands are occupied most frequently. The primary consideration for a terrestrial haulout site appears to be isolation from disturbances and predators, although social factors, learned behavior, protection from strong winds and surf, and proximity to food resources also likely influence the choice of terrestrial haulout sites (Richard 1990, p. 23). Walruses tend to use established haulout sites repeatedly and exhibit some degree of fidelity to these sites (Jay and Hills 2005, pp. 192–202), although the use of coastal haulouts appears to fluctuate over time, possibly due to localized prey depletion (Garlich-Miller and Jay 2000, pp. 58–65). Human disturbance is also thought to influence the choice of haulout sites; many historic haulouts in the Bering Sea were abandoned in the early 1900s when the Pacific walrus population was subjected to high levels of exploitation (Fay 1982, p. 26; Fay *et al.* 1984, p. 231).

Adult male walruses use land-based haulouts more than females or young, and consequently, have a greater geographical distribution through the ice-free season. Many adult males remain in the Bering Sea throughout the ice-free season, making foraging trips from coastal haulouts in Bristol Bay, Alaska, and the Gulf of Anadyr, Russia (Figure 1 in Garlich-Miller *et al.* 2011), while females and juvenile animals generally stay with the drifting ice pack throughout the year (Fay 1982, pp. 8–19). Females with dependent young may prefer sea-ice habitats because coastal haulouts pose greater risk from trampling injuries and predation (Fay and Kelly 1980, pp. 226–245; Ovsyanikov *et al.* 1994, p. 80; Kochnev

2004, pp. 285–286; Ovsyanikov *et al.* 2007, pp. 1–4; Kavry *et al.* 2008, pp. 248–251; Mulcahy *et al.* 2009, p. 3). Females may also prefer sea-ice habitats because they may have difficulty nourishing themselves while caring for a young calf that has limited swimming range (Cooper *et al.* 2006, p. 101; Jay and Fischbach 2008, p. 1).

The numbers of male walruses using coastal haulouts in the Bering Sea during the summer months, and the relative uses of different coastal haulout sites in the Bering Sea have varied over the past century. Harvest records indicate that walrus herds were once common at coastal haulouts along the Alaska Peninsula and the islands of northern Bristol Bay (Fay *et al.* 1984, pp. 231–376). By the early 1950s, most of the traditional haulout areas in the Southern Bering Sea had been abandoned, presumably due to hunting pressure. During the 1950s and 1960s, Round Island was the only regularly used haulout in Bristol Bay, Alaska. In 1960, the State of Alaska established the Walrus Islands State Game Sanctuary, which closed Round Island to hunting. Peak counts of walruses at Round Island increased from 1,000–2,000 animals in the late 1950s (Frost *et al.* 1983, pp. 379) to more than 10,000 animals in the early 1980s (Sell and Weiss, p. 12), but subsequently declined to 2,000–5,000 over the past decade (Sell and Weiss 2010, p. 12). General observations indicate that declining walrus counts at Round Island may, in part, reflect a redistribution of animals to other coastal sites in the Bristol Bay region. For example, walruses have been observed increasingly regularly at the Cape Seniavin haulout on the Alaska Peninsula since the 1970s, and at Cape Peirce and Cape Newenham in northwest Bristol Bay since the early 1980s (Jay and Hills 2005, p. 193; Figure 1 in Garlich-Miller *et al.* 2011).

Traditional male summer haulouts along the Bering Sea coast of Russia include sites along the Kamchatka Peninsula, the Gulf of Anadyr (most notably Rudder and Meechkin spits), and Arakamchechen Island (Garlich-Miller and Jay 2000, pp. 58–65; Figure 1 in Garlich-Miller *et al.* 2011). Several of the southernmost haulouts along the coast of Kamchatka have not been occupied in recent years, and the number of animals in the Gulf of Anadyr has also declined in recent years (Kochnev 2005, p. 4). Factors influencing abundance at Bering Sea haulouts are poorly understood, but may include changes in prey densities near the haulouts, changes in population size, disturbance levels, and changing seasonal distributions (Jay and Hills 2005, p. 198) (presumably mediated by sea-ice coverage or temperature).

Historically, coastal haulouts along the Arctic (Chukchi Sea) coast have been used less consistently during the summer months than those in the Bering Sea because of the presence of pack ice (a preferred substrate) for much of the year in the Chukchi Sea. Since the mid-1990s, reductions of summer sea ice coincided with a marked increase in the use of coastal haulouts along the Chukchi sea coast of Russia during the summer months (Kochnev 2004, pp. 284–288; Kavry *et al.* 2008, pp. 248–251). Large, mixed (composed of various age and sex groups) herds of walruses, up to several tens of thousands of animals, began to use coastal haulouts on Wrangel Island, Russia in the early 1990s, and several coastal haulouts along the northern Chukotka coastline of Russia have emerged in recent years, likely as a result of reductions in summer sea ice in the Chukchi Sea (Kochnev 2004, pp. 284–288; Ovsyanikov *et al.* 2007, pp. 1–4; Kavry *et al.* 2008, p. 248–251; Figure 1 in Garlich-Miller *et al.* 2011).

In 2007, 2009, and 2010, walruses were also observed hauling out in large numbers with mixed sex and age groups along the Chukchi Sea coast of Alaska in late August, September, and October (Thomas *et al.* 2009, p. 1; Service 2010, unpublished data). Monitoring studies conducted in association with oil and gas exploration suggest that the use of coastal haulouts along the Arctic coast of Alaska during the summer months is dependent upon the availability of sea ice. For example, in 2006 and 2008, walruses foraging off the Chukchi Sea coast of Alaska remained with the ice pack over the continental shelf during the months of August, September, and October. However in 2007, 2009, and 2010, the pack ice retreated beyond the continental shelf and large numbers of walruses hauled out on land at several locations between Point Barrow and Cape Lisburne, Alaska (Ireland *et al.* 2009, p. xvi; Thomas *et al.* 2009, p. 1; Service 2010, unpublished data; Figure 1 in Garlich-Miller *et al.* 2011).

Transitory coastal haulouts have also been reported in late fall (October–November) along the southern Chukchi Sea coast, coinciding with the southern migration. Mixed herds of walruses frequently come to shore to rest for a few days to weeks along the coast before continuing on their migration to the Bering Sea. Cape Lisburne, Alaska, and Capes Serdtse-Kamen' and Dezhnev, Russia, are the most consistently used haulouts in the Chukchi Sea at this time of year (Garlich-Miller and Jay 2000, pp. 58–67). Large mixed herds of walruses have also been reported in late fall and early winter at coastal haulouts in the northern Bering Sea at the Punuk Islands and Saint Lawrence Island, Alaska; Big Diomede Island, Russia; and King Island, Alaska, prior to the formation of sea ice in offshore breeding and feeding areas (Fay and Kelly 1980, p. 226; Garlich-Miller and Jay 2000, pp. 58–67; Figure 1 in Garlich-Miller *et al.* 2011).

Vital Rates

Walruses have the lowest rate of reproduction of any pinniped species (Fay 1982, pp. 172–209). Although male walruses reach puberty at 6–7 years of age, they are unlikely to successfully compete for access to females until they reach full body size at 15 years of age or older (Fay 1982, p. 33; Fay *et al.* 1984, p. 96). Female walruses attain sexual maturity at 4–7 years of age (Fay 1982, pp. 172–209), and the median age of first birth ranges from approximately 8 to 10 years of age (Garlich-Miller *et al.* 2006, pp. 887–893). Because gestation lasts 15–16 months, it extends through the following breeding season and thus, the minimum interval between successful births is 2 years. Ovulation may also be suppressed until the calf is weaned, raising the birth interval to 3 years or more (Garlich-Miller and Stewart 1999, p. 188). The age of sexual maturity and birth rates may be density-dependent (Fay *et al.* 1989, pp. 1–16; Fay *et al.* 1997, pp. 537–565; Garlich-Miller *et al.* 2006, pp. 892–893).

The low birth rate of walruses is offset in part by considerable maternal investment in offspring (Fay *et al.* 1997, p. 550). Assumed survival rates through the first year of life range from 0.5 to 0.9 (Fay *et al.* 1997, p. 550). Survival rates for juveniles through adults (*i.e.,* 4–20 years old) have been assumed to be as high as 0.96 to 0.99 per cent (DeMaster 1984, p. 78; Fay *et al.* 1997, p. 544), declining to zero by 40 to 45 years (Chivers 1999, p. 240). Using published estimates of survival and reproduction, Chivers (1999, pp. 239–247) developed an individual age-based model of the Pacific walrus population, which yielded a maximum population growth rate of 8 percent, but cautioned this should not be considered to be an estimate of the maximum growth rate (Chivers 1999, p. 239). Thus, the 8 percent figure remains theoretical because age-specific survival rates for free-ranging walruses are poorly known.

Abundance

Based on large sustained harvests in the 18th and 19th centuries, Fay (1982, p. 241) speculated that the preexploitation population was represented by a minimum of 200,000 animals. Since that time, population size is believed to have fluctuated in response to varying levels of human exploitation. Large-scale commercial harvests are believed to have reduced the population to 50,000–100,000 animals in the mid-1950s (Fay *et al.* 1997, p. 539). The population apparently increased rapidly in size during the 1960s and 1970s in response to harvest regulations that limited the take of females (Fay *et al.* 1989, p. 4). Between 1975 and 1990, visual aerial surveys jointly conducted by the United States and Russia at 5-year intervals produced population estimates ranging from 201,039 to 290,000. Efforts to survey the Pacific walrus population were suspended by both countries after 1990, due to unresolved problems with survey methods that produced population estimates with unknown bias and unknown—but presumably large—variances that severely limited their utility (Speckman *et al.* 2010, p. 3).

In 2006, a joint U.S.-Russian survey was conducted in the pack ice of the Bering Sea, using thermal imaging systems to detect walruses hauled out on sea ice and satellite transmitters to account for walruses in the water (Speckman *et al.* 2010, p. 4). The number of walruses within the surveyed area was estimated at 129,000, with 95-percent confidence intervals of 55,000 to 507,000 individuals. This is a minimum estimate, as weather conditions forced termination of the survey before much of the southwest Bering Sea was surveyed; animals were observed in that region as the surveyors returned to Anchorage, Alaska. Table 1 provides a summary of survey results.

TABLE 1—ESTIMATES OF PACIFIC WALRUS POPULATION SIZE, 1975–2006.

Year	Population size (with range or confidence interval) [a]	Reference
1975	214,687	(Udevitz *et al.* 2001, p. 614).
1980	250,000–290,000	(Johnson *et al.* 1982, p. 3; Fedoseev 1984, p. 58).
1985	242,366	(Udevitz *et al.* 2001, p. 614).
1990	201,039	(Gilbert *et al.* 1992, p. 28).
2006	129,000 (50,000–500,000)	(Speckman *et al.* 2010).

[a] Due to differences in methods, comparisons of estimates across years (population trends) are not possible. Most estimates did not provide a range or confidence interval.

We acknowledge that these survey results suggest to some that the walrus population may be declining; however, we do not believe the survey methodologies support such a definitive conclusion. Resource managers in Russia have concluded that the population has declined, and accordingly, have reduced harvest quotas in recent years (Kochnev 2004, p. 284; Kochnev 2005, p. 4; Kochnev, 2010, pers. comm.), based in part on the lower abundance estimate generated from the 2006 survey results. However, past survey results are not directly comparable among years due to differences in survey methods, timing of surveys, segments of the population surveyed, and incomplete coverage of areas where walruses may have been present (Fay *et al.* 1997, p. 537); thus, these results do not provide a basis for determining trends in population size (Hills and Gilbert 1994, p. 203; Gilbert 1999, pp. 75–84). Whether prior estimates are biased low or high is unknown, because of problems with detecting individual animals on ice or land, and in open water, and difficulties counting animals in large, dense groups (Speckman *et al.* 2010, p. 33). In addition, no survey has ever been completed within a timeframe that could account for the redistribution of individuals (leading to double counting or undercounting), or before weather conditions either delayed the effort or completely terminated the survey before the entire area of potentially occupied habitat had been covered (Speckman *et al.* 2010). Due to these general problems, as well as seasonal differences among surveys (fall or spring) and technological advancements that correct for some problems, we do not believe the survey results provide a reliable basis for estimating a population trend.

Changes in the walrus population have also been investigated by examining changes in biological parameters over time. Based on evidence of changes in abundance, distributions, condition indices, and life-history parameters, Fay *et al.* (1989, pp.1–16) and Fay *et al.* (1997, pp. 537–565) concluded that the Pacific walrus population increased greatly in size during the 1960s and 1970s, and postulated that the population was approaching, or had exceeded, the carrying capacity of its environment by the early 1980s. Harvest increased in the 1980s: changes in the size, composition, and productivity of the sampled walrus harvest in the Bering Strait Region of Alaska over this time frame are consistent with this hypothesis (Garlich-Miller *et al.* 2006, p. 892). Harvest levels declined sharply in the early 1990s, and increased reproductive rates and earlier maturation in females occurred, suggesting that density-dependent regulatory mechanisms had been relaxed and the population was likely below carrying capacity (Garlich-Miller *et al.* 2006, p. 893). However, Garlich-Miller *et al.* (2006, pp. 892–893) also noted that there are no data concerning the trend in abundance of the walrus population or the status of its prey to verify this hypothesis, and that whether density-dependent changes in life-history parameters might have been mediated by changes in population abundance or changes in the carrying capacity of the environment is unknown.

Summary of Information Pertaining to the Five Factors

Section 4 of the Act (16 U.S.C. 1533) and implementing regulations (50 CFR part 424) set forth the procedures for adding species to, removing species from, or reclassifying species on the Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the Act, a species may be determined to be endangered or threatened based on any of the following five factors:

(A) The present or threatened destruction, modification, or curtailment of its habitat or range;

(B) Overutilization for commercial, recreational, scientific, or educational purposes;

(C) Disease or predation;

(D) The inadequacy of existing regulatory mechanisms; or

(E) Other natural or manmade factors affecting its continued existence.

In making this 12-month finding, we considered and evaluated the best available scientific and commercial information. Information pertaining to the Pacific walrus in relation to the five factors provided in section 4(a)(1) of the Act is discussed below.

In considering what factors might constitute threats to a species, we must look beyond the exposure of the species to a particular stressor to evaluate whether the species may respond to that stressor in a way that causes actual impacts to the species. If there is exposure to a stressor and the species responds negatively, the stressor may be a threat and we attempt to determine how significant a threat it is. The threat is significant if it drives, or contributes to, the risk of extinction of the species such that the species warrants listing as endangered or threatened as those terms are defined in the Act. However, the identification of stressors that could impact a species negatively may not be sufficient to compel a finding that the species warrants listing. The information must include evidence sufficient to suggest that these stressors are operative threats that act on the species to the point that the species meets the definition of endangered or threatened under the Act. Also, because an individual stressor may not be a threat by itself, but could be in conjunction with one or more other stressors, our process includes considering the combined effects of stressors.

To inform our analysis of threats to the Pacific walrus, we also took into consideration the results of two Bayesian network modeling efforts; one conducted by the Service (Garlich-Miller *et al.* 2011), and the other conducted by the U.S. Geological Survey (USGS) (Jay *et al.* 2010b). Although quantitative, empirical data can be used in Bayesian networks, when primarily qualitative data are available, such as for the Pacific walrus, the models are well suited to formalizing and quantifying the opinions of experts (Marcot *et al.* 2006, p. 3063). Bayesian network models (also known as Bayesian belief networks, reflecting the importance of expert opinion) graphically display the relevant stressors, the interactions among stressors, and the cumulative impact of those stressors as they are integrated through the network. In general terms, the network is composed of input variables that represent key environmental correlates (*e.g.,* sea-ice loss, harvest, shipping) and response variables, (*e.g.,* population status). Although we did not rely on the results of the Bayesian models as the sole basis for our conclusions in this finding, the models corroborated the results of our threats analysis. Results of the models are presented in the five-factor analysis below, where pertinent.

Factor A. The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

The following potential stressors that may affect the habitat or range of the Pacific walrus are discussed in this section: (1) Loss of sea ice due to climate change; and (2) effects on prey species due to ocean warming and ocean acidification.

Effects of Global Climate Change on Sea-Ice Habitats

The Pacific walrus depends on sea ice for several aspects of its life history. This section describes recent observations and future projections of sea-ice conditions in the Bering and Chukchi Seas through the end of the 21st century. Following this presentation on the changing ice dynamics, we examine how these changing ice conditions may affect the Pacific walrus population.

The Arctic Ocean is covered primarily by a mix of multi-year sea ice, whereas more southerly regions, such as the Bering Sea, are seasonal ice zones where first-year ice is renewed every winter. The observed and projected effects of global warming vary in different parts of the world, and the Arctic and Antarctic regions are increasingly recognized as being extremely vulnerable to current and projected effects. For several decades, the surface air temperatures in the Arctic have warmed at approximately twice the global rate (Christensen *et al.* 2007, p. 904). The observed and projected effects of climate change are most extreme during summer in northern high-latitude regions, in large part due to the ice-albedo (reflective property) feedback mechanism, in which melting of snow and sea ice lowers surface reflectivity, thereby further increasing surface warming from absorption of solar radiation.

Since 1979 (the beginning of the satellite record of sea-ice conditions), there has been an overall reduction in the extent of Arctic sea ice (Parkinson *et al.* 1999, p. 20837; Comiso 2002, p. 1956; Stroeve *et al.* 2005, pp. 1–4; Comiso 2006, pp. 1–3; Meier *et al.* 2007, p. 428; Stroeve *et al.* 2007, p. 1; Comiso *et al.* 2008, p. 1; Stroeve *et al.* 2008, p. 13). Although the decline is a year-round trend, far greater reductions have been noted in summer sea ice than in winter sea ice. For example, from 1979 to 2009, the extent of September sea ice seen Arctic wide has declined 11 percent per decade (Polyak *et al.* 2010, p. 1797). In recent years, the trend in Arctic sea-ice loss has accelerated (Comiso *et al.* 2008, p. 1). In September 2007, the extent of Arctic Ocean sea ice reached a record low, approximately 50 percent lower than conditions in the 1950s through the 1970s, and 23 percent below the previous record set in 2005 (Stroeve *et al.* 2008, p. 13). Minimum sea-ice extent in 2010 was the third lowest in the satellite record, behind 2007 and 2008 (second lowest), and most of this loss occurred on the Pacific side of the Arctic Ocean.

Of long-term significance is the loss of over 40 percent of Arctic multi-year sea ice over the last 5 years (Kwok *et al.* 2009, p. 1). Since 2004, there has been a reversal in the volumetric and areal contributions between first-year ice and multi-year ice in regards to the total volume and area of the Arctic Ocean that they cover, with first-year ice now predominating (Kwok *et al.* 2009, p. 16). Export of ice through Fram Strait, together with the decline in multi-year ice coverage, suggests that recently there has been near-zero replenishment of multi-year ice (Kwok *et al.* 2009, p. 16). The area of the Arctic Ocean covered by ice predominantly older than 5 years decreased by 56 percent between 1982 and 2007 (Polyak *et al.* 2010, p. 1759). Within the central Arctic Ocean, old ice has declined by 88 percent, and ice that is at least 9 years old has essentially disappeared (Markus *et al.* 2009, p. 13: Polyak *et al.* 2010, p. 1759). In addition, from 2005 to 2008 there was a thinning of 0.6 m (1.9 ft) in multi-year ice thickness. It is likely that the rapid decline of sea ice in 2007 was in part the result of thinner and lower coverage, of the multi-year ice (Comiso *et al.* 2008, p. 6). It would take many years to restore the ice thickness through annual growth, and the loss of multi-year ice makes it unlikely that the age and thickness composition of the ice pack will return to previous climatological conditions with continued global warming. Further loss of sea ice will be a major driver of changes across the Arctic over the next decades, especially in late summer and autumn (NOAA 2010, p. 77503).

Due to asymmetric geography of the Arctic and the scale of weather patterns, there is considerable regional variability in sea-ice cover (Meier *et al.* 2007, p. 430), and although the early loss of summer sea ice and volumetric ice loss in the Arctic applies directly to the Chukchi Sea, it cannot be directly extrapolated to the seasonal ice zone of the Bering Sea (NOAA 2010, p. 77503). The contrasts between the two are dramatic: The Bering Sea is one of the most stable in terms of sea ice, especially in the winter, and the Chukchi Sea has had some of the most dramatic losses of summer sea ice

(Meier *et al.,* p. 431). Below, we describe the sea-ice conditions in the Bering and Chukchi Seas as they occur presently, as well as recent trends and projections for the future.

In March and April, at maximal sea-ice extent, the Chukchi Sea is typically completely frozen, and ice cover in the Bering Sea extends southward to a latitude of approximately 58–60 degrees north (Boveng *et al.* 2008, pp. 33–52). The Bering Sea spans the marginal sea-ice zone, where ice gives way to water at the southern edge, and around the peripheries of persistent polynyas. Sea ice in the Bering Sea is highly dynamic and largely a wind-driven system (Sasaki and Minobe 2005, pp. 1–2). Ice cover is comprised of a variety of first-year ice thicknesses, from young, very thin ice to first-year floes that may be upwards of 1.0-m (3.3-ft) thick (Burns *et al.* 1980, p. 100; Zhang *et al.* 2010, p. 1729). Depending on wind patterns, a variable (but relatively minor) fraction of ice that drifts south through the Bering Strait could be comprised of some thicker ice floes that originated in the Chukchi and Beaufort Seas (Kozo *et al.* 1987, pp. 193–195).

Ice melt in the Bering Sea usually begins in late April and accelerates in May, with the edge of the ice moving northward until it passes through the Bering Strait, typically in June. The Bering Sea remains ice free for the duration of the summer. Ice continues to retreat northward through the Chukchi Sea until September, when minimal sea-ice extent is reached.

Freeze-up begins in October, with the ice edge progressing southward across the Chukchi Sea. The ice edge usually reaches the Bering Strait in November and advances through the Strait in December. The ice edge continues to move southward across the Bering Sea until its maximal extent is reached in March. There is considerable year-to-year variation in the timing and extent of ice retreat and formation (Boveng *et al.* 2008, p. 37; Douglas 2010, p. 19).

Within various regions of the Arctic, there is substantial variation in the monthly trends of sea ice (Meier *et al.* 2007, p. 431). In the Bering Sea, statistically significant monthly reductions in the extent of sea ice over the period 1979–2005 were documented for March (−4.8 percent), October (−42.9 percent), and November (−20.3 percent), although the overall annual decline (−1.9 percent) is not statistically significant (Meier *et al.* 2007, p. 431). The Bering Sea declines were greatest in October and November, the period of early freeze-up. In the Chukchi Sea, statistically significant monthly reductions were also documented for 1979 to 2005 for May (−0.19 percent), June (−4.3 percent), July (−6.7 percent), August (−15.4 percent), September (−26.3 percent), October (−18.6 percent), and November (−8.0 percent): The overall annual reduction (−4.9 percent) is statistically significant (Meier *et al.* 2007, p. 431). In essence, the Chukchi Sea has shown declines in all months when it is not completely ice-covered, with greatest declines in months of maximal melt and early freeze-up (August, September, and October).

During the period 1979–2006, the September sea-ice extent in the Chukchi Sea decreased by 26 percent per decade (Douglas 2010, p. 2). In recent years, sea ice typically has retreated from continental shelf regions of the Chukchi Sea in August or September, with open water conditions persisting over much of the continental shelf through late October. In contrast, during the preceding 20 years (1979–1998), broken sea-ice habitat persisted over continental shelf areas of the Chukchi Sea through the entire summer (Jay and Fischbach 2008, p. 1).

From 1979 to 2007, there was a general trend toward earlier onset of ice melt and later onset of freeze-up in 9 of 10 Arctic regions analyzed by Markus *et al.* (2009, pp. 1–14), the exception being the Sea of Okhotsk. For the entire Arctic, the melt season length has increased by about 20 days over the last 30 years, due to the combined earlier melt and later freeze-up. The largest increases, of over 10 days per decade, have been seen for Hudson Bay, the East Greenland Sea, and the Laptev/East Siberian Seas. From 1979 to 2007, there was a general trend toward earlier onset of ice melt and later onset of freeze-up in both the Bering and Chukchi Seas: For the Bering Sea, the onset of ice melt occurred 1.0 day earlier per decade, while in the Chukchi/Beaufort Seas ice melt occurred 3.5 days earlier per decade. The onset of freeze-up in the Bering Sea occurred 1.0 day later per decade, while freeze-up in the Chukchi/Beaufort Seas occurred 6.9 days later per decade (Markus *et al.* 2009, p. 11).

Later freeze-up in the Arctic does not necessarily mean that less seasonal sea ice forms by winter's end in the peripheral seas, such as the Bering and Chukchi Seas (Boveng *et al.* 2008, p. 35). For example, in 2007 (the year when the record minimal Arctic summer sea-ice extent was recorded), the Chukchi Sea did not freeze until early December and the Bering Sea remained largely ice-free until the middle of December (Boveng *et al.* 2008, p. 35). However, rapid cooling and advancing of sea ice in late December and early January resulted in most of the eastern Bering Sea shelf being ice-covered by mid-January, an advance of 900 km (559 mi), or 30 km per day (19 mi per day). Maximum ice extent occurred in late March, with ice covering much of the shelf, resulting in a near record maximum ice extent. Ice then slowly retreated, and the Bering Sea was not ice-free until almost July. Therefore, winter ice conditions are not necessarily related to the summer-fall ice conditions of the previous year.

Model Projections of Future Sea Ice

The analysis and synthesis of information presented by the Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report (AR4) in 2007 represents the scientific consensus view on the causes and future of climate change. The IPCC AR4 used state-of-the-art Atmosphere-Ocean General Circulation Models (GCMs) and a range of possible future greenhouse gas (GHG) emission scenarios to project plausible outcomes globally and regionally, including projections of temperature and Arctic sea-ice conditions through the 21st century.

The GCMs use the laws of physics to simulate the main components of the climate system (the atmosphere, ocean, land surface, and sea ice) and to make projections as to the response of these components to future emissions of GHGs. The IPCC used simulations from about 2 dozen GCMs developed by 17 international modeling centers as the basis for the AR4 (Randall *et al.* 2007, pp. 596–599). The GCM results are archived as part of the Coupled Model Intercomparison Project–Phase 3 (CMIP3) at the Program for Climate Model Diagnosis and Intercomparison (PCMDI). The CMIP3 GCMs provide projections of future effects that could result from climate change, because they are built on well-known dynamical and physical principles, and they plausibly simulate many large-scale aspects of present-day conditions. However, the coarse resolution of most current climate models dictates careful application on smaller spatial scales in heterogeneous regions.

The IPCC AR4 used six "marker" scenarios from the Special Report on Emissions Scenarios (SRES) (Carter *et al.* 2007, p. 160) to develop climate projections spanning a broad range of GHG emissions through the end of the 21st century under clearly stated assumptions about socioeconomic factors that could influence the emissions. The six "marker" scenarios are classified according to their emissions as "high" (A1F1, A2), "medium" (A1B and B2) and "low" (A1T, B1). The SRES made no judgment as to which of the scenarios were more likely to occur, and the scenarios were not assigned probabilities of occurrence (Carter *et al.* 2007, p. 160). The IPCC focused on three of the marker scenarios—B1, A1B, and A2—for its synthesis of the climate modeling efforts, because they represented "low," "medium," and "high," scenarios; this choice stemmed from the constraints of available computer resources that precluded realizations of all six scenarios by all modeling centers (Meehl *et al.* 2007, p. 753). With regard to these three emissions scenarios, the IPCC Working Group I report noted: "Qualitative conclusions derived from these three scenarios are in most cases also valid for other SRES scenarios" (Meehl *et al.* 2007, p. 761). It is important to note that the SRES scenarios do not contain additional climate initiatives (*e.g.,* implementation of the United Nations Framework Convention on Climate Change or the emissions targets of the Kyoto Protocol) beyond current mitigation policies (IPCC 2007, p. 22). The SRES scenarios do, however, have built-in emissions reductions that are substantial, based on assumptions that a certain amount of technological change and reduction of emissions would occur in the absence of climate policies; recent analysis shows that two-thirds or more of all the energy efficiency improvements and decarbonization of energy supply needed to stabilize GHGs is built into the IPCC reference scenarios (Pielke *et al.* 2008, p. 531).

There are three main contributors to divergence in GCM climate projections: Large natural variations, across-model differences, and the range-in-emissions scenarios (Hawkins and Sutton 2009, p. 1096). The first of these, variability from natural variation, can be incorporated by averaging the projections over decades, or, preferably, by forming ensemble averages from several runs of the same model.

The second source of variation is model to model differences in the way that physical processes are incorporated into the various GCMs. Because of these differences, projections of future climate conditions depend, to a certain extent, on the choice of GCMs used. Uncertainty in the amount of warming out to mid-century is primarily a function of these model-to-model differences. The most common approach to address the uncertainty and biases inherent in individual models is to use the median or mean outcome of several predictive models (a multi-model ensemble) for inference. Excluding models that poorly simulate observational data is also a common approach to reducing the spread of uncertainty among projections from multi-model ensembles.

The third source of variation arises from the range in plausible GHG emissions scenarios. Conditions such as surface air temperature and sea-ice area are linked in the IPCC climate models to GHG emissions by the physics of radiation processes. When CO_2 is added to the atmosphere, it has a long residence time and is only slowly removed by ocean absorption and other processes. Based on IPCC AR4 climate models, expected global warming—defined as the change in global mean surface air temperature (SAT)—by the year 2100 depends strongly on the assumed emissions of CO_2 and other GHGs. By contrast, warming out to about 2040–2050 will be largely due to emissions that have already occurred and those that will occur over the next decade (Meehl 2007, p. 749). Thus, conditions projected to mid-century are less sensitive to assumed future emission scenarios. For the second half of the 21st century, however, and especially by 2100, the choice of the emission scenario becomes the major source of variation among climate projections and dominates over natural variability and model-to-model differences (IPCC 2007, pp. 44–46).

Because the SRES group and the IPCC made no judgment on the likelihood of any of the scenarios, and the scenarios were not assigned probabilities of occurrence, one option for representing the full range of variability in potential outcomes, would be to evaluate projections from all models under all marker scenarios for which sea-ice projections are available to the scientific community—A2, A1B, and B1. Another typical procedure for projecting future outcomes is to use an intermediate scenario, such as A1B, to predict changes, or one intermediate and one high scenario (*e.g.,* A1B and A2) to capture a range of variability.

Several factors suggest that the A1B scenario may be a particularly appropriate choice of scenario to use for projections of sea-ice declines in the Arctic and its marginal seas. First, the A1B scenario is widely used in modeling because it is a "medium" emissions scenario characterized by a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, rapid introduction of new and more efficient technologies, and development of energy technologies that are balanced across energy sources, and it contains no assumption of mitigation policies that may or not be realized. Thus, there are a number of studies in the published sea-ice literature that use the A1B scenario and can, therefore, be used for comparative purposes (*e.g.,* Overland and Wang 2007; Holland *et al.* 2010; Wang *et al.* 2010). Second, both the A1B and A2 scenarios project similar declines in hemispheric sea-ice extent out to 2100 (Meehl *et al.* 2007, Figure 10.13, p. 771); thus, little new understanding is gained by using projections from both scenarios (see discussion of Douglas 2010 in subsequent paragraphs). Third, model projections based on the B1 scenario appear to be overly conservative (Meehl *et al.* 2007, Figure 10.13, p. 771), in that sea ice is declining even faster than the decline forecasted by the A1B scenario (see discussion at end of this section). Fourth, current global carbon emissions appear to be tracking slightly above (Raupach *et al.* 2007, Figure 1, p. 10289; LeQuere *et al.* 2009, Figure 1a, p. 2; Global Carbon Project 2010 at *http://www.globalcarbonproject.org/carbonbudget/09/files/GCP2010_CarbonBudget2009_29November2010.pdf*) or slightly below (Manning *et al.* 2010, Figure 1, p. 377) the A1B trajectory at this point in time. It may be reasonable to project this or a higher trend in global carbon emissions into the near future (Garnaut *et al.* 2008, Figure 5, p. 392; Sheehan 2008, Figure 2, p. 220; but see caveat by van Vuuren *et al.* 2010). Fifth, there is a growing body of opinion that stabilizing GHG emissions at levels well below the A1B scenario (*e.g.,* at 450 parts per million (ppm), equivalent to a 2 degree Celsius increase in temperature) will be difficult in the absence of substantial policy-mandated mitigation (*e.g.,* Garnaut *et al.* 2007, p. 398; den Elzen and Höhne 2008, p. 250; Pielke *et al.* 2008, pp. 531–532; Macintosh 2009, p. 3; den Elzen *et al.* 2010, p. 314; Tomassini *et al.* 2010, p. 418; Anderson and Bows 2011, p. 20), largely as a result of continuing high emissions in certain developed countries, and recent and projected growth in the economies and energy demands of rapidly developing countries (*e.g.,* Garnaut *et al.* 2008, p. 392; Auffhammer and Carson 2008, p. 1; Pielke *et al.* 2008, p. 532; U.S. Energy Information Administration 2010, pp. 123–124, 128). Because of these factors, we conclude that sea-ice projections developed by using the A1B forcing scenario provide an appropriate basis for evaluating potential impacts to habitat and related impacts to the Pacific walrus population in the future.

Our analysis of sea-ice response to global warming within the range of the

Pacific walrus (Bering and Chukchi Seas) carefully considered the synthesis of GCM projections presented by Douglas (2010). We provide a broad overview of the methods and findings of the report by Douglas (2010), details of which are available in the full report.

Douglas (2010, pp. 4–5) quantified sea-ice projections (from the A2 and A1B scenarios) by 18 CMIP3 GCM models prepared for the IPCC fourth reporting period, as well as 2 GCM subsets which excluded models that poorly simulated the 1979–2008 satellite record of Bering and Chukchi sea-ice conditions. Analyses focused on the annual cycle of sea-ice extent within the range of the Pacific walrus population, specifically the continental shelf waters of the Bering and Chukchi Seas. Models were selected for the two subsets, respectively, when their simulated mean ice extent and seasonality during 1979–2008 were within two standard deviations (SD2) and one standard deviation (SD1) of the observed means. In consideration of observations of ice-free conditions across the Chukchi Sea in recent years in late summer, any models that failed to simulate at least 1 ice-free month in the Chukchi Sea were also excluded from the Chukchi Sea subset ensembles. Ice observations and the projections of individual GCMs were pooled over 10-year periods to integrate natural variability (Douglas 2010, p. 5).

To quantify projected changes in monthly sea-ice extent, Douglas (2010, p. 31) compared future monthly sea-ice projections for the Bering and Chukchi Seas at mid-century (2045–2054) and late-century (2090–2099) with two decades from the observational record (1979–1988 and 1999–2008). The earliest observational period (1979–1988), which coincides with a timeframe during which the Pacific walrus population was considered to be occupying most of its historical range (Fay 1982, pp. 7–21), provides a useful baseline for examining projected changes in sea-ice habitats.

Douglas (2010, p. 7) found that projected median sea-ice extents under both the A1B and A2 forcing scenarios are qualitatively similar in the Bering and Chukchi Seas in all seasons throughout the 21st century. This finding is consistent with the generally similar declines in hemispheric sea-ice extent between the A1B and A2 scenarios out to 2100 (Meehl *et al.* 2007, Figure 10.13, p. 771). Thus, our decision to focus on ice projections by the A1B forcing scenario (as described above) is further substantiated, as there would be little insight gained by considering the A2 scenario.

The analysis of Douglas (2010, pp. 24, 31) yields mid-century projections that indicate sea-ice extent in the Bering Sea will decline for all months when sea ice has historically been present, i.e., for October through June. The most pronounced reductions in Bering Sea ice extent at mid-century in terms of the percent change from baseline conditions are expected in the months of June and November, which reflects an increasingly early onset of ice-free or nearly ice-free conditions in the early summer and later onset of sea-ice development in the fall. In June, the projected extent of sea ice is −63 percent of the 1979–1988 baseline level, while the projected extent for November is approximately is −88 percent of the baseline level. By late century, substantial declines in Bering Sea ice extent are projected for all months, with losses ranging from 57 percent in April, to 100 percent loss of sea ice in November (Douglas 2010, p. 31). The onset of substantial freezing in the Bering Sea is projected to be delayed until January by late century, with little or no ice projected to remain in May by the end of the century (Douglas 2010, pp. 8, 24, 31).

Historically, sea-ice cover has persisted, to at least some extent, over continental shelf waters of the Chukchi Sea all 12 months of the year, although the extent of sea ice has varied by month. For example, for the 1979–1988 period, the median extent of sea ice varied from about 50 percent in September to essentially 100 percent from late November through early May (Douglas 2010, p. 19). A pattern of extensive sea-ice cover (approaching 100 percent) in late winter and early spring (February–April) is expected to persist through the end of the century.

Projections of sea-ice loss during June in the Chukchi Sea are relatively modest; however, the sea ice is projected to retreat rapidly during the month of July (Douglas 2010, p. 12). Model subset medians project a 2-month ice-free season at mid-century and a 4-month ice-free season at the end of the century, centered around the month of September (Douglas 2010, pp. 8, 22, 24), with some models showing up to 5 months ice-free by end of the century (Douglas 2010, pp. 12, 22, 24). In the most recent observational decade (1999–2008), the southern extent of the Arctic ice pack has retreated and advanced through the Bering Strait in the months of June and November, respectively. By the end of the century, these transition months may shift to May (1 month earlier) and January (2 months later), respectively (Douglas 2010, pp. 12, 25–26).

The projected loss of sea ice involves uncertainty. In discussing this, Douglas 2010 (p. 11) states, in part: "Ice-free conditions in the Chukchi Sea are attained for a 3-month period (August–October) at the end of the century (fig 7) with almost complete agreement among models of the SD2 subset (fig 12). Consequently, a higher degree of confidence can accompany hypotheses or decisions premised on this outcome and timeframe." Douglas also notes there is greater confidence in projections that the Chukchi Sea will continue to be completely ice covered during February–April at the end of century, and that large uncertainties are prevalent during the melt and freeze seasons, particularly June, November, and December (Douglas 2010, p. 11).

Several other investigations have analyzed model projections of sea-ice change in the Bering and Chukchi Seas and reported results that are consistent with those of Douglas (2010). Wang *et al.* (2010, p. 258) investigated sea-ice projections to mid-century for the Bering Sea using a subset of models selected on the basis of their ability to simulate sea-ice area in the late 20th century. Their projections show an average decrease in March–April sea-ice coverage of 43 percent by the decade centered on 2050, with a reasonable degree of consistency among models. Boveng *et al.* (2008, pp. 39–40) analyzed a subset of IPCC AR4 GCM models (selected for accuracy in simulating observed ice conditions) to evaluate spring (April–June) conditions in the Bering Sea out to 2050. Their analysis suggested that by mid-century, a modest decrease in the extent of sea ice in the Bering Sea is expected during the month of April, and that ice cover in May will remain variable, with some years having considerably reduced ice cover. June sea-ice cover in the Bering Sea since the 1970s has been consistently low or absent. Their models project that by 2050, ice cover in the Bering Sea will essentially disappear in June, with only a rare year when the ice cover exceeds 0.05 million sq km (0.03 million sq mi) (Boveng *et al.* 2008, pp. 39–40), a projection similar to that reported by Douglas (2010, p. 24).

Boveng *et al.* (2009, pp. 44–54) used a subset of IPCC AR4 models to further investigate sea-ice coverage in the eastern Bering Sea (the area of greatest walrus distribution in the Bering Sea), Bering Strait, and the Chukchi Sea out to 2070. For the eastern Bering Sea, they projected that sea-ice coverage will decline in the spring and fall, with fall declines exceeding those of spring. By 2050, average sea-ice extent in November and December would be approximately 14 percent of the 1980–1999 mean, while sea-ice extent from March to May would be about 70 percent of the 1980–1999 mean. For the Bering Strait region, the model projections indicated a longer ice-free period by 2050, largely as a result of decreasing ice coverage in November and December. By 2050, they project that the March–May sea-ice extent in the Bering Strait region would be 80 percent of the 1980–1999 mean, while November ice extent would be 20 percent of the mean for that reference period. For the Chukchi Sea, Boveng *et al.* (2009, pp. 49–50) reported a projected reduction in sea-ice extent for November by 2050, a slight decline for June by 2070, and a clear reduction for November and December by 2070.

Several authors note that sea-ice extent in the Arctic is decreasing at a rate faster than projected by most IPCC-recognized GCMs (Stroeve *et al.* 2007, p. 1; Overland and Wang 2007, p. 1; Wang and Overland 2009, p. 1; Wang *et al.* 2010, p. 258), suggesting that GCM projections of 21st century sea-ice losses may be conservative (Douglas 2010, p. 11, and citations therein) and that ice-free conditions in September in the Arctic may likely be achieved sooner than projected by most models using the A1B forcing scenario. In describing the "faster than forecast" situation, Douglas notes that the minimum ice extents in the Arctic for the summers of 2007–2009 were well below the previous record set in 2005, and concurs that serious consideration must be given to the possibility that the CMIP3 GCM projections collectively yield conservative time frames for sea-ice losses in this century (Douglas 2010, p. 11); i.e., the projected changes he reports for the range of the Pacific walrus may occur sooner than the model projections indicate.

In conclusion, the actual loss of sea ice in recent years in the Arctic has been faster than previously forecast, current GHG emissions are at or above those expected under the A1B scenario that we (and most scientists studying Arctic sea ice) relied on, models converge in predicting the extended absence of sea ice in the Chukchi Sea at the end of the century (Douglas 2010, pp. 12, 29), and there has been a marked loss of sea ice over the Chukchi Sea in the past decade. The best scientific information available gives us a high level of confidence that despite some uncertainty among the models, the projections are generally consistent and provide a reliable basis for us to conclude that sea-ice loss in the range of the Pacific walrus has a high likelihood of continuing.

Effects of Changing Sea-Ice Conditions on Pacific Walruses

The Pacific walrus is an ice-dependent species. Walruses are poorly adapted to life in the open ocean and must periodically haul out to rest. Floating pack ice creates habitat from which breeding behavior is staged (Fay *et al.* 1984, p. 81), and it provides a platform for calving (Fay 1982, p. 199), access to offshore feeding areas over the continental shelf of the Bering and Chukchi Seas, passive transportation among feeding areas (Ray *et al.* 2006, pp. 404–407), and isolation from terrestrial predators and hunters. In this section, we first analyze the effects of sea-ice loss on breeding and calving, because these are essential life-history events that depend on ice in specific seasons. In the second part of this section, we analyze how the anticipated increasing use of coastal haulouts due to the loss of sea-ice habitat may cause localized prey depletion and affect walrus foraging, as well as increase their susceptibility to trampling, predation, and hunting.

Effects of Sea-Ice Loss on Breeding and Calving

Breeding

During the January-to-March breeding season, walruses congregate in the Bering Sea pack ice (Fay 1982, pp. 8–11, 193; Fay *et al.* 1984, pp. 89–99), where the ice creates the stage for breeding. Females congregate in herds on the ice and the bulls station themselves in the water alongside the herd and perform visual and acoustical displays (Fay 1982, p. 193). Breeding aggregations have been reported southwest of St. Lawrence Island, Alaska, south of Nunivak Island, Alaska, and south of the Chukotka Peninsula in the Gulf of Anadyr, Russia (Fay 1982, p. 21; Mymrin *et al.* 1990, pp. 105–113). It is unlikely that breeding is tied to a specific geographic location, because of the large seasonal and inter-annual variability in sea-ice cover in the Bering Sea at this time of year. Fay *et al.* (1984, p. 80) indicate probable changes in the locations of breeding aggregations based on differing amounts of sea ice. We anticipate that seasonal pack ice will continue to form across large areas of the northern Bering Sea, primarily in January–March, and will persist in most years through April (Douglas 2010, p. 25).

The distribution of walruses during the winter breeding season will likely shift in the future in response to changing patterns of sea-ice development. Core areas of winter abundance south of Saint Lawrence Island and the Gulf of Anadyr will likely continue to have adequate ice cover to support breeding aggregations through mid-century, as the extent of sea ice will still be relatively substantial, although slightly diminished from the current extent (Douglas 2010, p. 25). Walruses currently wintering in Northern Bristol Bay will likely shift their distribution northward in response to the projected loss of seasonal pack ice in this region (Douglas 2010, p. 25). By the end of the century, winter sea-ice extent across the Bering Sea is expected to be greatly reduced, and the median sea-ice edge is projected to be farther to the north (Douglas 2010, p. 25). Based on these projections, core areas of winter abundance and breeding aggregations will likely shift farther north. Potentially, the breeding aggregations may shift into areas north of the Bering Strait in the southern Chukchi Sea in some years by the end of the century (Douglas 2010, pp. 24, 28).

Although the location of winter breeding aggregations will likely shift in response to projected reductions in sea-ice extent, sea-ice platforms for herds of females will persist during the breeding season; therefore, we conclude that suitable conditions for breeding will likely persist into the foreseeable future. We have no information that indicates that the specific location of the ice is important, and sea ice is expected to remain over shallow, food-rich areas. Therefore, we do not consider changes in sea-ice extent during the winter breeding season to be a threat now or in the foreseeable future.

Calving

Female walruses typically give birth to a single calf in May on sea ice, shortly before or during the northward spring migration through the Bering Strait. By mid-century, ice extent in the Bering Strait Region is projected to be reduced during the May calving season, and by end of century, the Bering Sea is projected to be largely sea-ice-free during the month of May (Douglas 2010, p. 25). As is the case with breeding, the birth of a calf and the natal period in the weeks that follow are probably not tied to specific geographic locations. It is reasonable to assume that suitable ice conditions for calving and post-calving activity on sea ice will persist into the foreseeable future, even though the location of favorable ice conditions is likely to shift further to the north over time.

We conclude that changes in sea ice during the spring calving season (April–May) are not a threat now or in the foreseeable future. We have no information that indicates the specific location of the ice is important, and sea ice would remain over shallow, food-rich areas.

Summary of Effects of Sea-Ice Loss on Breeding and Calving

Breeding and calving activities utilize ice as a platform in the months of January through May. Based on our current understanding of these activities, the specific location of the ice is not important. Although sea-ice extent is projected to move northward over time, sea ice is expected to persist in these months and be available for these life history functions. Therefore, we do not consider changes in sea-ice extent to be a threat to breeding or calving activities now or in the foreseeable future.

Effects of Increasing Dependence on Coastal Haulouts Due to Sea-Ice Loss

We begin this discussion with a summary of sea-ice loss projections and recent observations. We follow with an analysis of the potential effects to Pacific walrus from an increasing dependence on coastal haulouts, particularly in the Chukchi Sea, and examine the use of coastal haulouts by Atlantic walrus as a potential analog for Pacific walrus coastal haulout use. We analyze potential effects of increased dependency on coastal haulouts resulting from the loss of sea-ice habitats. Some of the effects to Pacific walrus that we have identified as a result of increasing dependence on coastal haulouts (i.e., trampling, predation, and hunting) would typically be discussed under other Factors. These effects are discussed in this section in the context of responses to declining sea ice; however, it should be noted that we also discuss predation under Factor C (*Disease or Predation*), and hunting under Factor B (*Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*) and Factor D (*The Inadequacy of Existing Regulatory Mechanisms*).

Summary of Sea-Ice Loss Projections

Sea ice has historically persisted over continental shelf regions of the Chukchi Sea through the entire melt season. Over the past decade, sea ice has begun to retreat beyond shallow continental shelf waters in late summer. The recent trend of rapid ice loss from continental shelf regions of the Chukchi Sea in July and August is projected to persist, and will likely accelerate in the future (Douglas 2010, p. 12). The onset of ice formation in the fall over continental shelf regions in the Chukchi and Bering Seas is expected to be delayed, and by mid-century (2045–2054), ice-free conditions over most continental shelf regions of the Chukchi Sea are projected to persist for 2 months (August–September). By late century, ice-free (or nearly sea-ice-free) conditions may persist for 3 months, and extend to 4 to 5 months in some years (Douglas 2010, pp. 8, 12, 22, 27). The average number of ice-free months in the Bering Sea is projected to increase from the approximately 5.5 months currently, to approximately 6.5 and 8.5 months at mid- and end of century, respectively (Douglas 2010, pp. 12, 27).

Observed and Expected Responses of Pacific Walruses to Declining Sea-Ice Habitats

Adult male walruses make greater use of coastal haulouts during ice-free seasons than do females and dependent young, and consequently, have a broader distribution during ice-free seasons. Several thousand bulls remain in the Bering Sea through the ice-free summer months, where they make foraging excursions from coastal haulouts in Bristol Bay, Alaska and the Gulf of Anadyr, Russia. The size of these haulouts has changed over time; for example, at Round Island, the number of hauled out walruses grew from about 3,000 animals in the late 1950s to about 12,000 in the early 1980s (Jay and Hills 2005, p. 193), and has subsequently declined to 2,000–5,000 animals in the past decade (Sell and Weiss 2010, p. 12). The reasons for changes in walrus haulout use in the Bering Sea are poorly understood. Factors that could affect use of haulouts include; prey abundance and distribution, walrus density, and physical alteration or chronic disturbance at the haulouts (Jay and Hills 2005, p. 198). Tagged males traveled up to 130 km (81 mi) to feed from haulout sites in Bristol Bay (Jay and Hills 2005, p. 198). Because the benthic densities are poorly documented, it is not possible to link the changes in haulout use by males to prey depletion. However, non-use of areas with shallow depths closer to the haulouts suggests prey was not adequate for effective foraging (Jay and Hills 2005, p. 198). Males have an advantage over females in that they are bigger and stronger and have no responsibilities related to the care of calves, and thus, can travel as far as necessary to locate food. Currently, males utilize terrestrial haulouts for 5 months or more (Jay and Hills 2005, p. 198). It is unlikely that the projected increase in ice-free months in the Bering Sea will alter male behavior or survival rates at terrestrial haulouts because the adult males that utilize Bering Sea haulouts do not rely on sea ice as a foraging platform. Indirect effects of global climate change on walrus prey species in this region are considered separately below in the section: *Effects of Global Climate Change on Pacific Walrus Prey Species.*

Most of the Pacific walrus population (adult females, calves, juveniles, and males that have not remained at coastal haulouts in the Bering Sea) migrate northward in spring following the retreating pack ice through the Bering Strait to summer feeding areas over the continental shelf in the Chukchi Sea. Historically, sufficient pack-ice habitat has persisted over continental shelf regions of the Chukchi Sea through the summer months such that walruses in the Chukchi Sea did not rely on coastal haulouts with great frequency or in large numbers. Over the past decade, however, sea ice has begun to retreat north beyond shallow continental shelf waters of the Chukchi Sea in late summer. This has caused walruses to relocate to coastal haulouts, which they use as sites for resting between foraging excursions. The number of walruses using land-based haulouts along the Chukchi Sea coast during the summer months, and the duration of haulout use, has increased substantially over the past decade, with up to several tens of thousands of animals hauling out at some locations along the coast of Russia during ice-free periods (Ovsyanikov *et al.* 2007, pp. 1–2; Kochnev 2008, p. 17–20, Kavry *et al.* 2008, p. 248–251). Coastal haulouts have also begun to form along the Arctic coast of Alaska in recent years (2007, 2009, and 2010) when sea ice retreated north of the continental shelf in late summer (Service 2010, unpublished data). The occupation of terrestrial haulouts along the Chukchi Sea coast for extended periods of time in late summer and fall represents a relatively new and significant change from traditional habitat use patterns. The consequences of this observed and projected shift in habitat use patterns is the primary focus of our analysis.

As sea ice withdraws from offshore feeding areas over the continental shelf of the Chukchi Sea, walruses are expected to become increasingly dependent on coastal haulouts as a foraging base during the summer months. With a delay the onset of ice formation in the fall, and in the absence of sea-ice cover in the southern Chukchi Sea and northern Bering Sea in the summer, walruses will likely remain at coastal haulouts for longer periods of time until sea ice reforms in the fall or early winter. By the end of the century, dependence on Chukchi Sea coastal haulouts by mixed groups of walruses for resting and as a foraging base may extend from July into early winter (December–January), when there may be up to a 2-month delay in freeze-up (Douglas 2010, pp. 12, 22). This expectation is consistent with observations made by Russian scientists that some of the coastal haulouts along the southern Chukchi Sea coast of Russia have persisted in recent years into December (Kochnev 2010, pers. comm.).

Increased dependence on coastal haulouts creates the following potential impacts for walruses: Changes in foraging patterns and prey depletion; increased vulnerability to mortality or injury due to trampling, especially for calves, juveniles, and females; greater vulnerability to mortality or injury from predation; and greater vulnerability to mortality due to hunting. Each is discussed in detail below.

Changes in Foraging Patterns and Prey Depletion

The loss of seasonal pack ice from continental shelf areas of the Chukchi Sea is expected to reduce access to traditional foraging areas across the continental shelf and increase competition among individuals for food resources in areas close to haulouts. Information regarding the density of walrus prey items accessible from coastal haulouts is limited; however, some haulouts have supported sizable concentrations of animals (up to several tens of thousands of animals) for periods of up to 4 months in recent years (Kochnev 2010, pers. comm.). Many walrus prey species are slow growing and potentially vulnerable to overexploitation, and intensive foraging from coastal haulouts by large numbers of walruses may eventually result in localized prey depletion (Ray *et al.* 2006, p. 412). A walrus requires approximately 29 to 74 kg (64 to 174 lbs) of food per day (Fay 1982, p. 160), and may consume 4,000 to 6,000 clams in one feeding bout (Ray *et al.* 2006, pp. 408, 412); therefore, when large numbers of walruses are concentrated on coastal haulouts, a large amount of prey (whether clams or other types of prey) must be available to support them.

The presence of large numbers of walruses at a coastal haulout over an extended time period could eventually lead to localized prey depletion. The most likely response to localized prey depletion will be for walruses to seek out and colonize other terrestrial haulouts that have suitable foraging areas (Jay and Hills 2005, p. 198). However, prey densities along the Arctic coast are not uniform (Grebmeier *et al.* 1989, p. 257; Feder *et al.* 1994, pp. 176–177; Grebmeier *et al.* 2006b, p. 346), and many coastal areas which provide the physical features of a suitable haulout, may not have sufficient food sources. A visual comparison of areas of high benthic production (*e.g.,* Springer *et al.* 1996, p. 209; Dunton *et al.* 2005, p. 3468; Grebmeier *et al.* 2006b, p. 346) and areas that have supported large terrestrial haulouts of walruses (*e.g.,* Cape Inkigur, Cape Serdtse-Kamen) indicates that walruses have historically selected sites near areas of very high benthic productivity. Benthic productivity along part of the western shore of Alaska (i.e., along the eastern edge of the Chukchi Sea) is low because of the nutrient-poor waters of the Alaska Coastal Current, especially for instance, in the Kotzebue Sound (Dunton *et al.* 2005, p. 3468; Dunton *et al.* 2006, p. 369; Grebmeier *et al.* 2006b, p. 346). Consequently, the number of sites with adequate food resources to support large aggregations of walruses is likely limited.

A consequence of prey depletion could be an increased energetic cost to locate sufficient food resources (Sheffield and Grebmeier 2009, p. 770; Jay *et al.* 2010b, pp. 9–10). Energetic costs to walruses will increase if they have to travel greater distances to locate prey, or foraging efficiency is reduced as a consequence of lower prey densities (Sheffield and Grebmeier 2009, p. 770; Jay *et al.* 2010b, pp. 9–10). Observations by Russian scientists at haulouts along the coast of Chukotka (along the western side of the Chukchi Sea) in recent years suggest that rates of calf mortality and poor body condition of adult females are inversely related to the persistence of sea ice over offshore feeding areas and the length of time that animals occupy coastal haulouts (Nikiforov *et al.* 2007, pp. 1–2; Ovsyanikov *et al.* 2007, pp. 1–3; Kochnev 2008, pp. 17–20; Kochnev *et al.* 2008, p. 265). Over time, poor body condition could lead to lower reproductive rates, greater susceptibility to disease or predation, and ultimately higher mortality rates (Kochnev 2004, pp. 285–286; Kochnev *et al.* 2008, p. 265; Sheffield and Grebmeier 2009, p. 770).

The energetic cost of swimming a long distance is demonstrated by the observations made in the summer of 2007, when the melt season in the Chukchi Sea began slowly, and then sea-ice retreat accelerated rapidly in July and August. The continental shelf of the Chukchi Sea was sea-ice-free by mid-August; the ice edge eventually retreated hundreds of miles north of the shelf, and ice did not re-form over the continental shelf until late October (National Snow and Ice Data Center, 2007). Ovsyanikov *et al.* (2007, pp. 2–3) reported that many of the walruses arriving at Wrangel Island, Russia, in August 2007 were emaciated and weak, some too exhausted to flee or defend themselves from polar bears patrolling the coast. The authors attributed the poor condition of these animals to the rapid retreat of sea ice off of the shelf in July to waters too deep for walrus to feed. They also noted that the exhausted walruses could not find enough food near the island for recovery (Ovsyanikov *et al.* 2007, p. 3).

Females with dependent young are likely to be disproportionally affected by prey depletion and increased reliance on coastal haulouts as a foraging base. Females with dependent young require two to three times the amount of food needed by nonlactating females (Fay 1982, p. 159). Over the past decade, females and dependent calves have responded to the loss of sea ice in late summer by occupying coastal haulouts along the coast of Chukotka, Russia, and more recently (2007–2010) haulouts along the coast of Alaska. Females typically nurse their calves between short foraging forays from sea-ice platforms situated over productive forage areas (Ray *et al.* 2006, pp. 404–407). Drifting ice provides walrus passive transport and access to new foraging areas with minimal effort. In 2007, radio-tagged females traveled on average, 30.7 km (19 mi) on foraging trips from several haulouts located along the Chukotka coastline (Kochnev *et al.* 2008, p. 265). Although we do not know the average distance of foraging trips taken from an ice platform, in general, we would expect them to be relatively short, because when the ice is over productive prey areas, the female only has to dive to the bottom and back up to the ice (Ray *et al.* 2006, pp. 406–407). Because calves do not have the swimming endurance of adults, if sufficient prey is not located within the swimming distance of the calf, the female either may not be able to obtain adequate nutrition or the calf may be abandoned when the female travels to locations beyond the swimming capability of the calf (Cooper *et al.* 2006, pp. 98–102). Lack of adequate prey for females could eventually lead to reduced body condition, lower reproductive success, and potentially death. Abandoned calves could face increased mortality from drowning, starvation, or predation.

In summary, by the end of the 21st century, ice-free conditions are expected to persist across the continental shelf of the Chukchi Sea for a period of up to several months (Douglas 2010). Based on the observed responses of walruses to periods of low ice cover in the Chukchi Sea in recent years, we expect walruses to become increasingly dependent on coastal haulouts as a foraging base, with animals restricted to coastal haulouts for most of the summer and into the fall and early winter. Walruses have the ability to use land in addition to ice as a resting site and foraging base, which will provide them alternate, if not optimal (as explained above), resting habitat. However, given the concentration of large numbers of animals in relatively small areas, the large amount of prey needed to sustain each walrus, and the increasing length of time coastal haulouts will have to be used due to sea-ice loss, the increased dependence on coastal haulouts is expected to result in increased competition for food resources in areas accessible from the coastal haulouts. Because of the energetic demands of lactation and limited mobility of calves, female walruses with dependent young are likely to be disproportionally affected by changes in habitat use patterns. Because near-shore food resources are unlikely to be able to support the current population, walruses will be required to swim farther to obtain prey, which will increase energetic costs. Accordingly, near-shore prey depletion will likely result in a population decline over time. It is unlikely that the projected increase in ice-free months in the Bering Sea will alter the behavior or survival rates of males at terrestrial haulouts because these males do not rely on sea ice as a foraging platform. In addition, males have an advantage over females in that they are bigger and stronger and have no responsibilities related to the care of calves, and thus, can travel as far as necessary to forage.

The degree to which depletion of food resources near coastal haulouts will limit population size will depend on a variety of factors, including: The location of coastal walrus haulouts, the number of animals utilizing the haulouts, the duration of time walruses occupy the haulouts, and the robustness of the prey base within range of those haulouts. However, it is highly unlikely that the current population can be sustained from coastal haulouts alone. In particular, females and their calves will be susceptible to the increased energetic demands of foraging from coastal haulouts. We do not anticipate effects to males using coastal haulouts in the Bering Sea, because their current behavior can continue unaltered into the future. We do not have evidence that prey depletion is currently having a population-level effect on the Pacific walrus. Our concern is based on projections of continued and more extensive sea-ice loss that will force the animals onto land. Therefore, we conclude that loss of sea-ice habitat, leading to dependence on coastal haulouts and localized prey depletion, will contribute to other negative impacts associated with sea-ice loss, and is a threat to the Pacific walrus in the foreseeable future.

Increased Vulnerability to Disturbances and Trampling

Another consequence of greater reliance on coastal haulouts is increased levels of disturbances and increased rates of mortalities and injuries associated with trampling. Walruses often flee land or ice haulouts in response to disturbances. Disturbance can come from a variety of sources, either anthropogenic (*e.g.,* hunters, airplanes, ships) or natural (*e.g.,* predators) (Fay *et al.* 1984, pp. 114–118, Kochnev 2004, p. 286). Haulout abandonment represents an increase in energy expenditure and stress, and disturbance events at densely packed coastal haulouts can result in intra-specific trauma and mortalities (COSEWIC 2006, pp. 25–26). Although disturbance-related mortalities at all-male haulouts in the Bering Sea are relatively uncommon (Fay and Kelly 1980, p. 244; Kochnev 2004, p. 285), the situation at mixed haulouts is different; because of their smaller size, calves, juveniles, and females are more susceptible to trampling injuries and mortalities (Fay and Kelly 1980, pp. 226, 244). Females likely avoid using terrestrial haulouts because their offspring are vulnerable to predation and trampling (Nikiforov *et al.* 2007, pp. 1–2; Ovsyanikov *et al.* 2007, pp. 1–3; Kochnev 2008, pp. 17–20; Kochnev *et al.* 2008, p. 265).

When walruses are disturbed on ice floes, escape into the water is relatively easy because fewer animals are concentrated in one area. In comparison, aggregations of walruses on land are often very large in number, densely packed, and "layered" several animals deep (Nikiforov *et al.* 2007, p. 2). The presence of some large males in groups using Chukchi Sea coastal haulouts increases the danger to calves, juveniles, and females. Consequently, the probability of direct mortality or injury due to trampling during stampedes is greater at terrestrial haulouts than it is on pack ice (USFWS 1994, p. 12). Also, whether on ice or land, calves may be abandoned as a result of disturbance to a haulout (Fay *et al.* 1984, p. 118).

In addition, sources of disturbance are expected to be greater at terrestrial haulouts than in offshore pack ice habitats, because the level of human activity such as hunting, fishing, boating, and air traffic is far greater along the coast. Haulout abandonment has been documented from these sources (Fay *et al.* 1984; p. 114; Kochnev 2004, pp. 285–286). There is also a greater chance of disturbance from terrestrial animals (Kochnev 2004, p. 286). As sea ice declines, and both polar bears and walruses are increasingly forced onto land bordering the Chukchi Sea, we anticipate that there will be greater interaction between the two species, especially during the summer. We expect that one outcome of increased interactions will be increased walrus mortality due to predation (discussed below). Of equal, or more importance than predation is the disturbance caused at a haulout through the arrival or presence of a polar bear, which can cause stampeding. Repeated stampeding also increases energy expenditure and stress levels, and may cause walruses to abandon the haulout (COSEWIC 2006, p. 25).

Losses that can occur when large numbers of walruses use terrestrial haulouts are illustrated by observations in 2007, along the coast of Chukotka, Russia. In response to summer sea-ice loss in 2007, walruses began to arrive at coastal haulouts in July, a month earlier than previously recorded (Kochnev 2008, pp. 17–20). Coastal aggregations ranged in size from 4,500 up to 40,000 animals (Ovsyanikov *et al.* 2007, pp. 1–2; Kochnev 2008, p. 17–20, Kavry *et al.* 2008, p. 248–251). Hunters from the Russian coastal villages of Vankarem and Ryrkaipii reported more than 1,000 walrus carcasses (mostly calves of the year and aborted fetuses) at coastal haulouts near the communities in September 2007 (Nikiforov *et al.* 2007, p. 1; Kochnev 2008, pp. 17–20). Noting the near absence of calves amongst the remaining animals, Kochnev (2008, pp. 17–20) estimated that most of the 2007 cohort using the site had been lost. Approximately 1,500 walrus carcasses (predominately adult females) were also reported near Cape Dezhnev in late October (Kochnev 2007, pers. comm.). Russian investigators estimate that between 3,000 and 10,000 animals died along the Chukotka coastline during the summer and fall of 2007, primarily from trampling associated with disturbance events at the haulouts (Kochnev 2010, pers. comm.).

Relatively few large mortality events at coastal haulouts have been documented in the past, but they have occurred (Fay 1982, p. 226). For example, Fay and Kelly (1980, p. 230) examined several hundred walrus carcasses at coastal haulouts on St. Lawrence Island and the Punuk Islands in the fall of 1978. Approximately 15 percent of those carcasses were aborted fetuses, 24 percent were calves, and the others were older animals (mostly females) ranging in age from 1 to 37 years old. The principal cause of death was trampling, possibly from disturbance-related stampedes or battling bulls. As walruses become increasingly dependent on coastal haulouts, interactions with humans and predators are expected to increase and mortality events are likely to become increasingly common. Long-term or chronic levels of disturbance related mortalities at coastal haulouts are likely to have a more significant population effect over time.

We recognize that Atlantic walruses (including females and calves) utilize coastal haulouts to a greater extent than Pacific walruses, foraging from shore along a relatively narrow coastal shelf; a situation that is similar to what Pacific walrus may experience in the future during ice-free months in the Chukchi Sea. However, Atlantic walrus occupy an area with abundant remote islands that are free or nearly free from disturbance from humans or terrestrial mammals. In essence, their insular habitats function in a manner analogous to the pack ice of the Pacific walrus, providing a refugium from disturbance. In contrast, when Pacific walruses are restricted to terrestrial haulouts, they face disturbance from a variety of terrestrial predators and scavengers, including bears, wolverines, wolves, and feral dogs, and higher levels of anthropogenic disturbances, because their haulouts are at the edge of continental land masses and there are very few islands in the Bering and Chukchi Seas. Sea ice, which has typically acted as a refugium from disturbance for Pacific walruses, particularly for females and young in the Chukchi Sea, will be lost entirely, or almost entirely, for increasingly long time periods annually in the foreseeable future. Therefore, although use of coastal haulouts is a form of adaptability available to Pacific walruses, it comes with negative impacts that are not associated with coastal haulouts for Atlantic walruses.

In summary, we anticipate that Pacific walruses will become increasingly dependent on coastal haulouts as sea ice retreats earlier off the continental shelf and the Bering and Chukchi Seas become ice-free for increasingly longer periods of time. The protection normally provided to females and calves by the dispersal of smaller groups of animals across a wide expanse of sea ice will be lost during periods of ice-free or nearly ice-free conditions. Significant mortality events from trampling have been documented at large haulouts, and we anticipate that they will continue with much greater frequency into the foreseeable future, resulting in increased mortality, particularly of calves and females. Therefore, we conclude that disturbances and trampling at haulouts is a threat to the Pacific walrus now and in the foreseeable future.

Increased Vulnerability to Predation and Hunting

As Pacific walruses become more dependent on coastal haulouts, they will become more susceptible to predation and hunting (Kochnev 2004, p. 286). Although hunting and predation are discussed separately below (see Factors B and C, respectively), we also consider them here due to their relationship to increased loss of sea-ice habitat.

Because of their large size and tusks, adult walruses are much less susceptible to predation than are young animals or females. Females likely avoid using terrestrial haulouts because their offspring are vulnerable to predation (Kochnev 2004, p. 286; Ovsyanikov *et al.* 2007, pp. 1–4; Kelly 2009, p. 302). Apparently, some polar bear routinely rush herds to cause a stampede, expecting that some calves will be left behind (Nikulin 1941; Popove 1958, 1960; as cited in Fay *et al.* 1984, p. 119). As sea ice declines in the foreseeable future, increased use of terrestrial habitats by both polar bears and walruses will likely lead to increased interaction between them, and most likely an increase in mortality, particularly of calves. We conclude that loss of sea ice, which will force increased overlap between these two species, will increase mortality from polar bears through direct take or indirect take due to trampling during stampedes. See the section on predation in Factor C below, for further information.

Large concentrations of walruses on shore for longer periods of time could result in increased harvest levels if the terrestrial haulouts form near coastal villages and environmental conditions allow access to haulouts. Kochnev (2004, pp. 285–286) notes that many of the haulouts along the Chukotka coast are situated near coastal villages, and hunting activities at the haulouts can result in stampedes and cause movements from one haulout to another. Some communities in Chukotka situated in close proximity to the new haulouts have responded by developing hunting restrictions to limit disturbances to resting animals (Patrol 2008, p. 1; Kavry 2010, pers. comm.; Kochnev 2010 pers. comm.). See the section on Subsistence Hunting in Factor B below, for further information.

Summary of the Effects of Sea-Ice Loss on Pacific Walruses

The Pacific walrus is an ice-dependent species. Changes in the extent, volume, and timing of the sea-ice melt and onset of freezing in the Bering and Chukchi Seas have been documented and described earlier in this finding, there are reliable projections that more extensive changes will occur in the foreseeable future. We expect these changes in sea ice will cause significant changes in the distribution and habitat-use patterns of Pacific walruses. At this time we anticipate that breeding behavior in winter and calving in the early spring will not be impacted by expected changes to sea-ice conditions, although the locations where these events occur will most likely change as the location of available sea ice shifts to the north.

With the loss of summer sea ice, the most obvious change, which has already been observed, will be a greater dependence on terrestrial haulouts by both sexes and all age groups. Although walruses of both sexes are capable of using terrestrial haulouts, historically, adult males have used terrestrial haulouts, particularly in the Bering Sea, to a much greater extent than females, calves, and juveniles. The loss of summer sea ice means that walruses of both sexes, but females and their young in particular, will be using coastal haulouts for longer periods of time. This change is particularly notable in the Chukchi Sea, which has historically had sufficient sea ice in the summer so that females and calves could remain over the shallow continental shelf throughout the summer. Since approximately 2005, the Chukchi Sea has become ice-free or nearly so during part of the summer. This condition is projected to increase over time, and may occur faster than forecast. The consequences of this shift from sea ice to increasing use of land include: Risk of localized prey depletion; increased energetic costs to reach prey, resulting in decreased body condition; calf abandonment; increased mortality from stampedes, especially to females, juveniles, and calves; and potentially increased exposure to predation and hunting. These events are expected to reduce survivorship.

As large numbers of animals are concentrated at coastal haulouts, prey may be locally depleted, and greater distances will be required to obtain it. Although males at haulouts in the Bering Sea function for several months each year from terrestrial haulouts, females with calves do not typically use terrestrial haulouts, and we expect the loss of sea ice to have a greater impact on them through the higher energetic cost of obtaining food. It is likely that these factors will lead to a population decline over time, as fewer walruses can be supported by the resources available from terrestrial haulouts. In the foreseeable future, as the duration of ice-free periods over offshore continental shelf regions of the Chukchi Sea increases from 1 to up to 5 months (July through November), we expect the effects of prey depletion near terrestrial haulouts will be heightened.

Periodic ice-free conditions, as are currently occurring, are expected to lead to higher mortality rates, primarily through trampling at haulouts when walruses congregate in large numbers. Although of concern, if these events happen sporadically, as has been the case in the past, the population may be able to recover between harsh years. Although trampling mortalities have been documented in the past, increasing use of terrestrial haulouts, the higher probability of disturbance occurring at these haulouts, and in the near-term, the very large numbers of animals using particular haulouts, increases the probability that mortality from trampling will become a more regular event.

The increasing reliance of both polar bears and walruses on terrestrial environments during ice free periods will likely result in increased interactions between these two species. Polar bear predation and associated disturbances at densely crowded coastal haulouts will likely contribute to increased mortality levels, particularly of calves, and may displace animals from preferred feeding areas. Hunting activity at coastal haulouts does not appear to be a significant source of mortality at the present time, but may become more of a factor in the future. Local hunting restrictions at coastal haulouts have been established in some communities in Chukotka to reduce disturbance-related mortalities. The efficacy of efforts to mitigate sources of anthropogenic disturbances at coastal walrus haulouts (including hunting, boating and air traffic) will influence the degree to which these factors will affect the Pacific walrus population. See Factors B and C for further discussion on harvest and predation.

In conclusion, the loss of sea-ice habitat creates several stressors on the Pacific walrus population. These stressors include: localized prey depletion; increased energetic costs to reach prey, resulting in decreased body condition; calf abandonment; increased mortality from stampedes, especially to females, juveniles, and calves; and increased exposure to predation and hunting. Because the Pacific walrus range is large, and the animals are not all in the same place at the same time, not all stressors are likely to affect the entire population in a given year. However, all stressors represent potential sources of increased mortality over the current condition, in which these stressors occur infrequently. In the foreseeable future, as the frequency of sea-ice loss in the summer and fall over the continental shelves increases to a near-annual event and the length of time ice is absent over the continental shelf increases from 1 to up to 5 months, we expect the effects on walruses to be heightened and a greater percentage of the population to be affected. Increased direct and indirect mortality, particularly of calves, juveniles, and females, will result in a declining population over time. Consequently, we conclude that the destruction, modification, and curtailment of sea-ice habitat is a threat to the Pacific walrus.

Outcome of Bayesian Network Analyses

Both the Service and USGS Bayesian network analyses (Garlich-Miller *et al.* 2011; Jay *et al.* 2010b) considered changes in sea ice projected through the 21st century. In both cases, the results indicate that expected loss of sea ice is an important risk factor for Pacific walrus population status over time. The USGS analysis deals more directly with projected outcomes of the Pacific walrus population, including the influence of sea-ice loss under different potential conditions (Jay *et al.* 2010b, p. 40). For the normative sea ice run (see Jay *et al.* 2010b for details), the probability of Pacific walruses becoming vulnerable, rare, or extirpated increases over time, from approximately 22 percent in 2050, to about 35 percent by 2075, and 40 percent in 2095 (Jay *et al.* 2010b, p. 40). A “worst case” influence run was also evaluated. For the worst case, model outputs were selected that have both the greatest number of ice-free months and the least ice extent for the Bering and Chukchi Seas and, therefore, represent the worst possible situation. The outcome for the worst case influence run for sea ice indicated that the probability of Pacific walruses becoming vulnerable, rare, or extirpated approximately doubles at mid-century to 40 percent, and reaches approximately 45 percent at 2075 (Jay *et al.* 2010b, p. 40). At the end of 21st century, the probability of Pacific walruses becoming vulnerable, rare, or extirpated in both the worst case scenario and the normative run are essentially equal, at about 40 percent; an outcome that is due to the projected amount of sea-ice loss being basically the same under the worst case and normative case by the end of the century. We note, however, that the models and emissions scenarios used by the IPCC in 2007 were the basis for this analysis. Thus, it is possible that the “worst case scenario” reflects the “faster than forecast” loss of sea ice that may be realized if sea-ice loss continues on the current downward trend that began in 1979 (National Snow and Ice Data Center, 2010). Regardless of which trajectory will actually occur, the modeling efforts show that the future status of the Pacific walrus is linked to sea ice, which already is declining substantially, and more rapidly than previously projected.

Effects of Global Climate Change on Pacific Walrus Prey Species

The shallow, ice-covered waters of the Bering and Chukchi Seas provide habitat that supports some of the highest benthic biomass in the world (Grebmeier *et al.* 2006a, p. 1461; Ray *et al.* 2006, p. 404). Sea-ice algae, pelagic (open ocean) primary productivity, and the benthos (organisms that live on or in the sea floor) are tightly linked through the sedimentation of organic particles (Grebmeier *et al.* 2006b, p. 339). Sea-ice algae provide a highly concentrated and high-quality food source for plankton food webs in the spring, which translates to high-quality food for the benthos such as clams (Grebmeier *et al.* 2006b, p. 339; McMahon *et al.* 2006, pp. 2–11; Gradinger 2009, p. 1211). Because zooplankton, which also feed on the algae, have correspondingly low populations at this time in the spring, much of the primary productivity of algae falls to the sea floor, where it is available to the benthic invertebrates (Grebmeier *et al.* 2006b, p. 339).

Spatial distribution and abundance in biomass in benthic habitat across the Bering and Chukchi Seas is influenced by a variety of ecological, oceanographic, and geomorphic features. In the subarctic region of the Bering Sea (from the Bering Strait south to latitude 50 degrees), benthic organisms are preyed upon by demersal fish (living near the bottom of the water column) and epifaunal invertebrates (those organisms living on top of the sea floor rather than in it), whose distribution is limited to the north by cold water (less than 0 °C (32 °F)) resulting from seasonal sea-ice cover, forming a temperature-mediated ecological boundary. In the absence of demersal fish and predatory invertebrates, benthic-feeding whales, walrus, and sea-birds are the primary consumers in the Arctic region of the Bering Sea (Grebmeier *et al.* 2006b, pp. 1461–1463).

Within the Arctic region of the Bering Sea, marginal sea-ice zones and areas of polynyas appear to be "hot spots" of high benthic diversity and productivity (Grebmeier and Cooper 1995, p. 4439). Benthic biomass is particularly high in the northern Bering Sea, the southern Chukchi Sea, and the Gulf of Anadyr. However, the high diversity and productivity of the benthic communities is not seen in the Southern Beaufort Sea shelf and areas of the eastern Chukchi Sea, which are influenced by the nutrient-poor Alaska coastal current (Fay *et al.* 1977, p. 12; Grebmeier *et al.* 1989, p. 261; Feder *et al.* 1994, p. 176; Smith *et al.* 1995, p. 243; Grebmeier *et al.* 2006b, p. 346; Bluhm and Gradinger 2008, p. 2).

Ocean Warming

For the last several decades, surface air temperatures throughout the Arctic, over both land and water, have warmed at a rate that exceeds the global average, and they are projected to continue on that path (Comiso and Parkinson 2004, pp. 38–39; Christensen *et al.* 2007, p. 904; Lawrence *et al.* 2008, p. 1; Serreze *et al.* 2009, pp. 11–12). In addition, the subsurface and surface waters of the Arctic Ocean and surrounding seas, including the Bering and Chukchi Seas have warmed (Steele and Boyd 1998, p. 10419; Zhang *et al.* 1998, p. 1745; Overland and Stabeno 2004, p. 309; Stabeno *et al.* 2007, pp. 2607–2608; Steele *et al.* 2008, p. 1; Mueter *et al.* 2009, p. 96). There are several mechanisms working in concert to cause these increases in ocean temperature, including: Warmer air temperatures (Comiso and Parkinson 2004, pp. 38–39; Overland and Stabeno 2004, p. 310), an increase in the heat carried by currents entering the Arctic from both the Atlantic (Drinkwater *et al.,* p. 25; Zhang *et al.* 1998, p. 1745) and Pacific Oceans (Stabeno *et al.* 2007, p. 2599; Woodgate *et al.* 2010, p. 1–5), and a shorter ice season, which decreases the albedo (reflective property) of ice and snow (Comiso and Parkinson 2004, p. 43; Moline *et al.* 2008, p. 271; Markus *et al.* 2009, p. 13). Due to their biological characteristics which include tolerance of considerable variations in temperature, direct effects to walrus are not anticipated with warmer ocean temperatures. Nevertheless, changes in the thermal dynamics of ocean conditions may affect walrus indirectly through impacts to their prey base. Changes to density, abundance, distribution, food quality, and species of benthic invertebrates may occur primarily through changes in habitat related to sea ice.

Walruses are the top predator of a relatively simple food web in which the primary constituents are bacteria, sea-ice algae, phytoplankton (tiny floating plants), and benthic invertebrates (Horner 1976, p. 179; Lowry and Frost 1981, p. 820; Grebmeier and Dunton 2000, p. 65; Dunton *et al.* 2006, p. 370; Aydin and Mueter 2007, p. 2507). Sea ice is important to the Arctic food webs because: (1) It is a substrate for ice algae (Horner 1976, pp. 168–171; Kern and Carey Jr. 1983, p. 161; Grainger *et al.* 1985, pp. 25–27; Melnikov 2000, pp. 79–81; Gradinger 2009, p. 1201); (2) it influences nutrient supply and phytoplankton bloom dynamics (Lovvorn *et al.* 2005, p. 136); and (3) it determines the extent of the cold-water pool on the southern Bering shelf (Aydin and Mueter 2007, p. 2503; Coyle *et al.* 2007, p. 2900; Stabeno *et al.* 2007, p. 2615; Mueter and Litzow 2008, p. 309).

In the spring, ice algae form up to a 1-cm- (0.4-in-) thick layer on the underside of the ice, but are also found at the ice surface and throughout the ice matrix (Horner 1976, pp. 168–171; Cota and Horne 1989, p. 111; Gradinger *et al.* 2005, p. 176; Gradinger 2009, p. 1207). Ice algae can be released into the water through water turbulence below the ice, through brine drainage through the ice, or when the algal mats are sloughed as the ice melts (Cota and Horne 1989, p. 117; Renaud *et al.* 2007, p. 7). As noted above, sea-ice algae provide a highly concentrated food source for the benthos and the plankton (organisms that float or drift in the water) food web that is initiated once the ice melts (Grebmeier *et al.* 2006b, p.339; McMahon *et al.* 2006, pp. 1–2; Renaud *et al.* 2007, pp. 8–9; Gradinger 2009, p. 1211). Areas of high primary productivity support areas of high invertebrate mass, which is food for walruses (Grebmeier and McRoy 1989, p. 87; Grebmeier *et al.* 2006b, p. 332; Bluhm and Gradinger 2008, p. S87).

Spring ice melt plays an important role in the timing, amount, and fate of primary production over the Bering Sea shelf, with late melting (as occurs now) leading to greater delivery of food from primary production to the benthos and earlier melting (as is projected to occur in the future) contributing food primarily to the pelagic system (Aydin and Mueter 2007, p. 2505; Coyle *et al.* 2007, p. 2901). When ice is present from late March to May (as occurs now), cold surface temperatures, thinning ice, and low-salinity melt water suppress wind mixing, and cause the water column to stratify, creating conditions that promote a phytoplankton bloom. The burst of phytoplankton, seeded in part by ice algae, persists until ocean nutrients are drawn down. Because it is early in the season and water temperatures are cold, zooplankton populations are still low. Consequently, the pulse of phytoplankton production is not consumed by zooplankton, but instead sinks to the sea floor, where it provides abundant food for the benthos (Coyle and Cooney 1988, p. 177; Coyle and Pinchuk 2002, p. 177; Hunt and Stabeno 2002, p. 11; Lovvorn *et al.* 2005, p. 136; Renaud *et al.* 2007, p. 9). Blooms form a 20- to 50-km- (12–31 mi-) wide belt off the ice edge and progress north as the ice melts, creating a zone of high productivity. In colder years in the Bering Sea, when the ice extends to the shelf edge, there is greater nutrient resupply through shelf-edge eddies and tidal mixing, creating a longer spring bloom (Tynan and DeMaster 1997, pp. 314–315).

The blooms that occur near the ice edge make up approximately 50 to 65 percent of the total primary production in Arctic waters (Coyle and Pinchuk 2002, p. 188; Bluhm and Gradinger 2008, p. S84). High benthic abundance and biomass correspond to areas with high deposition of phytodetritus (dead algae) (Grebmeier *et al.* 1989, pp. 253–254; Grebmeier and McRoy 1989, p. 79; Tynan and DeMaster 1997, p. 315). Regions with the highest masses of benthic invertebrates occur in the northern Bering Sea southwest of St. Lawrence Island, Alaska; in the central Gulf of Anadyr, Russia, north and south of the Bering Strait; at a few offshore sites in the East Siberian Sea; and in the northeast sector of the Chukchi Sea (Grebmeier and Dunton 2000, p. 61; Dunton *et al.* 2005, pp. 3468, 3472; Carmack *et al.* 2006, p. 165; Grebmeier *et al.* 2006b, pp. 346–351; Aydin and Mueter 2007, pp. 2505–2506; Bluhm and Gradinger 2008, p. S86). As noted above, the biomass of benthic invertebrates is much less in the eastern Chukchi Sea, which is under the influence of the nutrient-poor Alaska Coastal Current (Dunton *et al.* 2006, p. 369).

When the ice melts early (before mid-March, as projected for the future), conditions that promote the phytoplankton bloom do not occur until late May or June (Stabeno *et al.* 2007, p. 2612). The difference in timing is important, because when the bloom occurs later in the spring the surface water temperatures are 2.2 °C (3.6 °F) to more than 5 °C (9.4 °F) warmer (Hunt and Stabeno 2002, p. 11); this, in turn, is an important influence on the metabolism of zooplankton. In cold temperatures, zooplankton consume less than 2 percent of the phytoplankton production (Coyle and Cooney 1988, pp. 303–305; Coyle and Pinchuk 2002, p. 191). Warmer temperatures result in increased zooplankton growth rates, reduction in their time to maturity, and increased production rates (Coyle and Pinchuk 2002, p. 177; Hunt and Stabeno 2002, pp. 12–14). Zooplankton are efficient predators of phytoplankton, and when they are abundant, they can remove nearly all the phytoplankton available (Coyle and Pinchuk 2002, p. 191). Zooplankton are the primary food for walleye pollock (*Theragra chalcogramma*) and other planktivorous fishes (Hunt and Stabeno 2002, pp. 14–15). Consequently, when zooplankton populations are high, instead of the primary production being transmitted to the benthos, it becomes tied up in pelagic food webs. While this may be beneficial for fish-eating mammals, it reduces the amount of food delivered to the benthos and, thus, may reduce the amount of prey available to walrus (Tynan and DeMaster 1997, p.316; Carmack *et al.* 2006, p. 169; Grebmeier *et al.* 2006a, p. 1462). Most models project that sea-ice melt in the Bering Sea will occur increasingly early in the future, and will be 1 month earlier by the end of the century (Douglas 2010, p. 12). This is consistent with recent trends over the past two decades, and particularly in the past few years. Based on our current understanding of food web dynamics in the Bering Sea, this shift in timing would favor a shift to pelagic food webs over benthic production, consequently reducing the amount of prey available to walrus.

The importance of ice algae is not only in its role in seeding the spring phytoplankton bloom, but also in its nutritional value. As food supply to the benthos is highly seasonal, synchrony of reproduction with algal inputs insures adequate high-quality food for developing larvae or juveniles of benthic organisms (Renaud *et al.* 2007, p. 9). Ice algae have high concentrations of essential fatty acids, some of which cannot be synthesized by benthic invertebrates and, therefore, must be ingested in their diet (Arrigo and Thomas 2004, p. 477; Klein Breteler *et al.* 2005, pp. 125–126; McMahon *et al.* 2006, pp. 2, 5). Fatty acids in marine fauna play an integral role in physiological processes, including reproduction (Klein Breteler *et al.* 2005, p. 126). Because ice algae are a much better source of essential fatty acids than phytoplankton, a loss in sea ice could change the quality of food supplied to areas that currently support high levels of benthic biomass. These changes may affect the success of invertebrate reproduction and recruitment, which, in turn, may affect the quantity and quality of food available to walrus (Witbaard *et al.* 2003, p. 81; McMahon *et al.* 2006, pp. 10–12). By the end of the century, the March (winter maximum) extent of sea ice is projected to be approximately half of contemporary conditions (Douglas 2010, p. 8). We expect ice algae will persist where ice is present; however, because of the reduced ice extent, current areas of high benthic productivity may be reduced or shift northward.

The eastern and western Bering Sea shelves are fueled by nutrient-rich water supplied from the deep water of the Bering Sea (Sambrotto *et al.* 1984, pp. 1148–1149; Springer *et al.* 1996, p. 205). Concentrations of nitrate, phosphate, and silicate are among the highest recorded in the world's oceans and contribute to the high benthic productivity (Sambrotto *et al.* 1984, p. 1148; Grebmeier *et al.* 2006a, p. 1461; Aydin and Mueter 2007, p. 2504). High productivity on the northern Bering-Chukchi shelf is supported by the delivery of nutrient-rich water via the Anadyr Current that flows along the western edge of the Bering Sea and through the Bering Strait (Springer *et al.* 1996, p. 206; Aydin and Mueter 2007, p. 2504). Thus, the movement of highly productive water onto the northern Bering Sea shelf supports persistent hot spots of high benthic productivity, which in turn support large populations of benthic-feeding birds, walrus, and gray whales (Aydin and Mueter 2007, p. 2506). This contrasts with the southern subarctic region of the Bering Sea, which is south of the current range of the Pacific walrus, where the benthic mass is largely consumed by upper tropic-level demersal fish and epifaunal invertebrates whose northern distribution is limited by a pool of cold, near-freezing water in the northern region of the Bering Sea.

Benthic productivity on the northern Bering Sea shelf has decreased over the last two decades, coincident with a reduction of northward flow of the Anadyr current through the Bering Strait (Grebmeier *et al.* 2006a, p. 1462). Because of recent warming trends, the northern Bering Sea shelf may be undergoing a transition from an Arctic to a more subarctic ecosystem with a reduction in benthic prey populations and an increase in fish populations (Overland and Stabeno 2004, p. 310; Grebmeier *et al.* 2006a, pp. 1462–1463). The Bering Sea is a transition area between Arctic and subarctic ecosystems, with the boundary between the two loosely concurrent with the extent of the winter sea-ice cover (Overland and Stabeno 2004, p. 309). In the eastern Bering Sea, reductions in sea ice have been responsible for shrinking a large subsurface pool of cold water with water temperatures less than 2 °C (3.6 °F) (Stabeno *et al.* 2007, p. 2605; Mueter and Litzow 2008, p. 313). The southern edge of the cold pool, which defines the boundary region between the Arctic and subarctic communities, has retreated approximately 230 km (143 mi) north since the early 1980s (Mueter and Litzow 2008, p. 316).

The northward expansion of warmer water has resulted in an increase in pelagic species as subarctic fauna have colonized newly favorable habitats (Overland and Stabeno 2004, p. 309; Mueter and Litzow 2008, pp. 316–317). Walleye pollock, a species common in the subarctic, which avoid temperatures less than 2° C (3.6 °F), have now moved northward into the former Arctic zone. Arctic cod (*Boreogadus saida*), which prefer cold temperatures, have also moved north to remain in colder temperatures (Stabeno *et al.* 2007, p. 2605). Because of the redistribution of these species, benthic fauna will be facing a new set of predators (Coyle *et al.* 2007, pp. 2901–2902). The evidence suggests that warming on the Bering Sea shelf could alter patterns of energy flow and food web relationships in the benthic invertebrate community, leading to overall reductions in biomass of benthic invertebrates (Coyle *et al.* 2007, p. 2902).

Continued changes in the extent, thickness, and timing of the melt of sea ice are expected to create shifts in production and species distributions (Overland and Stabeno 2004, p. 316). Because some residents of the benthos are very long lived, it may take many years of monitoring to observe change (Coyle *et al.* 2007, p. 2902). Many simultaneous changes (*e.g.,* ocean currents, temperature, sea-ice extent, and wind patterns) are occurring in walrus-occupied habitats, and thus may impact walrus' prey base. Rapid warming might cause a major restructuring of regional ecosystems (Carmack and Wassmann 2006, p. 474; Mackenzie and Schiedek 2007, p. 1344). Mobile species such as fishes have the ability to move to areas of thermal preference and follow key forage species (Mueter *et al.* 2009, p. 106); immobile species such as bivalves must cope with the conditions where they are.

Projections by Douglas (2010, pp. 7, 23) indicate that the March (yearly maximum) sea-ice extent in the Bering Sea will be about 25 percent less than the 1979–1988 average by mid-century, and 60 percent less by the end of the century. In addition, spring melt of sea ice will occur increasingly earlier, and on average will be one month sooner by the end of the century (Douglas 2010, p. 8). As described above, the earlier spring melt may lead to a change in the food web dynamics that favors pelagic predators, which feed on zooplankton, over the delivery of high quantities of quality food to benthic invertebrates. In addition, reductions in the extent of the winter sea-ice cover may lead to a further or more permanent expansion of the subarctic ecosystem northward into the Arctic. Although there is uncertainty about the specific consequences of these changes, the best available scientific information suggests that because of the likely decreases in the quantity and quality of food delivered to benthic invertebrates, and because of a potential increase in predators from the south, the amount and distribution of preferred prey (bivalves) available to walrus in the Bering Sea will likely decrease in the foreseeable future as a result of the loss of sea ice and ocean warming. The extent to which this decrease may result in a curtailment of the range of the Pacific walrus or limit the walrus population in the future is unknown, and at this time we do not have sufficient information to predict it with reliability. The implications of the available information, however, are that impacts may include modification of habitat that could contribute to a reduction in the range of the Pacific walrus at the southern edge of its current distribution, as well as a possible reduction in the walrus population because of reduced prey. Although our conclusion is based on the best available science, we recognize that its validity rests on ecological hypotheses that are currently being tested.

Ocean Acidification

Since the beginning of the industrial revolution in the mid-18th century, the release of carbon dioxide (CO_2) from human activities ("anthropogenic CO_2") has resulted in an increase in atmospheric CO_2 concentrations, from approximately 280 to approximately 390 ppm currently, with 30 percent of the increase occurring in the last three decades (NOAA, *http://www.climatewatch.noaa.gov/2009/articlesclimate-change-atmospheric-carbon-dioxide,* downloaded 20 July 2010).

The global atmospheric concentration of CO_2 is now higher than experienced for more than 800,000 years (Lüthi *et al.* 2008, p. 379; Scripps 2011, p. 4). Over the industrial era, the ocean has been a sink for anthropogenic carbon emissions, absorbing about one-third of the atmospheric CO_2 (Feely *et al.* 2004, p. 362; Canadell *et al.* 2007, pp. 18867–18868). When CO_2 is absorbed by seawater, chemical reactions occur that reduce seawater pH (a measure of acidity) and the concentration of carbonate ions, in a process known as "ocean acidification."

Ocean acidification is a consequence of rising atmospheric CO_2 levels (The Royal Society 2005, p.1; Doney *et al.* 2008, p. 170). Seawater carbonate chemistry is governed by a series of chemical reactions (CO_2 dissolution, acid/base chemistry, and calcium carbonate dissolution) and biologically mediated reactions (photosynthesis, respiration, and calcium carbonate precipitation) (Wootton *et al.* 2008, p. 18848; Bates and Mathis 2009, p. 2450). The marine carbonate reactions allow the ocean to absorb CO_2 in excess of potential uptake based on carbon dioxide solubility alone (Denman *et al.* 2007, p. 529). Consequently, the pH of ocean surface waters has already decreased (become more acid) by about 0.1 units since the beginning of the industrial revolution (Caldeira and Wickett, 2003, p. 365; Orr *et al.* 2005, p. 681).

The absorption of carbon dioxide by seawater changes the chemical equilibrium of the inorganic carbon system and reduces the concentration of carbonate ions. Carbonate ions are required by organisms like clams, snails, crabs, and corals to produce calcium carbonate, the primary component of their shells and skeletons. Decreasing concentrations of carbonate ions may place these species at risk (Green *et al.* 2004, p. 729–730; Orr *et al.* 2005, p. 685; Gazeau *et al.* 2006 p. 1; Fabry *et al.* 2008, p. 419–420; Comeau *et al.* 2009, p. 1877; Ellis *et al.* 2009, p. 41). Two forms of calcium carbonate produced by marine organisms are aragonite and calcite. Aragonite, which is 50 percent more soluble in seawater than calcite, is of greatest importance in the Arctic region because clams, mussels, snails, crustaceans, and some zooplankton use aragonite in their shells and skeletons (Fritz 2001, p. 53; Fabry *et al.* 2008, p. 417; Steinacher *et al.* 2009, p. 515).

When seawater is saturated with aragonite or calcite, the formation of shells and skeletons is favored; when undersaturated, the seawater becomes corrosive to these structures and it becomes physiologically more difficult for organisms to construct them (Orr *et al.* 2005, p. 685; Gazeau *et al.* 2007, p. 2–5; Fabry *et al.* 2008, p. 415; Talmage and Gobler 2009, p. 2076; Findlay *et al.* 2010, pp. 680–681). The waters of the Arctic Ocean and adjacent seas are among the most vulnerable to ocean acidification, with undersaturation of aragonite projected to occur locally within a decade (Orr *et al.* 2005, p. 683; Chierici and Fransson 2009, pp. 4972–4973; Steinacher *et al.* 2009, p. 522). To date, aragonite saturation has decreased in the top 50 m (164 ft) in the Canadian Basin (Yamamoto-Kawai *et al.* 2009, p. 1099), and under-saturated waters have been documented on the Mackenzie shelf (Chierici and Fransson 2009, p. 4974), Chukchi Sea (Bates and Mathis 2009, p. 2441), and Bering Sea (Fabry *et al.* 2009, p. 164).

Factors that contribute to undersaturation of seawater with aragonite or calcite are: upwelling of carbon dioxide-rich subsurface waters; increased carbon dioxide concentrations from anthropogenic CO_2 uptake; cold water temperatures; and fresher, less saline water (Feely *et al.* 2008, p. 1491; Chierici and Fransson 2009, p. 4966; Yamamoto-Kawai *et al.* 2009, p. 1099). The loss of sea ice (causing greater ocean surface to be exposed to the atmosphere), the retreat of the ice edge past the continental shelf break that favors upwelling, increased river runoff, and increased sea ice and glacial melt are forces that favor undersaturation (Yamamoto-Kawai *et al.* 2009, pp. 1099–1100; Bates and Mathis 2009, pp. 2446, 2449–2450). The projected increase of 3 to 5 months of ice-free conditions in the Bering and Chukchi Seas by Douglas (2010, p. 7) indicates the potential for increased CO_2 absorption in the Arctic over the next century beyond what would occur from predicted CO_2 increases alone. However, there are opposing forces that may mitigate undersaturation to some extent, including photosynthesis by phytoplankton that may increase with reduced sea ice, and warmer ocean temperatures (Bates and Mathis 2009, p. 2451). However, according to Steinacher *et al.* (2009, p. 530), the question is not whether undersaturation will occur in the Arctic, but how large an area will be affected, how many months of the year it will occur, and how large its magnitude.

Because acid-base balance is critical for all organisms, changes in carbon dioxide concentrations and pH can affect reproduction, larval development, growth, behavior, and survival of all marine organisms (Green *et al.* 1998, p.

23; Kurihara and Shirayama 2004, pp. 163–165; Berge *et al.* 2006, p. 685; Fabry *et al.* 2008, pp. 420–422; Kurihara 2008, pp. 277–282; Pörtner 2008, pp. 209–211; Ellis *et al.* 2009, pp. 44–45; Talmage and Gobler 2009, p. 2076; Findlay *et al.* 2010, pp. 680–681). Pörtner (2008, p. 211) suggests that heavily calcified marine groups may be among those with the poorest capacity to regulate acid-base status. Although some animals have been shown to be able to form a shell in undersaturated conditions, it comes at an energetic cost which may translate to reduced growth rate (Talmage and Gobler 2009, p. 2075; Findlay *et al.* 2010, p. 679; Gazeau *et al.* 2010, p. 2938), muscle wastage (Pörtner 2008, p. 210), or potentially reduced reproductive output. Because juvenile bivalves have high mortality rates, if aragonite undersaturation inhibits planktonic larval bivalves from constructing shells (Kurihara 2008, p. 277) or inhibits them from settling (Hunt and Scheibling 1997, pp. 274, 278; Green *et al.* 1998, p. 26; Green *et al.* 2004, p. 730; Kurihara 2008, p. 278), the increased mortality would likely have a negative effect on bivalve populations.

The effects of ocean acidification on walrus may be through changes in their prey base, or indirectly through changes in the food chain upon which their prey depend. Walruses forage in large part on calcifying invertebrates (Ray *et al.* 2006, pp. 407–409; Sheffield and Grebmeier 2009, pp. 767–768; also see discussion of diet, above). Aragonite undersaturation has been documented in the area occupied by Pacific walrus (Bates and Mathis 2009, p. 2441; Fabry *et al.* 2009, p. 164), and it is projected to become widespread in the future (Steinacher 2009, p. 530; Frölicher and Joos 2010, pp. 13–14). Thus, it is possible that mollusks and other calcifying organisms may be negatively affected through a variety of mechanisms, described above. While the effects of observed ocean acidification on the marine organisms are not yet documented, the progressive acidification of oceans is expected to have negative impacts on marine shell-forming organisms in the future (The Royal Society 2005, p. 21; Denman *et al.* 2007, p. 533; Doney *et al.* 2009, p. 176; Kroeker *et al.* 2010, p. 9).

Uncertainty regarding the general effects of ocean acidification has been summarized by the Royal Society (2005, p. 23): "Organisms will continue to live in the oceans wherever nutrients and light are available, even under conditions arising from ocean acidification. However, from the data available, it is not known if organisms at the various levels in the food web will be able to adapt or if one species will replace another. It is also not possible to predict what impacts this will have on the community structure and ultimately if it will affect the services that the ecosystems provide." Consequently, although we recognize that effects to calcifying organisms, which are important prey items for Pacific walrus, will likely occur in the foreseeable future from ocean acidification, we do not know which species may be able to adapt and thrive, or the ability of the walrus to depend on alternative prey items. As noted in the introduction, the prey base of walrus includes over 100 taxa of benthic invertebrates from all major phyla (Sheffield and Grebmeier 2009, pp. 761–777). Although walruses are highly adapted for obtaining bivalves, they also have the potential to switch to other prey items if bivalves and other calcifying invertebrate populations decline. Whether other prey items would fulfill walrus nutritional needs over their life span is unknown (Sheffield and Grebmeier 2009, p. 770), and there also is uncertainty about the extent to which other suitable non-bivalve prey might be available, due to uncertainty about the effects of ocean acidification and the effects of ocean warming.

Both Bayesian network models (Garlich-Miller *et al.* 2010; Jay *et al.* 2010b) indicate that ocean warming and ocean acidification are likely to have little effect on Pacific walrus future status, but these conclusions were primarily because of the high degree of uncertainty associated with these factors. As described above, our analysis indicates that earlier melting of ice in the spring, a decreased extent of ice in winter and spring, and warming of the ocean may lead to changes in the distribution, quality, and quantity of food available to Pacific walrus over time. In addition, in the future, ocean acidification has the potential to have a negative impact on calcifying organisms, which currently represent a large portion of the walrus' diet. The best available science does not indicate that either of these factors will have a positive impact on the availability, quality, or quantity of food available to the walrus in the future. However, we are also unable to predict to what extent these factors may limit the Pacific walrus population in the future, in terms of reduction in its range or abundance, or the extent to which the walrus may be able to adapt to a changing prey base. Therefore, we conclude that ocean warming and ocean acidification are not threats to the Pacific walrus now or in the foreseeable future, although we acknowledge that the general indications are that impacts appear more likely to be negative than positive or neutral.

Summary of Factor A

We have analyzed the effects of the loss of sea ice, ocean warming, and ocean acidification as related to the present or threatened destruction, modification, or curtailment of the habitat or range of the Pacific walrus. Although we are concerned about the changes to walrus prey that may occur from ocean acidification and warming, and theoretically we understand how those stressors might operate, ocean dynamics are very complex and the changing conditions and related outcomes for these stressors are too uncertain at this time for us to conclude that these stressors are a threat to Pacific walrus now or in the foreseeable future.

Because of the loss of sea ice, Pacific walruses will be forced to rely on terrestrial haulouts to a greater and greater extent over time. Although coastal haulouts have been traditionally used by males, in the future both sexes and all ages will be restricted to coastal habitats for a much greater period of time. This will expose all individuals, but especially calves and females to increased stress, energy expenditure, and death or injury from disturbance-caused stampedes from terrestrial haulouts. Calf abandonment, and increased energy expenditure for females and calves is likely to occur from prey depletion near terrestrial haulouts. Increased energy expenditure could lead to decreased condition and decreased survival. In addition, there may be a small increase in direct mortality or injury of calves and females due to increased predation or hunting as a result of greater use of terrestrial haulouts. Although some of these stressors are acting on the population currently, we anticipate that their magnitude will increase over time as sea-ice loss over the continental shelf occurs more frequently and more extensively. Due to the projected increases in sea-ice habitat loss and the resultant stressors associated with increased dependence on coastal haulouts, as described above, we do not anticipate the projected Pacific walrus population decline to stabilize in the foreseeable future. Rather, the best scientific information available leads to a conclusion that the Pacific walrus will be increasingly at risk. Through our analysis, we have concluded that loss of sea ice, with its concomitant changes to walrus distribution and life-history patterns, will lead to a population decline. Therefore, we conclude, based on the best scientific and commercial data available, that the present or threatened destruction, modification, or curtailment of its habitat or range is a threat to Pacific walrus.

Factor B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The following potential factors that may result in overutilization of Pacific walrus are considered in this section: (1) Recreation, scientific, or educational purposes; (2) U.S. import/export; (3) commercial harvest; and (4) subsistence harvest. Under Factor A, we also discuss the potential increase in subsistence hunting associated with increasing dependence of Pacific walrus on coastal haulouts caused by the loss of sea-ice habitat.

Recreation, Scientific, or Educational Purposes

Overutilization for recreational, scientific, or educational purposes is currently not considered a threat to the Pacific walrus population. Recreational (sport) hunting has been prohibited in the United States since 1979. Russian legislation also prohibits sport hunting of Pacific walruses. The Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361, *et seq.)* (MMPA), allows the Service to issue a permit authorizing the take of walrus for scientific purposes in the United States, provided that the research will further a bona fide and necessary or desirable scientific purpose. The Service must consider the benefits to be derived from the research and the effects of the taking on the stock, and must consult with the public, experts in the field, and the United States Marine Mammal Commission.

Similarly, any take for an educational purpose is allowed by the MMPA only after rigorous review and with appropriate justification. No permits authorizing the take of walrus for educational and public display purposes have been requested in the United States since the 1990s. The Service has worked with the public display community to place stranded animals, which the Service has determined cannot be returned to the wild, at facilities for educational and public display purposes. By placing stranded walruses, which would otherwise be euthanized, at facilities that are able to care for and display the animals, we believe needs for the domestic public display community in the United States have been, and will continue to be, met. The Russian Federation intermittently authorizes the taking of walrus from the wild for scientific and educational purposes. For example, in 2009, a collection permit was issued for take of up to 40 walrus calves from the wild to be used for public display. This take was included in the subsistence harvest quota, and is therefore considered sustainable. We have no information that would lead us to believe this level of take from the wild will increase in the foreseeable future.

Based on the above, we conclude that utilization of walrus for recreational, scientific, or educational purposes is not a threat to the Pacific walrus population. Protections and regulatory mechanisms in both the United States and the Russian Federation have stopped recreational hunting. In the United States, the MMPA has effectively ensured that any removal for scientific or educational purposes has a bona fide and necessary or desirable scientific basis. In the Russian Federation, take for scientific or educational purposes is controlled by a quota. We believe the United States and the Russian Federation will continue to ensure that any future removal of walrus for recreational, scientific, or educational purposes will be consistent with the long-term conservation of the species. Therefore, we have determined, based on the best scientific and commercial data available, that the utilization of Pacific walrus for recreational, scientific, or educational purposes is not a threat to the species now or in the foreseeable future.

United States Import/Export

Based on data from the Service's Law Enforcement Management Information System (LEMIS), in 2008 more than 16,000 walrus parts, products, and derivatives (ivory jewelry, carvings, bone carvings, ivory pieces, and tusks) were imported into or exported from the United States. Over 98 percent of those specimens were from walrus that had originated in the United States. Most of these specimens were identified as fossilized bone and ivory shards, principally dug from historic middens on St. Lawrence Island, or carvings from such. Therefore, the harvest of the source animals predates adoption of the MMPA in 1972, and does not represent a threat to the species.

Since the passage of the MMPA in 1972, ivory and bone can only be exported from the United States after it has been legally harvested, and substantially altered to qualify as an Alaska Native handicraft and as a personal effect or as part of a cultural exchange. Trade in raw post-MMPA walrus ivory is closely monitored by the Service through existing import/export regulations (Garlich-Miller *et al.* 2011, Section 3.5.1 "International Agreements").

Most of the walrus parts imported into or exported from the United States are derived from historic ivory and bone shards, and parts from newly harvested walrus are subject to the MMPA requirements that limit U.S. trade to Alaska Native handicrafts. Therefore, we have determined, based on the best scientific and commercial data available, that United States Import/Export is not considered to be a threat to the Pacific walrus now or in the foreseeable future.

Commercial Harvest

Commercial harvest of the Pacific walrus is prohibited in the U.S., and has not occurred in Russia since 1991 (see discussion below). Pacific walrus ivory and meat was available on the commercial market starting in the seventeenth century (Fay 1957, p. 435; Elliot 1982, p. 98). Since then, commercial harvest levels have varied in response to population size and economic demand. Several of the larger reductions in the Pacific walrus population have been attributed to unsustainable harvest levels, largely driven by commercial hunting (Fay 1957, p. 437; Bockstoce and Botkin 1982, p. 183). Harvest regulations enacted in the United States and Russia in the 1950s and 1960s that reduced the size of the harvest and provided protection to females and calves allowed the population to recover and peak in the 1980s (Fay *et al.* 1989, p. 1).

Commercial harvest of marine mammals in U.S. waters is currently prohibited by the MMPA. Commercial harvest was last conducted in Russia in 1991 (Garlich-Miller and Pungowiyi 1999, p. 59). Russian legislation still allows for a commercial harvest, although a decree from the Russian Fisheries Ministry allocating a commercial harvest quota would be required prior to resumption of harvest (Kochnev 2010, pers. comm.). Quota recommendations are determined by sustainable removal levels, which are based on the total population and productivity estimates (Garlich-Miller and Pungowiyi 1999 p. 32). Therefore, any potential future commercial harvest in Russia is unlikely to become a threat to the population.

Commercial hunting of Pacific walrus is banned in the United States. Regulatory protections in the Russian Federation have been effective in ensuring that any removal for commercial purposes is consistent with long-term conservation of the species. Therefore, we have determined, based on the best scientific and commercial data available, that commercial harvest is not a threat to Pacific walrus either now or in the foreseeable future.

Subsistence

Pacific walrus have been an important subsistence resource for coastal Alaskan and Russian Natives for thousands of years (Ray 1975, p. 10). In 1960, the State of Alaska restricted the subsistence harvest of female walrus to seven per hunter per year in an effort to recover the population from a reduced state. Concurrently, Russia also implemented harvest quotas and prohibited shooting animals in the water (to reduce lost animals) (Fay *et al.* 1989, p. 4). In 1961, the State of Alaska further reduced the quota to five females per hunter per year, still allowing an unlimited number of males to be hunted. The limit of five adult females per hunter remained in effect until 1972, when passage of the Marine Mammal Protection Act transferred management responsibility to Federal control (Fay *et al.* 1997, p. 548). As a result of reducing the numbers of females harvested, the population increased substantially through the 1960s and 1970s, and by 1980 was probably approaching the carrying capacity of the habitat (Fay *et al.* 1989, p. 4).

Total harvest removals (combined commercial and subsistence harvests in the United States and Russia), including estimates of animals struck and lost, for the 1960s and 1970s averaged 5,331 and 5,747 walrus per year. Between the years of 1976 and 1979, the State of Alaska managed the walrus population under a federally imposed subsistence harvest quota of 3,000 walrus per year. Relinquishment of management authority by Alaska to the Service in 1979 lifted this harvest quota (the MMPA conditionally exempts Alaska Natives from the take prohibitions; i.e., subsistence harvest must not be conducted in a wasteful manner), which may have also contributed to the increased harvest rates in subsequent years (USFWS 1994, p. 2). Specifically, the 1980s saw an increase in harvest, with a total removal estimate averaging 10,970 walrus per year (Service, unpublished data). The increased harvest rates in this decade may reflect several factors, including the absence of a harvest quota (USFWS 1994, p. 2), commercial harvest in Russia, and increased availability of walruses to subsistence hunters coinciding with the population reaching carrying capacity (Fay and Kelly 1989, p. 1; Fay *et al.* 1997, p. 558). The increase in harvest in the 1980s was accompanied by an increase in the proportion of females harvested, and may have caused a population decline (Fay *et al.* 1997, p. 549). Harvest levels in the 1990s were about half those of the previous decade, averaging 5,787 walrus per year. The 2000–2008 average annual removal, which was 5,285 walrus per year, was about 9 percent lower than the removal in the 1990s (Service, unpublished data). In the United States for the years 2004–2008, the communities of Gambell and Savoonga on St. Lawrence Island, Alaska, have accounted for 84 percent of the reported U.S. harvest and 43 percent of the harvest rangewide (Garlich-Miller, *et al.* 2011, Section 3.3.1.4 "Regional Harvest Patterns"). The St. Lawrence Island average reported harvest, not corrected for animals that are struck and lost or hunter noncompliance with the Marking Tagging and Reporting Program, (the struck and lost correction and the MTRP are discussed below) for 2004–2008 is 988 animals (Service, unpublished data).

The lack of information on population status or trends makes it difficult to quantify sustainable removal levels for the Pacific walrus population (Garlich-Miller *et al.* 2011, Section 3.3.1.5 "Harvests Sustainability"). Recent (2003–2007) annual harvest removals in the United States and Russia have ranged from 4,960 to 5,457 walrus per year, representing approximately 4 percent of the minimum population estimate of 129,000 animals (FWS 2010, p. 2). These levels are lower than those experienced in the early 1980s (8,000–10,000 per year) that led to a population decline (Fay *et al.* 1989 pp. 3–4). Chivers *et al.* (1999, p. 239) modeled walrus population dynamics and estimated the maximum net productivity rate (*Rmax*) for the Pacific walrus population at 8 percent per year. Wade (1998, p. 21) notes that one half of *Rmax* (4 percent for Pacific walruses) is a reasonably conservative (i.e., sustainable) potential biological removal (PBR) level for marine mammal populations below carrying capacity, because it provides a reserve for population growth or recovery. The PBR level, as defined under the MMPA, is the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. Changes in productivity rates or population size could eventually result in unsustainable harvest levels if harvest rates do not adjust in concert with changes in population status or trend.

There are no Statewide harvest quotas in Alaska; however, some local harvest management programs have been developed. Round Island, within the Walrus Island State Game Sanctuary, was a traditional hunting area of several Bristol Bay communities prior to the development of the game sanctuary. Access to Round Island is controlled by the State of Alaska via a permit system. To continue the traditional hunt, the local communities proposed a cooperative agreement, which resulted in a quota of 20 walrus and a 40-day hunting season in the fall (Chythlook and Fall 1998, p. 5). The management agreement was negotiated by the Service, Bristol Bay Native Association/Qayassiq Walrus Commission, the Eskimo Walrus Commission, and Alaska Department of Fish and Game (ADFG), and sanctioned in a signed memorandum of understanding. The State of Alaska issues hunting access permits only during the open season. If the quota is reached, additional hunting access could be denied and existing permits could be revoked. Recent harvests at Round Island have ranged from zero to two walruses per year. No walrus were harvested on Round Island in 2009 or 2010. Bristol Bay hunters also hunt elsewhere in the area without restriction, and may be shifting hunting efforts to islands outside the State game sanctuary as the monetary cost of traveling to Round Island is often prohibitive.

With an interest in reviving traditional law, advancing the idea of self-regulation of the subsistence harvest, and initiating a local management infrastructure due to concern about changing sea-ice dynamics and the walrus population, the Native Villages of Gambell and Savoonga on St. Lawrence Island have recently formed Marine Mammal Advisory Committees (MMAC), and implemented local ordinances establishing a limit of four walruses per hunting trip. Walruses that are struck and lost (wounded and not retrieved), as well as calves, do not count against this limit. In addition, there is no limit on the number of trips, so the effectiveness of this ordinance in limiting total harvest is dependent on the total number of hunting trips. Factors such as subsistence needs, social mores, distance of walrus from the village, weather, success of previous trips, needs of immediate and extended family members, and monetary cost of making a trip all play a part in the number of trips a hunting party makes. The spring hunting season of 2010 was the first to have the trip-limit ordinances in place. We estimate that 91 percent of the hunting trips were in compliance with the ordinance by taking no more than four adult/subadult walrus per trip (Service, unpublished data).

Subsistence harvest reporting in the United States is required under section 109(i) of the MMPA, and is administered through a Marking, Tagging, and Reporting Program (MTRP) codified at 50 CFR 18.23(f). The MTRP requires Alaska Native hunters to report the harvest of walrus and present the ivory for tagging within 30 days of harvest. The Service also administers the Walrus Harvest Monitor Project (WHMP), which is an observer-based data-collection program conducted in the communities of Gambell and Savoonga during the spring harvest. This program is designed to collect harvest data and biological samples. Not all harvest in the United States is reported through the MTRP (regulatory program). The Service uses the WHMP (observer-based) harvest data to supplement MTRP data to develop a correction factor for noncompliance to estimate the number of walrus harvested, but not reported through the MTRP. The MTRP-reported harvest data (Statewide) is corrected for noncompliance (unreported harvest), and that total is then corrected to account for animals struck and lost (estimated at 42 percent of the walrus that are shot). Current accuracy of the struck and lost estimate is unknown and should be re-estimated (USFWS 2010, p. 4). Compliance rates with the MTRP vary considerably from year to year, with estimates ranging from a low of 60 percent to a high of 100 percent.

Subsistence harvest in Chukotka, Russia, is controlled through a quota system. An annual subsistence quota is issued through a decree by the Russian Federal Fisheries Agency. Quota recommendations are based on sustainable removal levels (approximately 4 percent of the population based on population and productivity estimates) (Garlich-Miller and Pungowiyi 1999 p. 32). Because the population is shared with the United States, Russian quota recommendations have generally been 2 percent or less of the estimated total population (Garlich-Miller and Pungowiyi 1999, p. 32; Kochnev 2010, pers. comm.). Russian harvest quotas are set annually and recent quota reductions in Russia of approximately 57 percent from 2003–2010 have been in response to a presumed population decline based in part on observed haulout mortalities from trampling and results from various population surveys. According to Kochnev (2004, p. 286), all the Pacific walrus haulouts of the Arctic coast of Chukotka, Russia, are characterized by a high disturbance level. The majority of these haulouts in Chukotka are near coastal villages, and used by local subsistence hunters (Kochnev 2004, p. 286).

The harvest reporting program in Russia is administered by the Russian Agricultural Department. The harvest in Russia has been traditionally conducted by hunting teams from each village. Team leaders are required to submit two harvest reports per month. However, walrus hunting by individual hunters (those not part of a harvest team) has increased since the inception of the Russian Federation, and there is no official mechanism for individuals to report their harvest; as a result, Russian harvest estimates are biased low to an unknown degree (Kochnev 2010, pers. comm.). In addition, the Russians do not adjust their harvest estimates for animals that are struck and lost. The Service assumes that the Russian struck and lost rate is comparable to the U.S. rate, and applies the struck and lost correction factor of 42 percent to the Russian harvest data when estimating total subsistence harvest levels. This correction provides a more accurate estimate of the number of animals removed from the population due to harvest.

Subsistence removals of walrus in the United States are closely tied to social and traditional customs, subsistence needs, sea-ice dynamics, weather, and monetary costs related to hunting. We predict that the range-wide walrus population will be smaller in the future, due to changes in summer sea-ice cover and associated impacts; thus, fewer walrus overall will be available for harvest. However, in the Bering Strait region, winter and spring sea ice is expected to persist through mid-century; walrus will likely continue to be locally abundant in numbers that would enable harvest to continue at levels similar to current ones, over time. Because these animals would be available to local subsistence hunters around St. Lawrence Island and other Bering Strait villages, the Pacific walrus would remain an important subsistence resource. Subsistence harvest of walrus is extremely important to several Alaska Native cultures. The primary factor influencing the number of walrus harvested each year will be the general availability of walruses in the Bering Strait region.

Given current and projected sea-ice conditions, and without additional Tribal, State or Federal hunting regulations to limit or restructure the harvest, we do not expect harvest pressure in the Bering Strait region to change appreciably in the foreseeable future (Garlich-Miller *et al.* 2011, Section 3.3.1.4.1 “Climate Change”). The St. Lawrence Island Tribal Governments and subsistence hunters have recently taken steps to modify their harvest patterns through the formation of Marine Mammal Advisory Committees, and the adoption of local ordinances limiting the number of walrus harvested per hunting trip by Tribal members. These are substantial efforts on the part of the Tribes and subsistence hunters, and the Service looks forward to continuing to work through the co-management structure (which allows for cooperative efforts between the Service, Alaska Natives, and State agencies; MMPA sec. 119(b)(4)) to ensure that the harvest of the Pacific walrus remains sustainable for future generations. However, the current measures to regulate the subsistence harvest do not limit the harvest of females or provide limits on the total number of walruses harvested and, therefore, are not wholly sufficient to ensure that harvest in the Bering Strait region will be sustainable long term. The tribal ordinances are structured in such a way that the Marine Mammal Advisory Committees could enact additional regulations in the future to address efficiency (reduce the number of animals that are struck and lost), restructure the sex ratio of the harvest, or impose quotas upon their Tribal members, or enact other measures to manage the harvest.

In the Bristol Bay and the Yukon-Kuskokwim regions of Alaska, levels of subsistence harvest of walrus may decline slightly, in light of declines in southern Bering Sea ice in the winter (subsistence hunters search for walrus that are resting on ice floes) and a recent trend of fewer male walrus remaining in Bristol Bay during the summer. However, harvest in these regions is already so low—averaging 5 and 18 walrus reported as harvested per year, respectively, for 2004 through 2008 (Service, unpublished data)—that it likely does not have an appreciable effect on the population. Future harvest patterns and levels are not anticipated to change significantly in either region (Garlich-Miller *et al.* 2011, Section 3.3.1.4.1 “Climate Change”).

In the North Slope region of Alaska, reported subsistence harvest averaged 48 walrus per year from 2004–2008. As summer sea ice in the Chukchi Sea recedes out over deep arctic basin waters, it is anticipated that coastal haulouts will form along the Chukchi coast into the foreseeable future. Large concentrations of walrus on shore for longer periods of time could afford opportunity for additional harvest. The potential for hunting activity to create a stampede resulting in injuries or mortalities, or to displace animals from preferred forage areas (Kochnev 2004, p. 285) is of greater concern than the direct mortalities associated with harvest. Although the potential for increased harvest exists, we do not expect the harvest to increase based on the fact that these communities' subsistence focus is on bowhead and beluga whales, due to a strong cultural connection and tradition as a whaling culture. North Slope coastal communities also have access to a wider array of resources than island communities and rely much more heavily on other marine mammals, seabirds, fish and terrestrial mammals to meet their subsistence needs (MMS 2007, p. IV–186). Due to the presence of the oil industry, North Slope communities also have a stronger economic base than the Bering Strait communities, and therefore do not rely as heavily on ivory carving as a source of cash in the local economy.

As stated above, barring additional Tribal or Federal regulations governing harvest, we predict that subsistence harvest is likely to continue at or near current levels, even as the walrus population declines in response to loss of summer sea ice. This is because walrus are expected to continue to remain locally abundant and available for subsistence harvest in the Bering Strait region in the winter and spring. Over time, depending on how quickly the population declines, future harvest levels will need to be reduced as population size declines, or subsistence harvest will become unsustainable. Therefore, we have determined that if subsistence harvest continues at current levels, as expected, it represents a threat to the walrus population in the foreseeable future. Although it is difficult to quantify sustainable removal levels because of the lack of information on Pacific walrus population status and trends, we have determined that the current harvest of approximately 4 percent is at a sustainable level based on a minimum population estimate of 129,000. Therefore, we do not consider the current level of subsistence harvest to be a threat to Pacific walrus at the present time. Our identification of subsistence harvest as a threat to the species in the foreseeable future is tied to expected population declines related to threats associated with reduced summer sea ice, and is based on the best scientific and commercial data available, including scientific projections to the end of the 21st century.

Although we have suggested that overall harvest must adjust with population size, there are strategies other than a numerical quota that could be utilized in an effort to assure sustainability over the long term. The co-management structure and the St. Lawrence Island Tribal ordinances provide an effective means to address improvements in hunting efficiency, and modification of the sex structure of the harvest. Improving hunting efficiency by reducing the number of animals which are struck and lost could potentially reduce the total number of walrus removed from the population due to subsistence harvest. Adult breeding-age females are the most important cohort of the population. An overall reduction in the number of females removed annually while still allowing an unlimited number of males to be harvested has had a positive effect on a declining population in the past and could be an effective means of managing harvests for sustainability into the future.

Our conclusion that subsistence harvest is a threat in the foreseeable future is supported by the BN models prepared by the Service and USGS. The sensitivity analyses of both models identified subsistence harvest as one of the major drivers of model predictions. The two models involved different assumptions relative to subsistence harvest levels. In the Service model, we assumed, for the reasons described above, that subsistence harvest levels would remain relatively constant over time, even as the walrus population declined in response to reduced sea-ice conditions. In the USGS model, Jay *et al.* (2010b, p. 15) assumed that future harvest rates would be proportional to walrus population size. However, these authors acknowledge that if in the future, the walrus population declines, but harvest continues at the current level, the population-level stress caused by the harvest would effectively increase (Jay *et al.* 2010b, p. 16), thereby amplifying the impact of subsistence harvest on the population. In the Service model, maintaining the harvest at replacement levels (sustainable) reduced the probabilities of negative effects by about 19 percent compared to a higher harvest (Garlich-Miller *et al.* 2011, Table 8). Results from the USGS model suggest that although minimizing harvest from current levels may have little positive effect on population outcomes in the future, harvests of high (greater than 4 percent of the population) and very high levels (greater than 6 percent) could add significantly to the adverse effects of future sea-ice conditions on population outcomes through the end of the century (Jay *et al.* 2010b, p. 16).

Summary of Factor B

As discussed above, scientific and educational utilization of walruses is currently at low levels, regulated both domestically and in the Russian Federation, and is not a threat to the Pacific walrus now or in the foreseeable future. Recreational (sport) hunting of Pacific walrus is prohibited under the MMPA and by Russian legislation; therefore, it is not a threat to the Pacific walrus now or in the foreseeable future. United States import/export is not a threat to the Pacific walrus now or in the foreseeable future because Pacific walrus specimens exported from or imported into the United States consist mostly of fossilized bone and ivory shards, and any other walrus ivory can only be imported into or exported from the United States after it has been legally harvested and substantially altered to qualify as a Native handicraft. Commercial hunting of Pacific walrus in the United States is prohibited under the MMPA. Commercial hunting in Russia has not occurred since 1991 and could not resume unless a harvest quota based on sustainability were established; therefore, it is unlikely that Russian commercial harvest will be a threat to the Pacific walrus population.

Over the past 50 years, Pacific walrus population annual harvest removals have varied from 3,200 to 16,000 per year. Over the past decade, subsistence harvest removals in the United States and Russia have averaged approximately 5,000 per year. Recent harvest levels are significantly lower than historical highs, although the lack of information on population status and trend make it difficult to quantify sustainable removal levels. Anticipated reductions in population size in response to losses in sea-ice habitats and associated impacts underscore the need for reliable population information as a basis for evaluating the sustainability of future harvest levels. Research leading to a better understanding of population responses to changing ice conditions and modeling efforts to examine the impact of various removal levels are currently under way by USGS and others.

Subsistence harvest levels in Russia are presently controlled under a quota system based upon the 2006 population estimate. The Russian quota has been reduced recently in response to the loss of several thousand calves at terrestrial haulouts as a result of trampling events in recent years and their belief that the population is in decline. Although the subsistence walrus harvest in Alaska is not regulated under a quota system, the MMPA provides for the development of voluntary co-management agreements with Alaska Native organizations. Notably, hunting ordinances were implemented in 2010 in Alaska's two primary hunting communities, providing a promising mechanism for self regulation of harvests. While it is premature to evaluate the efficacy of such local ordinances over the long term, the recent establishment of these local management programs offers a tangible framework for additional harvest management, as necessary. The existing harvest reporting and monitoring programs provide information on harvest program effectiveness and also provide data on harvest trends and composition. In conjunction with information on population status and trends, this information will be used to evaluate future harvest management strategies. Additionally, a multi-party agreement between the Service, State of Alaska, and two Alaska native groups includes a defined hunting season and a quota for the Round Island State Game Sanctuary.

We wish to underscore the importance of the efforts the Alaska Native community has undertaken to manage subsistence harvest, and we are hopeful that community-based harvest regulations to improve efficiency (reduce animals that are struck and lost), adjust the sex structure of the harvest (reduce the overall take of females), or limit the total number of walrus taken will be developed in the future. The Service prefers to develop community-based harvest regulations. To that end, we will continue working directly with the subsistence hunting community and the Eskimo Walrus Commission to continually refine harvest monitoring and reporting and to share information on population status and trend from both traditional ecological knowledge and western science. We recognize that to improve our ability to manage the walrus harvest, the refinement of methods to estimate walrus abundance and trend, productivity, and habitat carrying capacity is needed. Our longstanding co-management agreement between the Service and the Eskimo Walrus Commission provides an important forum for continued dialogue about these harvest-related issues and a mechanism for developing further harvest management options.

In summary, although the Service supports efforts by subsistence communities to implement voluntary programs with the goal of sustainable Pacific walrus harvests, we acknowledge that there are currently no regulatory mechanisms in place to assure the sustainability of subsistence harvests. In the absence of such regulatory mechanisms, we do not expect harvest levels in the Bering Strait region to change appreciably in the foreseeable future. Subsistence harvest is predicted to continue at similar levels, independent of future walrus population trends. Barring additional Tribal or Federal harvest management actions, we anticipate that the proportion of animals harvested will increase relative to the overall population, and this continued level of subsistence harvest will become unsustainable. Therefore, although we do not identify current subsistence harvest as a threat to the walrus population at the present time, we have determined that this continued level of subsistence harvest will become a threat to the walrus population, as it declines in the foreseeable future. Based on the best scientific and commercial data available, we find that overutilization in the form of subsistence harvest at current levels, is likely to threaten the Pacific walrus in the foreseeable future.

Factor C. Disease or Predation

Future disease and predation dynamics may be tied to environmental changes associated with changes in sea ice and other environmental parameters that influence disease vectors and exposure, and predation opportunities. Our ability to reliably predict the potential level and influence of disease and predation is tied to our ability to predict environmental change and is related to our understanding of sea-ice dynamics. Under Factor A, we also discussed the potential increase in predation by polar bears associated with increasing dependence of Pacific walrus on coastal haulouts caused by the loss of sea-ice habitat.

Disease

Infectious viruses and bacteria have the capacity to impact marine mammals, particularly when first introduced to a population (Duignan *et al.* 1994, p. 90; Osterhaus *et al.* 1997, p. 838; Ham-Lamme *et al.* 1999, p. 607; Calle *et al.* 2002, p. 98; Burek *et al.* 2008, p. 129). Pacific walrus have had exposure to several pathogens, such as Caliciviruses (Fay *et al.* 1984, p. 140; Smith *et al.* 1983, p. 86; Barlough *et al.* 1986, p. 166), Leptospirosis (Calle *et al.* 2002, p. 96), and Influenza A virus (Calle *et al.* 2002, p. 95–96), none of which have resulted in large die-offs of animals.

Additionally, the introduction of new viruses to populations of marine mammals may be the result of changing distribution patterns of the host (Duignan *et al.* 1994, p. 90; Dobson and Carper 1993; p. 1096). For example, phocine distemper virus (PDV) was recently found in the North Pacific (Goldstein *et al.,* 2009 p. 2009), and while antibodies to PDV have been found in Atlantic walrus (Duignan *et al.* 1994, p. 90; Nielson *et al.* 2000, p. 510), as yet there has been no evidence of exposure in Pacific walruses.

Parasites are common among pinnipeds, and their infestations result in various effects to individuals and populations, ranging from mild to severe (Fay 1982, p. 228; Dubey 2003, p. 275). For example, the ectoparasite *Antarctophthirus trichchi* is an anopluran (sucking) louse that lives in the skin folds of walruses (Fay 1982, p. 228), causing external itching, but no serious health issues (Fay 1982, p. 228).

Endoparasites, protozoa, and helminthes (microorganisms and parasitic worms) also may impact populations, as they rely on locating suitable hosts to complete all or part of their life cycle. Of the 17 species of helminthes known to parasitize Pacific walrus, 2 species are endemic (Fay 1982, p. 228; Rausch 2005, p. 134): The cestode *Diphyllobothrium fayi,* found only in the small intestine, and the nematode *Anisakis rosmari,* found only in stomachs (Heptner and Naumov 1976, p. 52).

Trichinella spiralis nativa (Rausch *et al.* 2007, p. 1249) infects Pacific walruses at a rate of about 1.5 percent (Bukina and Kolevatova 2007, p. 14). While the possibility of contracting Trichinosis from infected walrus has been an issue of concern to some subsistence hunters for decades, *Trichinella* does not appear to cause any ill effects in walrus (Rausch *et al.* 2007, p. 1249).

The intracellular parasite *Toxoplasma gondii* is a significant cause of encephalitis in sea otters and harbor seals (Dubey *et al.* 2003, p. 276), and heart, liver, intestine and lung lesions in sea lions (Dubey *et al.* 2003, p. 281). It has been isolated from at least 10 species of marine mammals, including walrus (Dubey *et al.* 2003, p. 278). Of the 53 Pacific walruses tested between 1976 and 1998, about 5.6 percent were positive for *T. gondii* (Dubey *et al.* 2003, p. 278). *T. gondii* has also been documented in some walrus prey (*e.g.,* seals and bivalves; Fay 1982, p. 146; Lowry and Fay 1984, p. 12; Dubey *et al.* 2003, p. 278; Lindsay *et al.* 2004, p. 1055; Jensen *et al.* 2009, p. 1); however, it will not likely play a significant role in the health of the Pacific walrus population, because they have a history of exposure and no large walrus mortality events have been attributed to this organism.

Neospora caninum is a protozoan parasite that was found in 3 of 53 walruses (Dubey *et al.* 2003, p. 281). The health implication for *N. caninum* exposure in walruses is unknown, but the potential for exposure appears low.

In summary, the occurrence and effects of diseases and parasites on Pacific walrus appear to be minor in terms of potential population-level effects. Several diseases and parasites appear at chronically low levels; however, no outbreaks resulting in large die-offs have been observed. A changing climate may increase exposure of walrus to new organisms. Additionally, increased use of terrestrial haulouts may escalate the risk of transmission of disease (Fay 1974, p. 394). This potential stressor is part of the USGS Bayesian network model, which linked lower-shelf ice availability to walrus crowding and incidence of disease and parasites in the population, by increasing the walrus haulout sizes and concentrating their locations (Jay *et al.* 2010b, p. 9). However, sensitivity analysis did not identify disease and predation as having a significant effect on model outcomes (Jay *et al.* 2010b, p. 86). In addition, increased exposure to disease or parasites has yet to be documented, and there are no clear transmission vectors that would change the level of exposure. At this time, disease and parasites are not considered to be threats to the Pacific walrus population, and no evidence exists that they will be in the foreseeable future.

Predation

Because of their large size and formidable tusks, adult walruses have few natural predators. Polar bears (*Ursus maritimus*) and killer whales (*Orcinus orca*) tend to prey on walruses only opportunistically and focus primarily on younger animals.

However, when suitable sea-ice platforms are not available, Pacific walruses haul out onto land, where they become vulnerable to terrestrial predators and associated stampede events. Walrus carcasses accumulating at coastal haulouts provide scavenging opportunities that may attract bears (Ovsyanikov 2003, p. 13). Brown bears, wolverines, and feral dogs have also been observed scavenging at coastal haulouts in Chukotka, Russia, in recent years (Kochnev 2010, pers. comm.) and contribute to disturbances at these haulout sites. Programs have been established in recent years at some coastal haulouts in Chukotka, Russia, to mitigate disturbance-related mortalities that include collection of walrus carcasses and establishment of polar bear feeding areas away from the haulouts and villages (Kavry 2010, pers. comm.).

The increase in walrus carcasses at coastal haulouts in Chukotka in recent years is likely playing an important role in shifting habitat-use patterns of some polar bears and their progeny (Kochnev 2006, p. 1). Walrus carcasses now represent an important food resource for polar bears on Wrangel Island in autumn and early winter (Kochnev 2002, p. 137). Polar bears begin to appear near walrus haulouts on Wrangel Island in early August, about a month prior to the arrival of walruses (Kochnev 2002, p. 137). In the 1990s, the number of polar bears coming ashore on Wrangel Island peaked in late October, averaging 50 bears (Kochnev 2002, p. 137). However, in 2007, approximately 500–600 polar bears were stranded on Wrangel Island (Ovsyanikov and Menyushina 2007, p. 1), along with herds of walruses (up to 15,000 in one group); some of the walruses were in poor condition and polar bears were able to kill them relatively easily. At least 11 cases of polar bear predation on motherless calves were also observed (Ovsyanikov *et al.* 2007, p. 1).

Because the summer/fall open-water period is projected to increase in the foreseeable future, polar bears are also predicted to spend more time on land. As a result, we anticipate that there will be greater interaction between the two species, and terrestrial walrus haulouts may become important feeding areas for polar bears. The presence of polar bears along the coast during the ice-free season will likely influence patterns of haulout use by walrus, and may play a significant role in the selection of coastal haulout sites (Garlich-Miller *et al.* 2011, Section 3.4.2.1 "Polar Bears"). We anticipate walrus to respond to this expected increase in interaction with polar bears by shifting to other coastal haulout locations. However, if walrus are forced to move to other locations to avoid predation by polar bears, the walrus may be displaced from preferred haulout locations with adequate prey resources to other areas that may or may not have less-suitable foraging habitat. It is also possible that walrus will be forced to move to different haulout locations more frequently, with increased energetic costs to them. Kochnev (2004, p. 286) asserted that when Pacific walrus migrate in autumn, from haulout to haulout on the Arctic coast of Chukotka, Russia, the increased pressure from humans and animal predators prevents walruses from getting adequate rest at the coastal haulouts, and some of the animals die in stampedes caused by disturbance events. The magnitude of these potential energetic costs would be determined by the frequency and distance of the shifts in location. Although predation by polar bears on Pacific walrus has been observed, no population-level effects have been documented to date; therefore, polar bear predation is not currently a threat to the Pacific walrus. As sea ice declines and Pacific walrus spend more time on coastal haulouts, however, it is likely that polar bear predation will increase. However, we cannot reliably predict the level of such predation. Although we have identified these issues as stressors for Pacific walrus, we are not able to conclude with sufficient reliability that they will rise to the level of a threat to the Pacific walrus population in the foreseeable future.

Although sea-ice habitats also provide some protection against killer whales, which have limited ability to penetrate far into the ice pack, accounts of killer whale predation on walrus have been observed by Russian scientists and Alaskan Natives (Fay 1982, pp. 216–220). Some observers suggest that killer whales primarily prey upon the youngest animals, and instances of killer whale predation on adult walruses have also been documented (Fay and Stoker 1982, p. 2). The mortality from killer whale predation is unknown, but an interpretation of an examination of 52 walrus carcasses that washed ashore on St. Lawrence Island in 1951 (Fay 1982, p. 220) suggested that 17 walrus (33 percent) died from injuries consistent with killer whale predation. Fay and Kelly reported that 2 of 15 (13 percent) animals they examined had likely been killed by killer whales (Fay and Kelly 1980, p. 235). The potential for killer whales to expand their range and begin to target walruses at northern haulouts exists; however, this remains speculative at this time. Reduced availability of sea ice may lead to walruses spending more time in the water where they may be more susceptible to predation by killer whales (Boveng *et al.* 2009, p. 169). However, there is no evidence that killer whale predation has ever limited the Pacific walrus population, and there is no evidence of increased presence of killer whales in the Bering or Chukchi seas; therefore, killer whale predation is not a threat to the Pacific walrus now and is unlikely to be a threat in the foreseeable future.

Sensitivity analyses of both BN models found that disease and predation had very little effect on model outcomes. For the Service model, disease and predation altered model outcomes by 1.2 and 2.2 percent, respectively (Garlich-Miller *et al.* 2011, Table 8). For the USGS model, disease and predation accounted for less than 1 percent of entropy (variation) reduction (Jay *et al.* 2010b, p. 85–86).

Summary of Factor C

Disease and predation are not considered to represent threats to the Pacific walrus population at this time. Although a changing climate may increase exposure of walrus to new pathogens, there are no clear transmission vectors that would change levels of exposure, and no evidence exists that disease will become a threat in the foreseeable future. As walruses and polar bears become increasingly dependent on coastal haulouts, we expect interactions between the two species to increase. The presence of polar bears stranded along the coast during the ice-free season will likely influence patterns of haulout use and may play a significant role in the selection of coastal haulout sites. There is no evidence that killer whale predation has ever limited the Pacific walrus population, and there is no evidence of increased presence of killer whales in the Bering or Chukchi seas. The net effect of future predation levels on the population cannot be reliably predicted, because of uncertainties relative to distribution of walrus and their potential predators and the amount of potential overlap, and the degree to which these predators would target Pacific walrus. The best available scientific information indicates that the effect of predation on Pacific walrus may be a source of concern in the foreseeable future, particularly at the localized scale, where walrus congregate at coastal haulouts. However, we do not anticipate predation to be a threat to the entire population. Therefore, we conclude, based on the best scientific and commercial data available, that disease and predation are not threats to the Pacific walrus now, nor are they likely to become threats to the population in the foreseeable future.

Factor D. The Inadequacy of Existing Regulatory Mechanisms

In determining whether the inadequacy of regulatory mechanisms constitutes a threat to the Pacific walrus, we focused our analysis on the specific laws and regulations aimed at addressing the two primary threats to the walrus–the loss of sea-ice habitat under Factor A and subsistence harvest under Factor B. These specific regulatory mechanisms are described below. Although none of the other stressors on walrus rise to the level of a threat, we also provide an overview of additional laws and regulations containing protective measures for the walrus.

Regulatory Mechanisms To Address Sea-Ice Loss

As explained under Factor A, a primary threat to the survival of the Pacific walrus is the projected loss of sea-ice habitat due to a warming climate and its consequences for walrus populations. Currently, there are no regulatory mechanisms in place that effectively address GHG emissions, climate change, and associated sea-ice loss.

National and international regulatory mechanisms to comprehensively address the causes of climate change are continuing to be developed. International efforts to address climate change began with the United Nations Framework Convention on Climate Change (UNFCCC), which was signed in May 1992. The UNFCCC states as its objective the stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, but it does not impose any mandatory and enforceable restrictions on GHG emissions. The Kyoto Protocol, negotiated in 1997, became the first agreement added to the UNFCCC to set GHG emissions targets for signatory counties, but the targets are not mandated. The Climate Change Act of 2008 established a long-term target to cut emissions in the United Kingdom (UK) by 80 percent by 2050 and by 34 percent in 2020 compared to 1990 levels, but the law does not pertain to any emissions outside the UK. Other international laws, regulations, or other legally binding requirements imposing limits on GHG emissions to further the goals set forth in the UNFCCC and the Kyoto Protocol have not yet been adopted.

In the United States, efforts to address climate change focus on the Clean Air Act and a number of voluntary actions and programs. Specifically, the Clean Air Act of 1970 (42 U.S.C. 7401 *et seq.*), as amended, requires the Environmental Protection Agency (EPA) to develop and enforce regulations to protect the general public from exposure to airborne contaminants hazardous to human health. In 2007, the Supreme Court ruled that gases that cause global warming are "pollutants" under the Clean Air Act, and that the EPA has the authority to regulate carbon dioxide and other heat-trapping gases (*Massachusetts et al.* v. *EPA* 2007 (Case No. 05–1120)). On December 29, 2009, the EPA adopted a regulation to require reporting of greenhouse gas emissions from fossil fuel suppliers and industrial gas suppliers, direct greenhouse gas emitters, and manufacturers of heavy duty and off-road vehicles and engines (EPA 2009, p. 56260). The rule does not actually regulate greenhouse gas emissions, however; but it merely requires that emissions above certain thresholds be monitored and reported (EPA 2009, p. 56260). On December 7, 2009, the EPA found that the current and projected concentrations of six greenhouse gases in the atmosphere threaten public health and welfare under section 202(a) of the Clean Air Act. This finding by itself does not impose any requirements on any industry or other entities to limit greenhouse gas emissions. While the finding could be considered a prerequisite for any future regulations developed by the EPA to reduce GHG emissions, no such regulations exist at this time. In addition, it is unknown whether any regulations will be adopted in the future as a result of the finding, or how effective such regulations would be in addressing GHG emissions and climate change.

Summary of Regulatory Mechanisms To Address Sea-Ice Loss

Based on our analysis (above), we conclude that there are no known regulatory mechanisms in place at the national or international level that are likely to effectively reduce or limit GHG emissions. This conclusion is corroborated by the projections we used to assess risks to sea ice from GHG emissions, as described earlier in this finding. Therefore, the lack of mechanisms to regulate GHG emissions is already included in our risk assessment in Factor A, which shows that, without additional regulation, GHG emissions and corresponding sea-ice losses are likely to increase in the foreseeable future. Thus, we conclude that regulatory mechanisms do not currently exist to effectively address the loss of sea-ice habitat.

Regulatory Mechanisms To Ensure Harvest Sustainability

While current harvest levels are considered sustainable, subsistence harvest has been identified as a threat to the Pacific walrus within the foreseeable future. As explained in Factor B, subsistence harvest is expected to continue at current levels, while the walrus population is projected to decline with the continued loss of sea ice and associated impacts. Barring additional Tribal or Federal regulations, we anticipate that the proportion of animals harvested will increase relative to the overall population. As a result, the current level of subsistence harvest will likely become unsustainable in the foreseeable future. To address this threat, regulatory mechanisms will need to be developed and implemented to ensure that future harvest levels are reduced in proportion to the declining walrus population such that subsistence harvest levels are sustainable. To determine whether such regulatory mechanisms currently exist, we evaluated the various international and domestic laws and regulations, cooperative agreements, and local ordinances relevant to the subsistence harvest of walrus.

In Russia, the Pacific walrus is a protected species managed primarily by the Fisheries Department within the Ministry of Agriculture. The subsistence harvest of walrus in Russia is authorized, but it is controlled through a quota system. Under the Russian "Law on Fishery and Protection of Aquatic Biological Resources," the harvest of walrus is based upon the total annual catch (TAC) of walrus (Food and Agriculture Organization of the United Nations 2007, p. 4). The TAC takes into account the total population and productivity, based in part on the recommendations of scientists from the Pacific Research Fisheries Center (Chukotka Branch-ChukotTINRO) regarding a sustainable removal level (Kochnev, 2010 pers. comm.). The 2010 quota has been set at 1,300 animals (Kochnev, 2010 pers. comm.).

In the United States, section 101(b) of the MMPA (16 U.S.C. 1371(b)) provides an exemption for the continued nonwasteful harvest of walrus by coastal Alaska Natives for subsistence and handicraft purposes. Pursuant to Section 101(b)(3), regulations limiting the subsistence harvest of walrus may be adopted, but only if a determination is first made that the species or stock has been depleted, following notice and determination by substantial evidence on the record following an agency hearing before an administrative law judge. To date, no determination has ever been made that the species or stock has been depleted, and thus, no regulations establishing limits on the subsistence harvest of Pacific walrus in the United States have been adopted.

Subsistence harvest reporting in the United States is required under section 109(i) of the MMPA. This requirement is administered through the Marking, Tagging, and Reporting Program (MTRP) and requires Alaska Native hunters to report the harvest of all walrus and present the ivory for tagging within 30 days of harvest. Since its implementation in 1988, the Service has used the program to improve its understanding of subsistence harvest by recruiting, training, and outfitting village residents to collect harvest data and tag tusks. Pursuant to the program, the Service has also maintained a walrus harvest reporting database and developed and implemented important outreach and education programs.

In addition to the MTRP, the Service also administers the Walrus Harvest Monitoring Program, which is an observer-based data collection program conducted in the communities of Gambell and Savoonga during the spring harvest. The program is designed to collect basic biological information on harvested walrus, collect biological samples for research, and supplement the MTRP data set, to allow the Service to more accurately account for the unreported segment of the harvest. The Service law enforcement office simultaneously conducts an enforcement program designed to enforce the nonwasteful take provision of the MMPA.

Some local harvest management programs have been adopted in addition to the above subsistence harvest data collection programs. Through a 1997 cooperative agreement between the Service, Bristol Bay Native Association/ Qayassiq Walrus Commission, the Eskimo Walrus Commission, and ADFG, the subsistence harvest of walrus at Round Island, a traditional hunting area now located within the Walrus Island State Game Sanctuary, is restricted to a 40-day fall hunting season and a quota of 20 walrus (Chythlook and Fall 1998, pp. 4, 5). The harvest level in this area has ranged from zero to two per year and represents a very minor portion of the harvest in the United States.

Similarly, out of a desire to revive traditional law, to advance the idea of self regulation of the subsistence harvest, and to initiate a local management infrastructure, the Native villages of Gambell and Savoonga on St. Lawrence Island have recently formed Marine Mammal Advisory Committees (MMAC) and implemented local ordinances establishing a limit of four walruses per hunting trip. The scope of these ordinances is limited, however, as walruses that are struck and lost and walrus calves do not count against this limit of four walruses per trip, and the number of trips is not restricted. Additionally, there is no quota on the total number of walruses that may be harvested.

Summary of Regulatory Mechanisms To Ensure Harvest Sustainability

After evaluating the laws, regulations, cooperative agreements, and local ordinances described above, we conclude that adequate regulatory mechanisms are not currently in place to address the threat that continued levels of subsistence harvest pose to the Pacific walrus as the population declines in the foreseeable future. The Russian harvest is currently regulated with a quota system, based on the sustainability of the harvest. In Alaska, no Statewide quota exists. An annual quota does exist on Round Island, but the number of walrus harvested in this area is miniscule in relation to the overall harvest. In the Bering Strait Region, where the vast majority of U.S. harvest (84 percent) and 43 percent of the rangewide harvest occurs, local ordinances recently adopted by two Native villages reflect the appreciation of the Native community for the important role of self-regulation in managing the subsistence harvest, and will serve as a starting point for future cooperative efforts and the development of harvest management strategies in the future. There are currently no tribal, Federal, or State regulations in place to ensure the likelihood that, as the population of walrus declines in response to changing sea-ice conditions, the subsistence harvest of walrus will occur at a reduced and sustainable level. As a result, we conclude that current regulatory mechanisms are inadequate to prevent subsistence harvest from becoming unsustainable in the foreseeable future. Therefore, we conclude that current regulatory mechanisms do not remove or reduce the threat to the Pacific walrus from future subsistence harvest.

Regulatory Mechanisms To Address Other Stressors

A number of regulatory mechanisms directed specifically at protecting and conserving the walrus and its habitat are in place at the international, national, and local level. These mechanisms may be useful in minimizing the adverse effects to walrus from potential stressors other than sea-ice loss and subsistence harvest, such as the take of walrus for scientific or educational purposes, commercial harvest, human disturbance, and oil spills. Because none of these other stressors rise to the level of a threat to the Pacific walrus, we acknowledge that the protections discussed here are not essential to our determination of the adequacy of existing regulatory mechanisms to address threats to the walrus.

International Agreements

The Convention on International Trade in Endangered Species of Wild Fauna and Flora

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a treaty aimed at protecting species that are or may be affected by international trade. The CITES regulates international trade in animals and plants by listing species in one of three appendices. The level of monitoring and regulation to which an animal or plant species is subject depends on the appendix in which the species is listed. At the request of Canada, the walrus was listed at the species level in Appendix III, which includes species that are subject to regulation in at least one country, and for which that country has asked the other CITES Party countries for assistance in controlling and monitoring international trade in that species. For exportation of walrus specimens from Canada, an export permit may be issued by the Canadian Management Authority if it finds that the specimen was legally obtained. The import of walrus specimens into countries that are parties to CITES requires the presentation of a certificate or origin and, if the import was from Canada, an export permit. All countries within the range of the walrus—that is, the United States (Pacific walrus); the Russian Federation (Pacific and Laptev Walrus), Canada, Norway, Greenland (Denmark), and Sweden (Atlantic walrus) are members to the CITES and have provisions in place to monitor international trade in walrus specimens.

Domestic Regulatory Mechanisms

Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq.)* (MMPA) was enacted to protect and conserve marine mammals so that they continue to be significant functioning elements of the ecosystem of which they are a part. The MMPA sets forth a national policy to prevent marine mammal species or population stocks from diminishing to the point where they are no longer a significant functioning element of the ecosystems.

The MMPA places an emphasis on habitat and ecosystem protection. The habitat and ecosystem goals set forth in the MMPA include: (1) Management of marine mammals to ensure they do not cease to be a significant element of the ecosystem of which they are a part; (2) protection of essential habitats, including rookeries, mating grounds, and areas of similar significance "from the adverse effects of man's action"; (3) recognition that marine mammals "affect the balance of marine ecosystems in a manner that is important to other animals and animal products," and that marine mammals and their habitats should therefore be protected and conserved; and (4) direction that the primary objective of marine mammal management is to maintain "the health and stability of the marine ecosystem." Congressional intent to protect marine mammal habitat is also reflected in the definitions section of the MMPA. The terms "conservation" and "management" of marine mammals are specifically defined to include habitat acquisition and improvement.

The MMPA established a general moratorium on the taking and importing of marine mammals, as well as a number of prohibitions that are subject to a number of exceptions. Some of these exceptions include take for scientific purposes, for purposes of public display, and for subsistence use by Alaska Natives, as well as unintentional take incidental to conducting otherwise lawful activities. The Service, prior to issuing a permit authorizing the taking or importing of a walrus, or a walrus part or product, for scientific or public display purposes, reviews each request, provides an opportunity for public comment, and consults with the U.S. Marine Mammal Commission (MMC), as described at 50 CFR 18.31. The Service has determined that there is sufficient rigor under the regulations at 50 CFR 18.30 and 18.31 to ensure that any activities so authorized are consistent with the conservation of this species and are not a threat to the species.

Take is defined in the MMPA to include the "harassment" of marine mammals. "Harassment" includes any act of pursuit, torment, or annoyance that "has the potential to injure a marine mammal or marine mammal stock in the wild" (Level A harassment), or "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (Level B harassment) (16 U.S.C. 1362(18)(A)).

The MMPA contains provisions for evaluating and permitting incidental take of marine mammals, provided the total take would have no more than a negligible effect on the population or stock. Specifically, under Section 101(a)(5) of the MMPA, citizens of the United States who engage in a specified activity other than commercial fishing (which is specifically and separately addressed under the MMPA) within a specified geographical region may petition the Secretary of the Interior to authorize the incidental, but not intentional, taking of small numbers of marine mammals within that region for a period of not more than 5 consecutive years (16 U.S.C. 1371(a)(5)(A)). The Secretary "shall allow" the incidental taking if the Secretary finds that "the total of such taking during each five-year (or less) period concerned will have no more than a negligible impact on such species or stock and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses" (16 U.S.C. 1371(a)(5)(A)(i)). If the Secretary makes the required findings, the Secretary also prescribes regulations that specify: (1) Permissible methods of taking; (2) means of affecting the least practicable adverse impact on the species, their habitat, and their availability for subsistence uses; and (3) requirements for monitoring and reporting. (16 U.S.C. 1371(a)(5)(A)(ii)). The regulatory process does not authorize the activities themselves, but authorizes the incidental take of the marine mammals in conjunction with otherwise legal activities.

Regulations authorizing the nonlethal incidental take of walrus from certain oil and gas activities in the Beaufort and Chukchi Seas are currently in place. These regulations are based on a determination that the effects of such activities, including noise, physical obstructions, human encounters, and oil spills, are likely to be sufficiently limited in time and scale that they would have no more than a negligible impact on the stock (USFWS 2008, pp. 33212, 33226). General operating conditions required to be imposed in specific authorizations include: (1) Restrictions on industrial activities, areas, and time of year; (2) restrictions on seismic surveys to mitigate potential cumulative impacts on resting, feeding, and migrating walrus; and (3) development of a site-specific plan of operation and a site-specific monitoring plan to enumerate and document any animals that may be disturbed. These and other safeguards and coordination with industry called for under the MMPA have been useful in helping to minimize industry effects on walrus.

A similar process exists for the promulgation of regulations authorizing the incidental take of small numbers of marine mammals where the take will be limited to harassment (16 U.S.C. 1371(a)(5)(D)). These authorizations, referred to as Incidental Harassment Authorizations, are limited to 1 year and require a finding by the Department that the taking will have no more than a negligible impact on the species or stock and will not have immitigable adverse impact on the availability of such species or stock for taking for subsistence uses. There are currently no incidental harassment authorizations in place for the walrus.

As discussed under Factor E, shipping and anthropogenic noises are expected to increase in the Chukchi and Beaufort Seas in the future, and could impact the walrus or its habitat. Under the MMPA, however, disturbance of walrus from such otherwise lawful human activity is generally prohibited. While the MMPA does allow for the incidental taking of walrus, any such authorizations for increasing shipping activities or anthropogenic noise from industry would be required to be based on a determination that impacts to the Pacific walrus would be negligible and would not have an immitigable adverse impact on the availability of Pacific walrus for the taking for subsistence uses, consistent with the procedures outlined previously regarding the promulgation of take regulations and incidental harassment authorizations.

Similarly, the potential for commercial fishing to expand into the Chukchi and Beaufort Seas could impact the Pacific walrus, as discussed later in this finding. However, the MMPA has protections in place to limit any potential incidental impacts of future commercial fisheries. Specifically, section 118 of the MMPA (16 U.S.C. 1387) calls for commercial fisheries to reduce any incidental mortality or serious injury of marine mammals to insignificant levels approaching zero. In its 2004 report to Congress regarding the commercial fisheries' progress toward reducing mortality and serious injury of marine mammals, the National Oceanic and Atmospheric Administration (NOAA) concluded that: (1) Most fisheries have achieved levels of incidental mortality consistent with the Zero Mortality Rate Goal; (2) substantial progress has been made in reducing incidental mortality through Take Reduction Plans; and (3) additional information will be needed for most fisheries and stocks of marine mammals to accurately assess whether mortality incidental to commercial fishing is at insignificant levels approaching a zero mortality and serious injury rate (NOAA 2004, Executive Summary). Thus, while commercial fishing could expand in the future, such expansions would need to be consistent with existing fisheries elsewhere in the United States that must limit their impacts to marine mammals.

Outer Continental Shelf Lands Act

The Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. 331 *et seq.*) established Federal jurisdiction over submerged lands on the outer continental shelf (OCS) seaward for 5 km (3 mi) in order to expedite exploration and development of oil and gas resources. The OCSLA is implemented by the Bureau of Ocean Energy, Management, Regulation and Enforcement (formerly the Minerals Management Service) of the Department of the Interior. The OCSLA mandates that orderly development of OCS energy resources be balanced with protection of human, marine, and coastal environments. Specifically, Title II of the OCSLA provides for the cancellation of leases or permits if continued activity is likely to cause serious harm to life, including fish and other aquatic life. It also requires economic, social, and environmental values of the renewable and nonrenewable resources to be considered in management of the OCS. Through consistency determinations, any license or permit issued under the OCSLA must be consistent with State coastal management plans (see also the Coastal Zone Management Act below). Thus, the OCSLA helps to increase the likelihood that projects on the OCS do not adversely impact Pacific walruses or their habitats.

Oil Pollution Act of 1990

The Oil Pollution Act of 1990 (OPA) (33 U.S.C. 2701) provides enhanced capabilities for oil spill response and natural resource damage assessment by the Service. The OPA requires the Service to consult on developing a fish and wildlife response plan for the National Contingency Plan, provide input to Area Contingency Plans, review Facility and Tank Vessel Contingency Plans, and conduct damage assessments for the purpose of obtaining damages for the restoration of natural resources injured from oil spills. However, we note that there are limited abilities to respond to a catastrophic oil spill event described in the plan (Alaska Regional Response Team 2002, pp. G–71, G–72). The U.S. Coast Guard, despite planning efforts, has limited offshore capability to respond in the event of a large oil spill in northern or western Alaska, and we only marginally understand the science of recovering oil in broken ice (O'Rourke 2010, p. 23).

Coastal Zone Management Act

The Coastal Zone Management Act of 1972 (CZMA) (16 U.S.C. 1451 *et seq.*) was enacted to "preserve, protect, develop, and where possible, to restore or enhance the resources of the Nation's coastal zone." The CZMA provides for the submission of a State program subject to Federal approval. The CZMA requires that Federal actions be conducted in a manner consistent with the State's Coastal Zone Management Plan (CZMP) to the maximum extent practicable. Federal agencies planning or authorizing an activity that affects any land or water use or natural resource of the coastal zone must provide a consistency determination to the appropriate State agency. The CZMA applies to walrus habitats of northern and western Alaska. In Alaska, consistency determinations are reviewed for compliance with the Alaska Coastal Management Program (Alaska Stat. section 46.39–40). The Alaska Coastal Management Plan is developed in partnership with Alaska's natural resource agencies, the Alaska Department of Environmental Conservation, the ADFG, and the Department of Natural Resources (Alaska Coastal Management Plan 2005, p. A85). The CZMA applies to walrus habitats of northern and western Alaska by ensuring that any permitted actions are consistent with the State of Alaska's CZMP, which, among other things, sets standards that require exposed high energy coasts to be managed so as to avoid, minimize, or mitigate significant adverse impacts to the mix and transport of sediments. As such, these requirements provide potential protection to current or future coastal haulouts.

Alaska National Interest Lands Conservation Act

The Alaska National Interest Lands Conservation Act of 1980 (ANILCA) (16 U.S.C. 3101 *et seq.*) created or expanded National Parks and National Wildlife Refuges in Alaska, including the expansion of the Togiak National Wildlife Refuge (NWR) and the Alaska Maritime NWR. One of the purposes of these National Wildlife Refuges under the ANILCA is the conservation of marine mammals and their habitat. Walrus haulouts at Cape Peirce and Cape Newenham are located within Togiak NWR while haulouts at Cape Lisburne occur in the Alaska Maritime NWR. Access to the Cape Peirce is tightly controlled through a permitted visitor program. Refuge staff require that visitors must remain out of sight, downwind, and a minimum of 107 m (100 yards) from walruses. Visitors are advised that disturbances to walruses or seals are a violation of the MMPA (Miller 2010, pers. comm.). Cape Newenham has no established refuge visitor program, because public access is extremely limited due to the presence of Department of Defense lands surrounding the Cape. As discussed under Factor A above, the change in the nature and location of walrus haulouts in response to changing ice conditions is anticipated into the foreseeable future. Significant portions of the Chukchi Sea coastal zone in Alaska are National Wildlife Refuge lands created under ANILCA, and they have the ability to provide haulout locations that are free from human disturbance.

Marine Protection, Research and Sanctuaries Act

The Marine Protection, Research and Sanctuaries Act (MPRSA) (33 U.S.C. 1401 *et seq.*) was enacted in part to "prevent or strictly limit the dumping into ocean waters of any material that would adversely affect human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." The MPRSA does not itself regulate the take of walrus; however, it does help maintain water quality, which likely benefits walrus prey.

Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson Fishery Conservation and Management Act in 1976 (renamed the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)) (16 U.S.C. 1800 *et seq.*) established the North Pacific Fishery Management Council (NPFMC), one of eight regional councils established by the MSFCMA to oversee management of the U.S. fisheries. With jurisdiction over the 2,331,000-sq-km (900,000-sq-mi) Exclusive Economic Zone (EEZ) off Alaska, the NPFMC has primary responsibility for groundfish management in the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI), including Pacific cod (*Gadus macrocephalus*), pollock, mackerel (*Pleurogrammus monopterygius*), sablefish (*Anoplopoma fimbria*), and rockfish (*Sebastolobus* and *Sebastes* species) species harvested mainly by trawlers, hook and line, longliners, and pot fishermen. In 2009, the NPFMC released its Fishery Management Plan for Fish Resources of the Arctic Management Area, covering all U.S. waters north of the Bering Strait. Management policy for this region is to prohibit all commercial harvest of fish until sufficient information is available to support the sustainable management of a commercial fishery (NPFMC 2009, p. 3). The policy helps to protect walrus from potential impacts of commercial fishery activities.

Additionally, the Sustainable Fisheries Act of 1996 amended the MSFCMA, requiring the NOAA to describe and identify Essential Fish Habitat, which includes those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. "Waters" include aquatic areas and their associated physical, chemical, and biological properties. "Substrate" includes sediment underlying the waters. "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Spawning, breeding, feeding, or growth to maturity covers all habitat types utilized by a species throughout its life cycle, and includes not only the water column but also the benthos layers. The NOAA's "Final Rule for the implementation of the Fisheries of the Exclusive Economic Zone off Alaska; Groundfish Fisheries of the Bering Sea and Aleutian Islands Management Area," published July 25, 2008 (NOAA 2008, p. 43362), protects areas adjacent to walrus haulouts and feeding areas from potential impacts of trawl fisheries. For example, the St. Lawrence Island Habitat Conservation Area closes waters around the St. Lawrence Island to federally permitted vessels using nonpelagic trawl gear. Such closures provide important refuge for the walrus, but, more importantly, protect feeding habitat from disturbance.

Russian Federation

The walrus in Russia is a protected species managed primarily by the Fisheries Department within the Ministry of Agriculture. Regulations regarding the subsistence harvest of walrus were discussed previously. There is currently no commercial harvest of walrus authorized in Russia (Kochnev 2010, pers. comm.).

Important terrestrial haulout sites in Russia are also protected, and human disturbance is minimized. For example, Wrangel Island, an area which has seen large influxes of walrus, as discussed above, has been a nature reserve since 1979 and prohibits human disturbance (United Nations Environmental Program 2005, p. 1). Additionally, the haulouts at Cape Kozhevnikov near the village of Ryrkaipyi and Cape Vankarem near the village of Vankarem were recently granted protections by the Government of Chukotka to minimize disturbance, and a local conservation organization known as the "UMKY Patrol" has organized a quiet zone and implemented visitor guidelines to reduce disturbance (Patrol 2008, p. 1; Kavry 2010, pers. comm.).

State of Alaska

While the Service has the primary authority to manage Pacific walrus in the United States, the State of Alaska has regulatory programs that compliment Federal regulations and work in concert to provide conservation for walrus and their habitats. For example, as discussed above, the State's Coastal Zone Management Plan works to ensure that beach integrity is maintained. Additionally, oil and gas lease permits issued by the State of Alaska in State waters or along the coastal plain contain specific requirements for Pacific walrus that, for example, prohibit above-ground lease-related facilities and structures within 1 mile inland from the coast, in an area extending 1 mile northeast and 1 mile southwest of the Cape Seniavin walrus haulout (ADNR 2005, p. 3). In addition, walrus and their habitats are protected in various State special-use areas. For example, the Walrus Island State Game Sanctuary is a State of Alaska–managed conservation area with regulations in place that allow only limited access to the sanctuary, prohibit any disturbance of walrus, and limit access to beaches and water. These regulations protect walrus and their haulouts (5 AAC 92.066, Permit for access to Walrus Islands State Game Sanctuary).

Summary of Factor D

As explained in Factor A, the sea-ice habitat of the Pacific walrus has been modified by the warming climate, and sea-ice losses are projected to continue into the foreseeable future. There currently are no regulatory mechanisms in place to effectively reduce or limit GHG emissions. This situation was considered as part of our analysis in Factor A. Accordingly, there are no existing regulatory mechanisms to effectively address loss of sea-ice habitat.

As explained in Factor B, harvest, while currently sustainable, is identified as a threat within the foreseeable future because we anticipate that harvest levels will continue at current levels while the population declines due to sea-ice loss; as a result, the proportion of animals harvested will increase. Harvest in Russia is managed for sustainability through a quota system. Harvest in the United States is well-monitored and limited to subsistence harvest by Alaska Natives, with further restrictions on use and sale of walrus parts; however, the U.S. harvest is not directly limited by quota. Emerging local harvest management efforts offer a promising approach to developing harvest management initiatives. Effectiveness of such measures can be evaluated with existing harvest monitoring and reporting programs. In the Bering Strait Region, where the vast majority of U.S. harvest and 43 percent of the rangewide harvest occurs, local ordinances recently adopted by two Native villages reflect the important role of self-regulation in managing the subsistence harvest, and will be important in the development of harvest management strategies in the future. However, there are currently no tribal, Federal, or State regulations in place to ensure the likelihood that, as the population of walrus declines in response to changing sea-ice conditions, the subsistence harvest of walrus will occur at a reduced and sustainable level. As a result, we conclude that current regulatory mechanisms are inadequate to address the threat of subsistence harvest becoming unsustainable in the foreseeable future, as the Pacific walrus population declines due to sea-ice habitat loss and associated impacts.

While laws and regulations exist that help to minimize the effect of other stressors on the Pacific walrus, there are no regulatory mechanisms currently in place that adequately address the primary threats of habitat loss due to sea-ice declines (Factor A) and subsistence harvest (Factor B). As a result, we conclude that the existing regulatory mechanisms do not remove or reduce the threats to the Pacific walrus from the loss of sea-ice habitat and overutilization.

Factor E. Other Natural or Manmade Factors Affecting Its Continued Existence.

We evaluated other factors that may have an effect on the Pacific walrus, including pollution and contaminants; oil and gas exploration, development, and production; commercial fisheries interactions; shipping; oil spills; and icebreaking activities. The potential effects of many of the stressors under this factor are tied directly to changes in sea ice. Potential increases in commercial shipping due to the opening of shipping lanes that have been unavailable in the past are one example. In addition, oil and gas exploration and development activities are in part dependent on ice conditions, as is the potential for expanding commercial fisheries. Because the potential effects of these stressors are related to sea-ice losses, our ability to reliably predict the potential level and influence of these stressors is tied to our ability to predict environmental changes associated with sea-ice losses, as discussed previously under Factor A.

Pollution and Contaminants

Understanding the potential effects of contaminants on walruses is confounded by the wide range of contaminants present, each with different chemical properties and biological effects, and the differing geographic, temporal, and ecological exposure regimes. Nevertheless, Robards *et al.* (2009, p. 1) in their assessment of contaminant information available for Pacific walruses conclude that Pacific walruses contain generally low contaminant levels; however, an absence of data limited definitive conclusions about the effects current contaminant had on Pacific walruses.

Of particular concern in the Arctic are persistent organic pollutants (POPs), because they do not break down in the environment and are toxic. "Legacy" POPs (those no longer used in the United States) include polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT, chlordanes, toxaphene, and mirex. POPS with continued use include hexachlorocyclohexanes (HCHs). Although numerous POPs have been detected in the Arctic environment, concentrations of POPs found in Pacific walrus are relatively low (Seagars and Garlich-Miller 2001, p. 129; Taylor *et al.* 1989, pp. 465–468) because walruses generally feed at relatively lower trophic levels than other marine mammals. In 1981, Atlantic walruses had the lowest concentrations of organochlorines in any pinniped measured (Born *et al.* 1981, p. 255), and recent data show walruses had much lower levels of brominated compounds and perfluorinated sulfonates (PFSA) than other Arctic marine mammals (Letcher *et al.,* 2010, In press). Some Atlantic walrus individuals and populations specialize in feeding on pelagic fish and ringed seals, moving them higher in the food chain than the Pacific walrus, resulting in greater POP concentrations (Dietz *et al.* 2000, p. 221). For example, PCBs and DDT concentrations in Pacific walruses were lower than concentrations found in Atlantic walruses from Greenland and Hudson Bay, Canada, collected in the 1980s (Muir *et al.* 1995, p. 335).

Heavy metals of concern in Arctic marine mammals include mercury (Hg), cadmium, and lead. Defining mercury trends is complicated by mercury's complex environmental chemistry, although in general anthropogenic mercury is increasing in the Arctic, as it is globally (AMAP 2005, p. 17), primarily due to combustion processes. Temporally, mercury concentrations in fossils and fresh walrus teeth collected at Nunavut in the Eastern Canadian Arctic were no higher in the 1980s and 1990s compared to A.D. 1200–1500, "indicating an absence of industrial Hg in the species at this location." Increases of mercury were seen in beluga teeth from the Beaufort Sea over the same time span (Outridge *et al.* 2002, p. 123). There was also no change in mercury in walruses from Greenland from 1973 to 2000 (Riget *et al.* 2007, p. 76). Born *et al.* (1981, p. 225) found low methyl mercury accumulation in Atlantic walruses compared to seals in Greenland and the eastern Canadian Arctic.

The presence of cadmium has been of concern to subsistence hunters who eat Pacific walruses, though it does not appear to be having effects on walrus health. Mollusks accumulate cadmium, so it is not surprising that walruses had relatively high levels. However, Lipscomb (1995, p. 1) found no histopathological (effects of disease on tissue) effects in Pacific walrus liver and kidney tissues, although liver concentrations were great enough to cause concern about contamination levels, walrus health, and the consumption of walrus. Over the time period 1981 to 1991, cadmium in Pacific walrus liver declined from 41.2 to 19.9 milligrams/kg dry weight (Robards 2006, p. 24).

Radionuclide (a radioactive substance) sources include atmospheric fallout from Chernobyl, nuclear weapons testing, and nuclear waste dumps in Russia (Hamilton *et al.* 2008, p. 1161). Pacific walrus muscle had non-naturally occurring cesium 137 levels lower than did bearded seals (*Erignathus barbatus*) sampled from the same area, and lower than seals from Greenland sampled one to two decades earlier (Hamilton *et al.* 2008, p. 1162). Barring new major accidents or releases, with decay of anthropogenic radionuclides from fallout and Chernobyl and improved regulation and cleanup of waste sources, radionuclide activities are expected to continue to decline in Arctic biota (AMAP 2009, p. 66).

Tributyltin (TBT; from ship antifouling paints) is ubiquitous in the marine environment (Takahashi *et al.* 1999, p. 50; Strand and Asmund 2003, p. 31), although TBT and its toxic metabolites are found at greatest concentrations in harbors and near shore shipping channels (Takahashi *et al.* 1999, p. 52; Strand and Asmund 2003, p. 34). Pacific walruses will likely see increased exposure to this contaminant class as shipping increases in their habitats as a result of longer ice-free seasons due to climate change.

Climate-related change will affect long-range and oceanic transport of contaminants, and may provide additional sources of contaminants. Increasing water temperatures may increase methylation of mercury, which increases the availability of mercury for bioaccumulation (Sunderland *et al.* 2009, p. 1) and may release contaminants from melting pack ice (Metcalf and Robards 2008, p. S153). It is projected that Cesium 137 from nuclear weapons testing fallout and Chernobyl may be liberated from storage in trees as the incidence of forest fires increases due to climate change (AMAP 2009, p. 66).

Although few data exist with which to evaluate the status of the Pacific walrus population in relation to contaminants, information available indicates that Pacific walruses have generally low concentrations of contaminants of concern. Further, based on the general observations of a lack of effect on individual animals, there is currently no evidence of population-level effects in walruses from contaminants of any type. Climate change, with projected increases in mobilization of contaminants to and within the Arctic, combined with potential changes in Pacific walrus prey base, may lead to increased exposure. However, potential effects are likely to be limited by the trophic status and distribution of walruses: As benthic feeders that specialize on prey lower in the food web, walruses would have a low rate of bioaccumulation and therefore limited exposure to contaminants. Based on our estimation of low current contaminant loads and the likelihood of minimal future exposure as walruses feed on lower trophic levels, we conclude that contaminants are not a threat now and are not likely to be a threat to the Pacific walrus population in the foreseeable future.

Oil and Gas Exploration, Development, and Production

Oil and gas related activities have been conducted in the Beaufort and Chukchi Seas since the late 1960s, with most activity occurring in the Beaufort Sea (USFWS 2008, p. 33212). Three existing projects are located off the coast of Alaska in the Beaufort Sea (Endicott, Northstar, and Oooguruk). Current and foreseeable future activity in the Chukchi Sea is related to Lease Sale 193, the first Chukchi Sea lease sale since 1991 (MMS 2008, p. 1). While no development of leases issued pursuant to the lease sale has occurred to date, future activity is anticipated. Our ability to predict effects of these activities on walrus is based, in part, on reasonably foreseeable development scenarios prepared for this lease sale, which project exploration, development, and production activities to last through roughly 2049 (USFWS, Final Biological Opinion for Beaufort and Chukchi Sea Program Area Lease Sales and Associated Seismic Surveys and Exploratory Drilling, Anchorage, Alaska, September 3, 2009, pp. 10–11).

In the Chukotka Russia region, the oil and gas industry is targeting regions of the Bering and Chukchi Seas for exploration. Recently, there has been renewed interest in exploring for oil and gas in the Russian Chukchi Sea, as new evidence suggests that the region may harbor large reserves. In 2006, seismic exploration was conducted in the Russian Chukchi to explore for economically viable oil and gas reserves (Frantzen 2007, p. 1).

Currently, Pacific walruses do not normally range into the Beaufort Sea, although individuals and small groups have been observed there. From 1994 to 2004, industry monitoring programs recorded a total of 9 walrus sightings, involving a total of 10 animals. No disturbance events or lethal takes have been reported to date (USFWS 2008, p. 33212). Because of the small numbers of walruses encountered by past and present oil and gas activity in the Beaufort Sea, impacts to the Pacific walrus population appear to have been minimal (USFWS 2008, p. 33212). Even with less ice, it is unlikely that walrus numbers will increase significantly in the Beaufort Sea, as habitat is limited by a relatively narrow continental shelf, which results in deep and less-productive waters. Therefore, we do not anticipate significant interactions with, or impacts from, oil and gas activities in the Beaufort Sea on the Pacific walrus population.

Pacific walruses are seasonally abundant in the Chukchi Sea. Exploratory oil and gas operations in the Chukchi Sea have routinely encountered Pacific walruses; however, potential impacts to walruses are regulated through the MMPA. Specifically, incidental take regulations (ITRs) have been promulgated for the non-lethal, incidental take of walruses from oil and gas exploration activities in the Chukchi Sea, including geophysical, seismic, exploratory drilling and associated support activities for the 5-year period ending in June 2013. In a detailed analysis of the effects of such activities, including noise, physical obstructions, human encounters, and oil spills, the Service concluded that exploration activities would be sufficiently limited in time and scope that they would result in the take of only small numbers of walruses with no more than a negligible impact on the stock (73 FR 33212 (2008)). Prior to commencing exploration activities, operators are currently required by the Bureau of Ocean Energy, Management, Regulation and Enforcement (BOEMRE, formerly MMS) to obtain letters of authorization (LOA) pursuant to the ITRs or an incidental harassment authorization (IHA) (Wall 2011, pers. comm.). If operators commence operations without such authorization, their operations may be shut down, (Wall 2011, pers. comm.), and any take of walrus would be in violation of the MMPA.

While we anticipate oil and gas exploration activities to occur in the Chukchi Sea in the foreseeable future, we expect industry to request that the ITRs be renewed, so that any non-lethal, incidental take associated with exploration is authorized under the MMPA. The ITRs could not be renewed, and LOAs could not be issued, unless a determination were made that the activities would result in the take of only small numbers of walrus and have a negligible impact on the stock.

Monitoring studies performed to date have documented minimal effects of various exploration activities on walruses (USFWS 2008, p. 33212). In 1989 and 1990, aerial surveys and vessel-based observations of walruses were carried out to examine the animals' response to drilling operations at three Chukchi Sea prospects. Aerial surveys documented several thousand walruses (a small percentage of the estimated population) in the vicinity of the drilling prospects. The monitoring reports concluded that: (1) Walrus distributions were closely linked with pack ice; (2) pack ice was near active drill prospects for relatively short time periods; and (3) ice passing near active prospects contained relatively few animals. Walruses either avoided areas of operations or were passively carried away by the ice floes, and because only a small proportion of the population was near the operations, and for short periods of time, the effects of the drilling operations on walruses were limited in time, area, and proportion of the population (USFWS 2008, p. 33212). However, if walrus are forced to avoid areas of operations and associated disturbance by abandoning ice haulouts and swimming to other areas, they will likely experience increased energetic costs related to active swimming as opposed to passive transport on ice floes.

Disturbances caused by vessel and air traffic may cause walrus groups to abandon land or ice haulouts. One study suggests that walruses may be tolerant of ship activities; Brueggeman *et al.* (1991, p. 139) reported that 75 percent of walruses encountered by vessels in the Chukchi Sea exhibited no reaction to ship activities within 1 km (0.6 mi) or less. This conclusion is corroborated by another study, which reported observations that walruses in water generally show little concern about potential disturbance from approaching vessels and will dive or swim away if a vessel is nearing a collision with them (Fay *et al.* 1984, p. 118).

Open-water seismic exploration, which produces underwater sounds typically with air gun arrays, may potentially affect marine mammals. Walruses produce a variety of sounds (grunts, rasps, clicks), which range in frequency from 0.1 to 10.0 Hertz (Hz, sine wave of a sound) (Richardson *et al.* 1995, p. 108). The effects of seismic surveys on walrus hearing and communications have not been studied. Seismic surveys in the Beaufort and Chukchi Seas will not impact vocalizations associated with breeding activity (one of the most important times of communication), because walruses do not currently breed in the open water areas that are subject to survey. Injury from seismic surveys would likely occur only if animals entered the zone immediately surrounding the sound source (Southall *et al.* 2007, p. 441). Walrus behavioral responses to dispersal and diving vessels associated with seismic surveys were monitored in the Chukchi Sea OCS in 2006. Based upon the transitory nature of the survey vessels, and the behavioral reactions of the animals to the passage of the vessels, we conclude that the interactions resulted in temporary changes in animal behavior with no lasting impacts to the species (Ireland *et al.* 2009, pp. xiii–xvi).

Future seismic surveys are anticipated to have minimal impacts to walrus. Surveys will occur in areas of open water, where walrus densities are relatively low. Monitoring requirements (vessel-based observers) and mitigation measures (operations are halted when close to walrus) in U.S. waters are expected to minimize any potential interactions with large aggregations of walruses. Because seismic operations likely would not be concentrated in any one area for extended periods, any impacts to walruses would likely be relatively short in duration and have a negligible overall impact on the Pacific walrus population.

Currently, there are no active offshore oil and gas developments in the U.S. Bering or Chukchi Seas. Therefore, the risk of an oil spill is low at the present time. The potential for an oil spill increases as offshore oil and gas development and shipping activities increase. No large oil spills have occurred in areas inhabited by walruses; however, a large oil spill could result in acute mortalities and chronic exposure that could substantially reduce the Pacific walrus population for many years (Garlich-Miller *et al.* 2011, Section 3.6.2.3.3 "Oil Spills"). A spill that oiled coastal haulouts occupied by females and calves could be particularly significant and could have the potential to impact benthic communities upon which walruses depend. As discussed below, oil spill cleanup in the broken-ice and open-water conditions that characterize walrus habitat would be more difficult than in other areas, primarily because effective strategies have yet to be developed. The Coast Guard has no offshore response capability in northern or western Alaska (O'Rourke 2010, p. 23).

According to BOEMRE, if oil and gas development of leases issued pursuant to Chukchi Lease Sale 193 occurs, the chance of one or more large oil spills (greater than or equal to 1,000 barrels) occurring over the production life of the development is between 35 and 40 percent (MMS 2007, p. IV–156). However, the estimated probability that oil reserves sufficient for development will be discovered range from 1 to 10 percent (MMS 2007, p. IV–156), reducing the chance of a large oil spill to 0.33 to 4 percent.

Our analysis of oil and gas development potential and subsequent risks was based on the analysis BOEMRE (MMS 2007, p. 1–631) conducted for the Chukchi Sea lease sales. Following the Deepwater Horizon incident in the Gulf of Mexico, offshore oil and gas activities have come under increased scrutiny. Policy and management changes are under way within the Department of the Interior that will likely affect the timing and scope of future offshore oil and gas activities. In addition, BOEMRE has been restructured to increase the effectiveness of oversight activities, eliminate conflicts of interest, and increase environmental protections (USDOI 2010, p. 1). As a result, we anticipate that the potential for a significant oil spill will remain small; however, we recognize that should a spill occur, there are no effective strategies for oil spill cleanup in the broken-ice conditions that characterize walrus habitat. In addition, the potential impacts to Pacific walrus from a spill could be significant, particularly if subsequent cleanup efforts are ineffective. Potential impacts would be greatest if walrus are aggregated in coastal haulouts where oil comes to shore. Overall, the chance of a large oil spill occurring in the Pacific walrus' range in the foreseeable future, however, is considered low.

In summary, oil and gas activities have occurred sporadically throughout the range of the Pacific walrus. Specific studies on the effects of exploratory drilling activities and associated shipping and seismic surveys have documented minimal effects on walrus—namely, transitory behavioral changes that were temporary in nature. Exploration activities are currently regulated under the MMPA, and the take of walrus during exploration activities is only authorized if operators have first obtained an LOA or an IHA. These authorizations are only issued for the non-lethal, incidental take of walrus, where the activities are considered likely to result in the take of small numbers of walrus with a negligible impact on the stock. We expect that future exploration to be similarly regulated under the MMPA. Therefore, we conclude that impacts of oil and gas exploration likely to occur over the foreseeable future will have minimal effects on walruses. Further, although a significant oil spill in the Chukchi Sea from exploration, development or production activities could have a detrimental impact on Pacific walrus, depending on timing and location, the potential for such a spill is low. As a result, we conclude that oil and gas exploration, development, and production are not threats to the Pacific walrus now, nor are they likely to become threats in the foreseeable future.

Commercial Fisheries

Commercial fisheries occur primarily in ice-free waters and during the open-water season, which limits the overlap between fishery operations and walruses. Where they do overlap, fisheries may impact Pacific walruses through interactions that result in the incidental take of walrus or through competition for prey resources or destruction of benthic prey habitat. A complete list of fisheries is published annually by NOAA Fisheries. The most recent edition (NOAA 2009a, p. 58859), showed about nine fisheries that have the potential to occur within the range of the Pacific walrus.

Currently, incidental take in the form of mortality from commercial fishing is low. Pacific walruses occasionally interact with trawl and longline gear of groundfish fisheries. In Alaska each year, fishery observers monitor a percentage of commercial fisheries and report injury and mortality of marine mammals affected incidental to these operations. Incidental mortality to Pacific walruses during 2002–2006 was recorded for only one fishery, the Bering Sea/Aleutian Island flatfish trawl fishery, which is a Category II Commercial Fishery with 34 vessels or persons. During the years 2002–2006, observer coverage for this fishery averaged 64.7 percent. The mean number of observed mortalities was 1.8 walrus per year, with a range of 0 to 3 walrus per year. The total estimated annual fishery-related incidental mortality in Alaska was 2.66 walrus per year (USFWS 2010, pp. 3–4).

In addition to incidental take from fishing activities, however, fishery vessel traffic has the potential to take Pacific walruses through collisions and disturbance of resting, foraging, or travelling behaviors. We consider the likelihood of collisions between fishing vessels and walruses to be very low, however, as we unaware of any documented ship strikes, and it has been observed that walruses typically dive or swim off to the side if a shipping vessel comes close to colliding with them (Fay *et al.* 1984, p. 118). Fisheries occurring near terrestrial haulouts may affect animals approaching, leaving, or resting at the haulouts.

The Bristol Bay region in the Bering Sea is home to some of the largest U.S. land haulouts and several fisheries. For some haulouts, regulations are in place to minimize disturbance. Round Island is buffered from all fishing activities by a 0-to-3-nautical-mile "no transit" closure. Capes Peirce and Newenham and Round Island are buffered from fishing activities in Federal waters from 3 to 12 nautical miles; however, this buffer only applies to vessels with Federal fisheries permits. The haulout at Hagemeister Island has no protection zone in either Federal or State waters. Large catcher/processer vessels associated with the yellowfin sole fishery, as well as smaller fishing vessels 32 ft or less in length routinely pass between the haulout and the mainland to a site for offloading product to foreign vessels. Anecdotal reports indicate potential disturbance of walruses using the Hagemeister haulout (Wilson and Evans 2009b, p. 28). To address concerns of disturbance associated with the yellowfin sole fleet, the Service has engaged the North Pacific Fisheries Management Council to examine alternatives to provide increased protection for the haulout at Hagemeister Island (Wilson and Evan 2009a, pp. 1–23); however, no specific measures have been implemented. The haulout at Cape Seniavin currently has no Federal or State protection zones. No Federal fisheries occur near Cape Seniavin, but State of Alaska–managed salmon fisheries do occur in the immediate vicinity and pose a potential for disturbance. In general, however, within Bristol Bay, the proportion of walruses potentially affected is small relative to the population. The population is also comprised predominantly of males, which are less susceptible to trampling injuries as a result of disturbance; however, repeated disturbance events have the potential to result in haulout abandonment.

State-managed nearshore herring and salmon gillnet fisheries also have the potential to take walruses. The ADFG does not have an observer or self-reporting program to record marine mammal interactions, but it is believed that gear interactions with walruses have not occurred in the recent past (Murphy 2010, pers. comm.; Sands 2010, pers. comm.). Spotter planes used in the spring herring fishery in Bristol Bay have the potential to cause disturbance at terrestrial haulouts. To mitigate this potential, the Service developed and distributed guidelines for appropriate use of aircraft within the vicinity of Bristol Bay walrus haulouts (USFWS 2009, p. 1), and these were in effect during the fishing season.

In summary, given the current low rates of walrus encounters and deaths associated with commercial fishing, we expect that any increase in the level of fishery-related mortality to walrus will occur at a very low level relative to the total walrus population. Similarly, although walrus may be subject to disturbance from commercial fishing, the proportion of walrus affected is low, and efforts are under way to minimize the impacts. Accordingly, we do not consider fishery-related take of walrus to be a threat to the Pacific walrus population now or in the foreseeable future.

Commercial fisheries may also impact walruses through competition for prey resources or destruction of benthic prey habitat. With regard to competition, there is little overlap between commercial fish species and Pacific walrus prey species. The principal prey items consumed by weaned walruses are bivalves, gastropods, and polychaete worms (Fay 1982, p. 145; Sheffield and Grebmeier 2009, p. 767). Fay (1982, pp. 153–154) notes that the scarcity in walruses of endoparasites of known fish origin indicates that walruses rarely ingest fish. Fay (1982, pp. 152,154) also notes that various authors have reported occasionally finding several different crab species in walrus stomachs, but apparently at low frequency. Thus, direct competition for prey from commercial fisheries does not appear to be a threat to the Pacific walrus population now or in the foreseeable future.

Commercial fisheries—specifically pelagic (mid-water trawl) and nonpelagic (bottom trawl) fisheries—have the potential to indirectly affect walruses through destruction or modification of benthic prey or their habitat. Pelagic or mid-water trawls make frequent contact with the bottom, as evidenced by the presence of benthic species (*e.g.,* crabs, halibut) that are brought up as bycatch. NFMS estimates that approximately 44 percent of the area shadowed by the gear receives bottom contact from the footrope (NMFS 2005, pp. B–11). The majority of the pelagic trawl effort in the eastern Bering Sea is directed at walleye pollock in waters of 50–300 m (164–960 ft) (Olsen 2009, p. 1). The area north of Unimak Island along the continental shelf edge receives high fishing effort (Olsen 2009, p. 1). This puts the majority of pelagic fishing effort on the periphery of walrus-preferred habitat, as walruses are usually found over the continental shelf in waters of 100 m (328 ft) or less (Fay and Burns 1988, pp. 239–240; Jay *et al.* 2001, p. 621).

Nonpelagic fisheries also have the potential to indirectly affect walruses by destroying or modifying benthic prey or their habitat, or both. The predominant effects of nonpelagic trawl include "smoothing of sediments, moving and turning of rocks and boulders, resuspension and mixing of sediments, removal of sea grasses, damage to corals, and damage or removal of epigenetic organisms" (Mecum 2009, p. 57). Numerous studies on the effects of trawl gear on infauna have been conducted, and all note a reduction in mass (Brylinsky *et al.* 1994, p. 650; Bergman and van Santbrink 2000, p. 1321; McConnaughey *et al.* 2000, p. 1054; Kenchington *et al.* 2001, p. 1043). Two such studies comparing microfaunal populations between unfished and heavily fished areas in the eastern Bering Sea reported that, overall, the heavily trawled and untrawled areas were significantly different. In relation to walrus prey, the abundance of neptunid snails was significantly lower in the heavily trawled area, and mean body size was smaller, as was the trend for a number of bivalve species (*Macoma, Serripes, Tellina*), indicating a general decline in these species. The abundance of Mactromeris was greater in the heavily trawled area, but mean body size was smaller (McConnaughey *et al.* 2000, pp. 1381–1382; McConnaughey *et al.* 2005, pp. 430–431).

The areas open to nonpelagic trawling, however, are limited. The Final Environmental Impact Statement (EIS) for Essential Fish Habitat Identification and Conservation in Alaska concluded that nonpelagic trawling in the southern Bering Sea has long-term effects on benthic habitat features, but little impact on fish stock productivity. The EIS concludes that the reduction of infaunal and epifanual prey for managed fish species would be 0 to 3 percent (NMFS 2005, p. 10; Mecum 2009, p. 47). While not a direct measure of impacts to walrus prey, the analysis provides some insight on the level of impact to benthic species and indicates that impacts are likely to be minimal.

Nonpelagic trawls are designed to remain on the bottom of the ocean floor, but they may bring up walrus prey items as bycatch, albeit in very small quantities. Wilson and Evans (2009, p. 15) report bycatch of walrus prey items in the nonpelagic trawl fishery in the Northern Bristol Bay Trawl Area (NBBTA). Data were collected through the NMFS Fisheries Observer program and are aggregated for the years 2001 to 2009. Bivalves (mussels, oysters, scallops, and clams) accounted for 334 kg (735 lb) of the 457 kg (1005 lb) (73 percent) of total bycatch reported; snails, which are consumed by walruses, were listed as a bycatch species, but no amounts were reported. This level of bycatch is very low relative to the total amount of prey consumed by walrus. The NMFS is currently developing regulations to require the use of modified nonpelagic trawl gear in the Bering Sea subarea for the flatfish fishery and for nonpelagic trawl gear fishing in the northern Bering Sea subarea (Brown 2010, pers. comm.), which will likely reduce impacts on walrus prey. When implemented, the regulations will reopen an area within the NBSRA to modified gear nonpelagic trawl fishing (Brown 2010, pers. comm.; Mecum 2009, pp. 1–194).

Ecosystem shifts in the Bering Sea are expected to extend the distribution of fish populations northward and, along with this shift, nonpelagic bottom trawl fisheries are also expected to move northward (NOAA 2009b, p. 1). Because we currently lack information on benthic habitats and community ecology of the northern Bering Sea, we are unable to forecast the specific impacts that may occur from nonpelagic bottom trawling within this area (NOAA 2009b, p. 1) and how it may affect the Pacific walrus.

Commercial fisheries in all U.S. waters north of the Bering Strait are covered by the Fishery Management Plan for Fish Resources of the Arctic Management Area, which was released by the NPFMC in 2009. Management policy for this region is to prohibit all commercial harvest of fish until sufficient information is available to support the sustainable management of a commercial fishery (NPFMC 2009, p. 3). At some point, the Arctic Management Area may be opened to commercial fishing, but to date the NPFMC has taken a conservative stance. It is unclear whether the Arctic Management Area will open to commercial fishing at all, and if so, when it would be opened. If commercial fishing does open up in this area, however, we would work with the NPFMC to ensure that any necessary measures to minimize negative effects to Pacific walrus are implemented.

Accordingly, although commercial fisheries—specifically pelagic and nonpelagic trawl fisheries—have the potential to indirectly affect walruses through destruction or modification of benthic prey or their habitat, those fisheries do not appear to be a threat to Pacific walrus now or in the foreseeable future, because of limited overlap between the areas currently open to trawling and areas of walrus prey habitat as well as ongoing efforts to minimize detrimental impacts to walrus prey and benthic habitat.

In summary, we find that commercial fisheries have limited overlap with walrus distribution, and reported direct takes are nominal. Indirect effects on walruses are also limited, with some site-specific potential effects to walrus near terrestrial haulouts in Bristol Bay. Indirect effects to prey and benthic habitats due to various types of trawls occur, but are limited with respect to overlap with the range of walrus and walrus feeding habitat. We did not identify any direct competition for prey resources between walruses and fisheries. In addition, as fisheries currently do not occur in the Chukchi Sea, they are not considered a serious threat to walrus at this time. We recognize the potential future interest by the fishing industry to initiate fisheries further north as fish distribution changes in association with predicted changes in ocean conditions. However, based on the limited fishing-related impacts to walrus that have occurred in other areas to date, and the active engagement of the NPFMC through the Arctic Fisheries Management Plan, we conclude that commercial fishing is not now a threat to Pacific walrus and is not likely to become a threat in the foreseeable future.

Shipping

Commercial shipping and marine transportation vessels include oil and gas tankers, container ships, cargo ships, cruise ships, research vessels, icebreakers, and commercial fishing vessels. These vessels may travel to or from destinations within the Arctic (destination traffic), or may use the Arctic as a passageway between the Atlantic and Pacific Oceans (nondestination traffic). While the level of shipping activity is currently limited, the potential exists for increased activity in the future if changes in sea-ice patterns open new shipping lanes and result in a longer navigable season. Whether, and to what extent, marine transportation levels may change in the Arctic depends on a number of factors, including the extent of sea-ice melt, global trade dynamics, infrastructure development, the safety of Arctic shipping lanes, the marine insurance industry, and ship technology. Given these uncertainties, forecasts of future shipping levels in the Arctic are highly speculative (Arctic Council 2009, p. 1).

Two major shipping lanes in the Arctic intersect the range of Pacific walrus: The Northwest Passage, which runs parallel to the Alaskan Coast through the Bering Strait up through the Canadian Arctic Archipelago; and the Northern Sea Route, which refers to a segment of the Northeast Passage paralleling the Russian Coast through the Bering Strait and into the Bering Sea (Garlich-Miller *et al.* 2011, Section 3.6.4.1 "Scope and Scale of Shipping").

Shipping levels in the Northwest Passage and Northern Sea Route are highly dependent on the extent of sea-ice cover. Walrus occur along both of these routes where they pass through the Bering Sea, Bering Strait, and Chukchi Sea. Given the dependence of shipping activities on the absence of sea ice, shipping levels are seasonally variable. Almost all activity occurs in June through September, and to a lesser extent, October and November, and April and May. Most walrus are in the Chukchi Sea during the height of the shipping season, although at times they are associated with sea ice or terrestrial haulouts. There is currently no commercial shipping or marine transportation in December through March (Arctic Council 2009, p. 85).

Based on predicted sea-ice loss (Douglas 2010, p. 12), the navigation period in the Northern Sea Route is forecast to increase from 20–30 days to 90–100 days per year by 2100. Other factors that may lead to increased vessel traffic in the Arctic, in addition to reduced sea ice, include increased oil and gas development, Arctic community population growth and associated development, and increased tourism (Brigham and Ellis 2004, pp. 8–9; Arctic Council 2009, p. 5).

No quantitative analyses of changes in shipping levels currently exist. Both the Arctic Marine Shipping Assessment (AMSA) and the Arctic Marine Transport Workshop note that the greatest potential for increased shipping and marine transportation is the potential use of the Arctic as an alternative trade route connecting the Atlantic and Pacific Oceans. The Northwest Passage is not considered a viable Arctic throughway, given that the oldest and thickest sea ice in the Arctic is pushed into the western edge of the Canadian Arctic Archipelago, making the passage dangerous to navigate (Arctic Council 2009, p. 93). However, the passage was open in 2007 and 2010, due to ice-free conditions.

The broad range of future shipping scenarios described in the AMSA and the Arctic Marine Transport Workshop underscore the uncertainties regarding future shipping levels. The AMSA notes that while the reduction in sea ice will provide the opportunity for increased shipping levels, ultimately it is economic factors, such as the feasibility of utilizing the Northern Sea Route as an alternative connection between the Atlantic and Pacific Oceans, that will determine future shipping levels (Arctic Council 2009, pp. 120–121).

Increased shipping in the Bering and Chukchi Seas has the potential to impact Pacific walrus during the spring, summer, and fall seasons. An increase in shipping will result in increased potential for disturbance in the water and at terrestrial haulouts. According to Garlich-Miller *et al.* (2011, Section 3.2.1.2.3 "Summer/Fall"), recent trends suggest that most of the Pacific walrus population will be foraging in open water from coastal haulouts along the Chukotka coast during the shipping season. Because the Northern Sea Route passes through this area, it is reasonable to expect walruses may be encountered along this route (Garlich-Miller *et al.* 2011, Figure 9). According to one study, however, walruses may be tolerant of ship activities, as 75 percent of walruses encountered by vessels in the Chukchi Sea exhibited no reaction to ship activities within 1 km (0.6 mi) or less (Brueggeman *et al.* 1991, p. 139). This is confirmed by another study, which noted that walruses in water have been observed to generally show little concern about potential disturbance from approaching vessels, unless the ship came in very close proximity to them, in which case they dove or swam off to the side (Fay *et al.* 1984, p. 118). Therefore, we expect disturbance to walruses from shipping to be minimal. In situations where negligible impacts to a small number of walrus are anticipated from repeated displacement from a preferred feeding area, for example, or noise disturbance at haulouts, incidental take regulations could potentially be developed for U.S. vessels to permit take caused by shipping activities, which are subject to the MMPA. These activities likely would require mandatory monitoring and mitigation measures designed to minimize effects to walrus through vessel-based observers to avoid collisions and disturbance.

As a result, shipping is not currently a threat to the Pacific walrus population, because shipping occurs at low levels, and shipping in support of other activities (*e.g.,* oil and gas exploration) is sufficiently regulated and mitigated by MMPA incidental take regulations. Shipping may increase in the future, but shipping lanes are typically limited to narrow corridors, and disturbance from such activities is expected to be low. Moreover, given the uncertainties identified related to potential future shipping activities, we conclude that increased shipping activities are unlikely to cause population-level effects to the Pacific walrus in the foreseeable future. In addition, take provisions of the MMPA can be effective in regulating shipping that may disturb haulouts and interrupt foraging activity in U.S. waters.

Oil Spills

To date, there have been relatively few oil spills caused by marine vessel travel in the Bering and Chukchi seas. Within the seasonal range of walrus, there were approximately six vessel oil spill incidents between 1995 and 2004: two caused by fires, two by machinery damage or failure, one by grounding, and one by damage to the vessel. These incidents were small in scale and did not cause widespread impacts to walrus or their habitat. In general, the pattern of past vessel incidents corresponds to areas of high vessel traffic. Given anticipated increases in marine vessel travel within the range of Pacific walrus due to sea-ice decline, it is likely that the number of vessel incidents will increase in the foreseeable future.

Oil spill response for walruses, and for wildlife in general, can be broken into three phases (Alaska Regional Response Team 2002, p. G1). Phase One is focused on eliminating the source of the spill, containing the spilled oil, and protecting environmentally sensitive areas. Phase Two involves efforts to herd or haze potentially affected wildlife away from the spill area. Phase Three, the most involved and most infrequently undertaken phase of oil spill response for wildlife, includes the capture and rehabilitation of oiled individuals.

Even under the most stringent control systems, some tanker spills, pipeline leaks, and other accidents are likely to occur from equipment leaks or human error (O'Rourke 2010, p. 16). The history of oil spills and response in the Aleutian Islands raises concerns for potential spills in the Arctic region: "The past 20 years of data on response to spills in the Aleutians has also shown that almost no oil has been recovered during events where attempts have been made by the responsible parties or government agencies, and that in many cases, weather and other conditions have prevented any response at all" (O'Rourke 2010, p. 23). Moreover, the Commander of the Coast Guard's 17th District, which covers Alaska, noted in an online journal that "* * * we are not prepared for a major oil spill [over 100,000 gallons] in the Arctic environment. The Coast Guard currently has no offshore response capability in northern or western Alaska and we only dimly understand the science of recovering oil in broken ice" (O'Rourke 2010, p. 23). The behavior of oil spills in cold and icy waters is not well understood (O'Rourke 2010, p. 23). Cleaning up oil spills in ice-covered waters will be more difficult than in other areas, primarily because effective strategies have yet to be developed.

The Arctic conditions present several hurdles to oil cleanup efforts. In colder water temperatures, there are fewer organisms to break down the oil through microbial degradation and oil evaporates at a slower rate. Although slower evaporation may allow for more oil to be recovered, evaporation removes the lighter, more toxic hydrocarbons that are present in crude oil (O'Rourke 2010, p. 24). The longer the oil remains in an ecosystem, the more opportunity there is for exposure. Oil spills may get trapped in ice, evaporating only when the ice thaws, and in some cases, oil could remain in the ice for years. Icy conditions enhance emulsification—the process of forming different states of water in oil, often described as "mousse." Emulsification creates oil cleanup challenges by increasing the volume of the oil/water mixture and the mixture's viscosity (resistance to flow). The latter change creates particular problems for conventional removal and pumping cleanup methods (O'Rourke 2010, p. 24). Moreover, two of the major nonmechanical recovery methods—insitu burning and dispersant application—may be limited by the Arctic conditions and lack of logistical support such as aircraft, vessels, and other infrastructure (O'Rourke 2010, p. 24).

As stated earlier, vessel-related spills were, and will likely continue to be, small in scale with localized impact to walrus and their habitat. A large-scale spill could have a major impact on the Pacific walrus population, depending on the spill and location relative to coastal aggregations. However, at present the chance of a large oil spill occurring in the Pacific walrus' range in the foreseeable future is considered low. Because most oil spills will have only localized impact to walrus, and the chance of a large-scale spill occurring in the walrus' range in the foreseeable future is low, oil spills do not appear to be a threat to Pacific walrus now or in the foreseeable future.

Icebreaking Activities

Icebreaking activities can create noise that causes marine mammals to avoid areas where these activities are occurring. Further, icebreaking activities may increase the risk of oil spills by increasing vessel traffic in ice-filled waters. Given that marine mammals, including walrus, have been found to concentrate in and around temporary breaks in the ice created by icebreakers, there may be greater environmental impact associated with an oil spill involving an icebreaker or a vessel operating in a channel cleared by an icebreaker.

Currently, Russian and Canadian icebreakers are used along the Northern Sea Route and within the Canadian Arctic Archipelago to clear passageways utilized by commercial shipping vessels (Arctic Council 2009, p. 74), primarily in the summer months. The United States does not currently engage in icebreaking activities for navigational purposes in the Arctic (NRC 2005, p. 16). There are no current U.S. or State of Alaska regulations on icebreaking activities, mainly because icebreaking along the Alaskan Coast is minimal and usually carried out by the Coast Guard. However, in the last few years, oil and gas exploration activities in the Beaufort and Chukchi Seas have used privately contracted icebreakers in support of their operations.

Icebreaking activities may increase in the future, given increases in commercial shipping and marine transportation. In particular, the establishment of the Northern Sea Route as a viable alternative trade route connecting the Atlantic and Pacific Oceans is contingent on, among other factors, the availability of a reliable government or private icebreaking fleet to clear the entire Route and provide predictable open shipping lanes (Arctic Marine Transport Workshop 2004, p. 1; Arctic Council 2009, p. 20). Although there are no current regulations on icebreaking activities in the Arctic, voluntary guidelines addressing icebreaking activities could be included as part of unified, multilateral regulation on Arctic shipping. According to the U.S. Department of Transportation, the International Maritime Organization (IMO) is considering developing icebreaking guidelines.

Icebreaking is currently not a threat to the Pacific walrus population, because of the limited amount of icebreaking activity, current regulations associated with shipping in support of other activities (*e.g.,* oil and gas development), and the relatively narrow corridors in which the activities occur. Shipping activity and associated icebreaking are predicted to increase in the future, but the magnitude and rate of increase are unknown and dependent on both economic and environmental factors. Given the uncertainties identified related to potential future shipping activities, the available information does not enable us to conclude that these activities will cause population-level effects to the Pacific walrus in the foreseeable future.

Both the Service and USGS BN models included oil and gas development, commercial fisheries, and shipping as stressors (Garlich-Miller *et al.* 2011, Section 3.8.5 "Other Natural or Human Factors"; Jay *et al.* 2010b, p. 37). The USGS model also included air traffic and shipping activities simultaneously (Jay *et al.* 2010b, p. 37). In both models, these stressors had little influence on model outcomes (Garlich-Miller *et al.* 2011 Section 3.8.5 "Other Natural or Human Factors"; Jay *et al.* 2010b, pp. 85–86, respectively).

Summary of Factor E

Based on our estimation of low current contaminant loads and the likelihood of minimal future exposure as walruses feed on lower trophic levels, we conclude that contaminants are not a threat now and are not likely to be a threat to the Pacific walrus population in the foreseeable future. Oil and gas exploration, development, and production are currently not a threat to the Pacific walrus and are not expected to be in the foreseeable future, due to the anticipated increased scrutiny oil and gas development will undergo in the future, the continued application of incidental take regulations, and the low risk of an oil spill. Commercial fishing is also currently not a threat to walrus, as it occurs only on the periphery of the walrus' range and results in minimal impacts on the population. We recognize the potential future interest by the fishing industry to initiate fisheries further north as fish distribution changes in association with predicted changes in ocean conditions. However, based on the limited fishing-related impacts to walrus that have occurred in other areas to date, and the active engagement of the NPFMC through the Arctic Fisheries Management Plan, we conclude that commercial fishing is not now, and is not likely to become, a threat to Pacific walrus in the foreseeable future. Shipping is not currently a threat to the Pacific walrus population, because it occurs at low levels, and shipping in support of other activities (*e.g.,* oil and gas exploration) is sufficiently regulated and mitigated by MMPA incidental take regulations. Shipping may increase in the future, but shipping lanes are typically limited to narrow corridors, and disturbance from such activities is expected to be low. Moreover, given the uncertainties identified related to potential future shipping activities, we conclude that increased shipping activities are unlikely to cause population-level effects to the Pacific walrus in the foreseeable future. In addition, take provisions of the MMPA can be effective in regulating shipping in U.S. waters that may disturb haulouts and interrupt foraging activity. Because most oil spills will have only localized impact to walrus, and the chance of a large-scale spill occurring in the walrus' range in the foreseeable future is considered low, oil spills do not appear to be a threat to Pacific walrus now or in the foreseeable future. Finally, shipping activity and associated icebreaking is predicted to increase in the future, but the magnitude and rate of increase are unknown and dependent on both economic and environmental factors. Based on the best information available at this time, we are unable to conclude that these shipping activities will be a threat to the Pacific walrus in the foreseeable future, in light of the uncertainties in projecting the magnitude and rate of increase of these activities in the future.

Therefore, based on our review of the best commercial and scientific data available, we conclude that none of the potential stressors identified and discussed under Factor E ("Other Natural or Manmade Factors Affecting Its Continued Existence of the Pacific Walrus") is a threat to the Pacific walrus now, or is likely to become a threat in the foreseeable future.

Finding

As required by the Act, we considered each of the five factors under section 4(a)(1)(A) in assessing whether the Pacific walrus is endangered or threatened throughout all or a significant portion of its range. We carefully examined the best scientific and commercial information available regarding the past, present, and future threats faced by the Pacific walrus. We considered the information provided in the petition submitted to the Service by the Center for Biological Diversity; information available in our files; other available published and unpublished information; information submitted to the Service in response to our Federal Register notice of September 10, 2009; and information submitted to the Service in response to our public news release requesting information on September 10, 2010. We also consulted with recognized Pacific walrus experts and other Federal, State, and Tribal agencies.

In our analysis of Factor A, we identified and evaluated the risks of present or threatened destruction, modification, or curtailment of habitat or range of the Pacific walrus from (1) loss of sea ice due to climate change and (2) effects on prey species due to ocean warming and ocean acidification. We examined the likely responses and effects of changing sea-ice conditions in the Bering and Chukchi Seas on Pacific walruses. Pacific walrus is an ice-dependent species. Individuals use ice for many aspects of their life history throughout the year, and because of the projected loss of sea ice over the 21st century, we have identified the loss of sea ice and associated effects to be a threat to the Pacific walrus population. Although we anticipate that sufficient ice will remain, so that breeding behavior and calving will still occur in association with sea ice, the locations of these activities will likely change in response to changing ice patterns. The greatest change in sea ice, walrus distribution, and behavioral responses is expected to occur in the summer (June–August) and fall (October and November), when sea-ice loss is projected to be the greatest.

Based on the best scientific information available, in the foreseeable future, we anticipate that there will be a 1–5-month period in which sea ice will typically retreat northward off of the Chukchi continental shelf. The Chukchi Sea is projected to be ice-free in September every year by mid-century. However, loss of sea ice is occurring faster than forecast and, on average, sea ice has retreated off the continental shelf for approximately 1 month per year during the last decade. At mid-century, model subsets project a 2-month ice-free season in the Chukchi Sea, and a 4-month ice-free season at the end of the century, centered on the month of September (Douglas 2010, p. 8), with some models indicating there will be 5 ice-free months. Based on the current rate of sea-ice loss, and the current rate of GHG increases, these changes may occur earlier in the century than currently projected.

Through our analysis, we have concluded that loss of sea ice, with its concomitant changes to walrus distribution and life-history patterns, will lead to a population decline, and is a threat to Pacific walrus in the foreseeable future. We base this conclusion on the fact that, over time, walruses will be forced to rely on terrestrial haulouts to an increasingly greater extent. Although coastal haulouts have been traditionally used more frequently by males than by females with calves, in the future both sexes and all ages will be restricted to coastal habitats for a much greater period of time. This will expose all individuals, but especially calves, juveniles, and females, to increased levels of stress from depletion of prey, increased energetic costs to obtain prey, trampling injuries and mortalities, and predation. Although some of these stressors are currently acting on the population, we anticipate that their magnitude will increase over time as sea-ice loss over the continental shelf occurs regularly and more extensively. Given this persistent and increasing threat of sea-ice loss, we conclude that this anticipated Pacific walrus population decline will continue into the foreseeable future.

Under Factor A, we also analyzed the effects of ocean warming and ocean acidification on Pacific walrus. Although we are concerned about the changes to the walrus prey base that may occur from ocean acidification and warming, and theoretically we understand how those stressors might operate, ocean dynamics are very complex and the specific outcomes for these stressors are too unreliable at this time for us to conclude that they are a threat to Pacific walrus now or in the foreseeable future. We therefore conclude that these stressors do not rise to the level of a threat, now or in the foreseeable future.

In our analysis of Factor B, we identified and evaluated the risks to Pacific walrus from overutilization for commercial, recreational, scientific, or educational purposes. Under Factor B, we considered four potential risks to the Pacific walrus from overutilization relating to (1) Recreation, scientific, or educational purposes; (2) United States import/export; (3) commercial harvest; and (4) subsistence harvest. We found that recreational, scientific, and educational utilization of walruses is currently at low levels and is not projected to be a threat in the foreseeable future. United States import/export is not considered to be a threat to Pacific walrus now or in the foreseeable future, because most specimens imported into or exported from the United States are fossilized bone and ivory shards, and any other walrus ivory can only be imported into or exported from the United States after it has been legally harvested and substantially altered to qualify as a Native handicraft. Commercial and sport hunting of Pacific walrus in the United States is prohibited under the MMPA. Russian legislation also prohibits sport hunting of Pacific walruses. Commercial hunting in Russia has not occurred since 1991, and resumption would require the issuance of a governmental decree. In addition, any future commercial harvest in Russia must be based on a sustainable quota; therefore, it is unlikely that any potential future Russian commercial harvest will become a threat to the Pacific walrus population.

With regard to the subsistence harvest of walrus, subsistence harvest in Chukotka, Russia, is controlled through a quota system. An annual subsistence quota is issued through a decree by the Russian Federal Fisheries Agency. Quota recommendations are based on what is thought to be a sustainable removal level (approximately 4 percent of the population), based on the total population and productivity estimates. However, there are no U.S. quotas on subsistence harvest. Although at present it is difficult to quantify sustainable removal levels because of the lack of information on Pacific walrus population status and trends, we determined that 4 percent is a conservative sustainable harvest level. The current level of subsistence harvest rangewide is about 4 percent of the 2006 population estimate. Therefore, we do not consider the current level of subsistence harvest to be a threat to Pacific walrus at the present time.

Pacific walrus are an important subsistence resource in the Bering Strait region, and we expect Pacific walrus to continue to remain available for harvest there, even as sea-ice conditions change. Because there are no U.S. subsistence harvest quotas, we do not expect harvest levels in the Bering Strait region to change appreciably in the foreseeable future, unless regulations are put in place to restrict harvest by limiting the number of walrus that may be taken. There are two paths that could result in harvest quotas: (1) Self-regulation activities by Alaska Natives; and (2) implementation of procedures in the MMPA. Neither of these is currently in place, except for one quota on Round Island, as discussed below. Instead, we predict that subsistence harvest is likely to continue at similar levels to those currently, even as the walrus population declines in response to loss of summer sea ice. Over time, as the proportion of animals harvested increases relative to the overall population, this continued level of subsistence harvest likely will become unsustainable. Therefore, we determine that subsistence harvest is a threat to the walrus population in the foreseeable future.

In our analysis of Factor C, we identified and evaluated the risks to Pacific walrus from disease and predation, and we determined that neither component currently, or in the foreseeable future, represents threats to the Pacific walrus population. Although a changing climate may increase exposure of walrus to new pathogens, there are no clear transmission vectors that would change levels of exposure, and no evidence exists that disease will become a threat in foreseeable future.

As the use of coastal haulouts by both walruses and polar bears during summer increases, we expect interactions between the two species to also increase, and terrestrial walrus haulouts may become important feeding areas for polar bears. The presence of polar bears along the coast during the ice-free season will likely influence patterns of haulout use as walrus shift to other coastal haulout locations. These movements may result in increased energetic costs to walrus, but it is not possible to predict the magnitude of these costs. Although predation by polar bears on Pacific walrus has been observed, the lack of documented population-level effects leads us to conclude that polar bear predation is not currently a threat to the Pacific walrus. As sea ice declines and Pacific walrus spend more time on coastal haulouts, however, it is likely that polar bear predation will increase. However, we cannot reliably predict the level of predation in the future, and therefore we are not able to conclude with sufficient reliability that it will rise to the level of a threat to the Pacific walrus population in the foreseeable future. There is no evidence that killer whale predation has ever limited the Pacific walrus population, and there is no evidence of increased presence of killer whales in the Bering or Chukchi Seas; therefore, killer whale predation is not a threat to the Pacific walrus now, and it is unlikely to become a threat in the foreseeable future.

In our analysis under Factor D, we identified and evaluated the risks from the inadequacy of existing regulatory mechanisms by focusing our analysis on the specific laws and regulations aimed at addressing the two primary threats to the walrus—the loss of sea-ice habitat and subsistence harvest. As discussed previously under Factor A, GHG emissions have contributed to a warming climate and the loss of sea-ice habitat for the Pacific walrus. There are currently no regulatory mechanisms in place to reduce or limit GHG emissions. This situation was considered as part of our analysis in Factor A. Accordingly, there are no existing regulatory mechanisms to effectively address sea-ice loss.

With regard to the other main threat to the walrus, subsistence harvest, there is currently no limit on the number of walrus that may be taken for subsistence purposes rangewide. While the subsistence harvest in Russia is controlled through a quota system, no national or Statewide quota exists in the United States. One local quota restricts the number of walrus that may be taken on Round Island (Alaska), but the harvest level in this area represents only a very minor portion of the harvest rangewide. Local ordinances recently adopted by two Native communities in the Bering Strait region, where 84 percent of the harvest in the United States and 43 percent of the rangewide harvest occurs, contain provisions aimed at restricting the number of hunting trips that may be taken for subsistence purposes. While these ordinances provide an important framework for future co-management initiatives and the potential development of future localized harvest limits, we acknowledge that no limits currently exist on the total number of walrus that may be taken in the Bering Strait region or rangewide. Nor are there other restrictions in place to ensure the likelihood that, as the population of walrus declines in response to changing sea-ice conditions, the subsistence harvest of walrus will occur at a reduced level. As a result, we determine that the existing regulatory mechanisms are inadequate to address the threat of subsistence harvest to the Pacific walrus in the foreseeable future.

In our analysis under Factor E, we evaluated other factors that may have an effect on the Pacific walrus, including pollution and contaminants; oil and gas exploration, development, and production; commercial fisheries interactions; shipping; oil spills; and icebreaking activities. Based on our estimation of low current contaminant loads and the likelihood of minimal future exposure as walruses feed on lower trophic levels, we conclude that contaminants are not a threat now and are not likely to be a threat to the Pacific walrus population in the foreseeable future. Oil and gas development is currently not a threat to the Pacific walrus and is not expected to be in the foreseeable future due to the anticipated increased scrutiny oil and gas development will undergo in the future, the continued application of incidental take regulations, and the low risk of an oil spill. Commercial fishing is also currently not a threat to walrus as it occurs only on the periphery of the species' range and results in minimal impacts on the population. We recognize the potential future interest by the fishing industry to initiate fisheries further north as fish distribution changes in association with predicted changes in ocean conditions. However, based on the limited fishing-related impacts to walrus that have occurred in other areas to date, and the active engagement of the NPFMC through the Arctic Fisheries Management Plan, we conclude that commercial fishing is not now a threat to Pacific walrus, and is not likely to become a threat in the foreseeable future. Shipping is not currently a threat to the Pacific walrus population, because it occurs at low levels, and shipping in support of other activities (*e.g.,* oil and gas exploration) is sufficiently regulated and mitigated by MMPA incidental take regulations. Shipping may increase in the future, but given the uncertainties identified related to potential future shipping activities, the available information does not allow us to conclude that these activities will cause population-level effects to the Pacific walrus in the foreseeable future. In addition, take provisions of the MMPA can be effective in regulating shipping in U.S. waters that may disturb haulouts and interrupt foraging activity. Because most oil spills will have only localized impact to walrus, and the chance of a large-scale spill occurring in the walrus' range in the foreseeable future is considered low, oil spills do not appear to be a threat to Pacific walrus now or in the foreseeable future. Finally, shipping activity and associated icebreaking are predicted to increase in the future, but the magnitude and rate of increase are unknown and dependent on both economic and environmental factors. Given the uncertainties identified related to potential future shipping activities, the available information does not enable us to conclude that icebreaking will cause population-level effects to the Pacific walrus in the foreseeable future. Therefore, we determine that none of the potential stressors identified and discussed under Factor E is a threat to the Pacific walrus now, or is likely to become a threat in the foreseeable future.

In summary, we identify loss of sea ice in the summer and fall and associated impacts (Factor A) and subsistence harvest (Factor B) as the primary threats to the Pacific walrus in the foreseeable future. These conclusions are supported by the Bayesian Network models prepared by USGS and the Service. Our Factor D analysis determined that existing regulatory mechanisms are currently inadequate to address these threats. These threats are of sufficient imminence, intensity, and magnitude to cause substantial losses of abundance and an anticipated population decline of Pacific walrus that will continue into the foreseeable future.

Therefore, on the basis of the best scientific and commercial information available, we find that the petitioned action to list the Pacific walrus is warranted. We will make a determination on the status of the species as threatened or endangered when we prepare a proposed listing determination. However, as explained in more detail below, an immediate proposal of a regulation implementing this action is precluded by higher priority listing actions, and expeditious progress is being made to add or remove qualified species from the Lists of Endangered and Threatened Wildlife and Plants.

We reviewed the available information to determine if the existing and foreseeable threats render the species at risk of extinction at this time such that issuing an emergency regulation temporarily listing the species under section 4(b)(7) of the Act is warranted. We determined that issuing an emergency regulation temporarily listing the species is not warranted for this species at this time, because the threats acting on the species are not immediately impacting the entire species across its range to the point where the species will be immediately lost. However, if at any time we determine that issuing an emergency regulation temporarily listing the Pacific walrus is warranted, we will initiate this action at that time.

Listing Priority Number

The Service adopted guidelines on September 21, 1983 (48 FR 43098), to establish a rational system for utilizing available resources for the highest priority species when adding species to the Lists of Endangered and Threatened Wildlife and Plants or reclassifying species listed as threatened to endangered status. These guidelines, titled "Endangered and Threatened Species Listing and Recovery Priority Guidelines," address the immediacy and magnitude of threats, and the level of taxonomic distinctiveness. The system places greatest importance on the immediacy and magnitude of threats, but also factors in the level of taxonomic distinctiveness by assigning priority in descending order to monotypic genera (genus with one species), full species, and subspecies (or equivalently, distinct population segments of vertebrates).

As a result of our analysis of the best available scientific and commercial information, we assigned the Pacific walrus a Listing Priority Number (LPN) of 9, based on the moderate magnitude and imminence of threats. These threats include the present or threatened destruction, modification or curtailment of Pacific walrus habitat due to loss of sea-ice habitat; and overutilization due to subsistence harvest. In addition, existing regulatory mechanisms fail to address these threats. These threats affect the entire population, are ongoing, and will continue to occur into the foreseeable future. Our rationale for assigning the Pacific walrus an LPN of 9 is outlined below.

Under the Service's Guidelines, the magnitude of threat is the first criterion we look at when establishing a listing priority. The guidelines indicate that species with the highest magnitude of threat are those species facing the most severe threats to their continued existence. These species receive the highest listing priority. As discussed in the finding, the Pacific walrus is being impacted by two primary threats; the loss of sea-ice habitat, and subsistence harvest. The main threat to the Pacific walrus is the loss of sea-ice habitat due to climate change. Sea-ice losses have been observed to date and are projected to continue through the end of the 21st century. The loss of sea-ice habitat, while affecting individual walrus or localized populations, does not appear to be currently resulting in significant population-level effects. However, the modeled projections of the loss of sea-ice habitat and the associated impacts on the Pacific walrus are expected to greatly increase within the foreseeable future, thereby resulting in significant population-level effects. Because the threat of the loss of sea-ice habitat is not having significant effects currently, but is projected to, we have determined the magnitude of this threat is moderate, and not high.

Subsistence harvest is also identified as a threat to the Pacific walrus. Harvest is currently occurring at sustainable levels. With the loss of sea-ice habitat and the projected associated population decline, and because subsistence harvest is expected to continue at current levels, we concluded that subsistence harvest would have a population-level effect on the species in the future. Because harvest is occurring at sustainable levels now, but may become unsustainable in the foreseeable future due to the projected population decline, we have determined the magnitude of the threat of subsistence harvest is considered to be moderate, and not high.

Under our Guidelines, the second criterion we consider in assigning a listing priority is the immediacy of threats. This criterion is intended to ensure that species that face actual, identifiable threats are given priority over those species for which threats are only potential or species that are intrinsically vulnerable but are not known to be presently facing such threats. We have determined that loss of sea-ice habitat is affecting the Pacific walrus population currently and is expected to continue and likely intensify in the foreseeable future. Similarly, we have determined that subsistence harvest is presently occurring and expected to continue at current levels into the foreseeable future, even as the Pacific walrus population declines due to sea-ice loss. Because both the loss of sea-ice habitat and subsistence harvest are presently occurring, we consider the threats to be imminent.

The third criterion in our guidelines is intended to devote resources to those species representing highly distinctive or isolated gene pools as reflected by taxonomy, with the highest priority given to monotypic genera, followed by species and then subspecies. The Pacific walrus is a valid subspecies and therefore receives a lower priority than species or a monotypic genus. As discussed, the threats affecting the Pacific walrus are of moderate magnitude and imminent. Accordingly we have assigned the Pacific walrus an LPN of 9, pursuant to our guidelines.

We will continue to monitor the threats to the Pacific walrus, as well as the species' status, on an annual basis, and should the magnitude or the imminence of the threats change, we will revisit our assessment of the LPN.

Preclusion and Expeditious Progress

Preclusion is a function of the listing priority of a species in relation to the resources that are available and the cost and relative priority of competing demands for those resources. Thus, in any given fiscal year (FY), multiple factors dictate whether it will be possible to undertake work on a listing proposal regulation or whether promulgation of such a proposal is precluded by higher-priority listing actions.

The resources available for listing actions are determined through the annual Congressional appropriations process. The appropriation for the Listing Program is available to support work involving the following listing actions: Proposed and final listing rules; 90-day and 12-month findings on petitions to add species to the Lists of Endangered and Threatened Wildlife and Plants (Lists) or to change the status of a species from threatened to endangered; annual "resubmitted" petition findings on prior warranted-but-precluded petition findings as required under section 4(b)(3)(C)(i) of the Act; critical habitat petition findings; proposed and final rules designating critical habitat; and litigation-related, administrative, and program-management functions (including preparing and allocating budgets, responding to Congressional and public inquiries, and conducting public outreach regarding listing and critical habitat). The work involved in preparing various listing documents can be extensive and may include, but is not limited to: Gathering and assessing the best scientific and commercial data available and conducting analyses used as the basis for our decisions; writing and publishing documents; and obtaining, reviewing, and evaluating public comments and peer review comments on proposed rules and incorporating relevant information into final rules. The number of listing actions that we can undertake in a given year also is influenced by the complexity of those listing actions; that is, more complex actions generally are more costly. The median cost for preparing and publishing a 90-day finding is $39,276; for a 12-month finding, $100,690; for a proposed rule with critical habitat, $345,000; and for a final listing rule with critical habitat, the median cost is $305,000.

We cannot spend more than is appropriated for the Listing Program without violating the Anti-Deficiency Act (see 31 U.S.C. 1341(a)(1)(A)). In addition, in FY 1998 and for each fiscal year since then, Congress has placed a statutory cap on funds which may be expended for the Listing Program, equal to the amount expressly appropriated for that purpose in that fiscal year. This cap was designed to prevent funds appropriated for other functions under the Act (for example, recovery funds for removing species from the Lists), or for other Service programs, from being used for Listing Program actions (see House Report 105–163, 105th Congress, 1st Session, July 1, 1997).

Since FY 2002, the Service's budget has included a critical habitat subcap to ensure that some funds are available for other work in the Listing Program ("The critical habitat designation subcap will ensure that some funding is available to address other listing activities" (House Report No. 107–103, 107th Congress, 1st Session, June 19, 2001)). From FY 2002 to FY 2006, the Service has had to use virtually the entire critical habitat subcap to address court-mandated designations of critical habitat, and consequently none of the critical habitat subcap funds have been available for other listing activities. In some FYs since 2006, we have been able to use some of the critical habitat subcap funds for proposed listing determinations for high-priority candidate species. In other FYs, while we were unable to use any of the critical habitat subcap funds to fund proposed listing determinations, we did use some of this money to fund the critical habitat portion of some proposed listing determinations so that the proposed listing determination and proposed critical habitat designation could be combined into one rule, thereby being more efficient in our work. At this time, for FY 2011, we do not know if we will be able to use some of the critical habitat subcap funds to fund proposed listing determinations.

We make our determinations of preclusion on a nationwide basis to ensure that the species most in need of listing will be addressed first and also because we allocate our listing budget on a nationwide basis. Through the listing cap, the critical habitat subcap, and the amount of funds needed to address court-mandated critical habitat designations, Congress and the courts have, in effect, determined the amount of money available for other listing activities nationwide (i.e., actions other than critical habitat designation). Therefore, the funds in the listing cap, other than those needed to address court-mandated critical habitat for already listed species, set the limits on our determinations of preclusion and expeditious progress.

Congress identified the availability of resources as the only basis for deferring the initiation of a rulemaking that is warranted. The Conference Report accompanying Pub. L. 97–304 (Endangered Species Act Amendments of 1982), which established the current statutory deadlines and the warranted-but-precluded finding, states that the amendments were "not intended to allow the Secretary to delay commencing the rulemaking process for any reason other than that the existence of pending or imminent proposals to list species subject to a greater degree of threat would make allocation of resources to such a petition [that is, for a lower-ranking species] unwise." Although that statement appeared to refer specifically to the "to the maximum extent practicable" limitation on the 90-day deadline for making a "substantial information" finding, that finding is made at the point when the Service is deciding whether or not to commence a status review that will determine the degree of threats facing the species, and therefore the analysis underlying the statement is more relevant to the use of the warranted-but-precluded finding, which is made when the Service has already determined the degree of threats facing the species and is deciding whether or not to commence a rulemaking.

In FY 2011, on December 22, 2010, Congress passed a continuing resolution which provides funding at the FY 2010 enacted level through March 4, 2011. Until Congress appropriates funds for FY 2011 at a different level, we will fund listing work based on the FY 2010 amount. Thus, at this time in FY 2011, the Service anticipates an appropriation of $22,103,000 based on FY 2010 appropriations. Of that, the Service anticipates needing to dedicate $11,632,000 for determinations of critical habitat for already listed species. Also $500,000 is appropriated for foreign species listings under the Act. The Service thus has $9,971,000 available to fund work in the following categories: compliance with court orders and court-approved settlement agreements requiring that petition findings or listing determinations be completed by a specific date; section 4 (of the Act) listing actions with absolute statutory deadlines; essential litigation-related, administrative, and listing program-management functions; and high-priority listing actions for some of our candidate species. In FY 2010 the Service received many new petitions and a single petition to list 404 species. The receipt of petitions for a large number of species is consuming the

Service's listing funding that is not dedicated to meeting Court-ordered commitments. Absent some ability to balance effort among listing duties under existing funding levels, it is unlikely that the Service will be able to make expeditious progress on candidate species in FY 2011.

In 2009, the responsibility for listing foreign species under the Act was transferred from the Division of Scientific Authority, International Affairs Program, to the Endangered Species Program. Therefore, starting in FY 2010, we used a portion of our funding to work on the actions described above for listing actions related to foreign species. In FY 2011, we anticipate using $1,500,000 for work on listing actions for foreign species which reduces funding available for domestic listing actions, however, currently only $500,000 has been allocated. Although there are currently no foreign species issues included in our high-priority listing actions at this time, many actions have statutory or court-approved settlement deadlines, thus increasing their priority. The budget allocations for each specific listing action are identified in the Service's FY 2011 Allocation Table (part of our record).

For the above reasons, funding a proposed listing determination for the Pacific walrus is precluded by court-ordered and court-approved settlement agreements, listing actions with absolute statutory deadlines, and work on proposed listing determinations for those candidate species with a higher listing priority (i.e., candidate species with LPNs of 1–8).

Based on our September 21, 1983, guidance for assigning an LPN for each candidate species (48 FR 43098), we have a significant number of species with an LPN of 2. Using this guidance, we assign each candidate an LPN of 1 to 12, depending on the magnitude of threats (high or moderate to low), immediacy of threats (imminent or nonimminent), and taxonomic status of the species (in order of priority: monotypic genus (a species that is the sole member of a genus); species, or part of a species (subspecies, distinct population segment, or significant portion of the range)). The lower the listing priority number, the higher the listing priority (that is, a species with an LPN of 1 would have the highest listing priority).

Because of the large number of high-priority species, we have further ranked the candidate species with an LPN of 2 by using the following extinction-risk type criteria: International Union for the Conservation of Nature and Natural Resources (IUCN) Red list status/rank, Heritage rank (provided by NatureServe), Heritage threat rank (provided by NatureServe), and species currently with fewer than 50 individuals, or 4 or fewer populations. Those species with the highest IUCN rank (critically endangered), the highest Heritage rank (G1), the highest Heritage threat rank (substantial, imminent threats), and currently with fewer than 50 individuals, or fewer than 4 populations, originally comprised a group of approximately 40 candidate species ("Top 40"). These 40 candidate species have had the highest priority to receive funding to work on a proposed listing determination. As we work on proposed and final listing rules for those 40 candidates, we apply the ranking criteria to the next group of candidates with an LPN of 2 and 3 to determine the next set of highest-priority candidate species. Finally, proposed rules for reclassification of threatened species to endangered are lower priority, since as listed species, they are already afforded the protection of the Act and implementing regulations. However, for efficiency reasons, we may choose to work on a proposed rule to reclassify a species to endangered if we can combine this with work that is subject to a court-determined deadline.

With our workload so much bigger than the amount of funds we have to accomplish it, it is important that we be as efficient as possible in our listing process. Therefore, as we work on proposed rules for the highest priority species in the next several years, we are preparing multi-species proposals when appropriate, and these may include species with lower priority if they overlap geographically or have the same threats as a species with an LPN of 2. In addition, we take into consideration the availability of staff resources when we determine which high-priority species will receive funding to minimize the amount of time and resources required to complete each listing action.

As explained above, a determination that listing is warranted but precluded must also demonstrate that expeditious progress is being made to add and remove qualified species to and from the Lists of Endangered and Threatened Wildlife and Plants. As with our "precluded" finding, the evaluation of whether progress in adding qualified species to the Lists has been expeditious is a function of the resources available for listing and the competing demands for those funds. (Although we do not discuss it in detail here, we are also making expeditious progress in removing species from the list under the Recovery program in light of the resource available for delisting, which is funded by a separate line item in the budget of the Endangered Species Program. So far during FY 2011, we have completed one delisting rule.) Given the limited resources available for listing, we find that we are making expeditious progress in FY 2011 in the Listing program. This progress included preparing and publishing the following determinations:

FY 2011 COMPLETED LISTING ACTIONS

Publication date	Title	Actions	FR pages
10/6/2010	Endangered Status for the Altamaha Spinymussel and Designation of Critical Habitat.	Proposed Listing Endangered	75 FR 61664–61690
10/7/2010	12-month Finding on a Petition to list the Sacramento Splittail as Endangered or Threatened.	Notice of 12-month petition finding, Not warranted.	75 FR 62070–62095
10/28/2010	Endangered Status and Designation of Critical Habitat for Spikedace and Loach Minnow.	Proposed Listing Endangered (uplisting).	75 FR 66481–66552
11/2/2010	90-Day Finding on a Petition to List the Bay Springs Salamander as Endangered.	Notice of 90-day Petition Finding, Not substantial.	75 FR 67341–67343
11/2/2010	Determination of Endangered Status for the Georgia Pigtoe Mussel, Interrupted Rocksnail, and Rough Hornsnail and Designation of Critical Habitat.	Final Listing Endangered	75 FR 67511–67550
11/2/2010	Listing the Rayed Bean and Snuffbox as Endangered	Proposed Listing Endangered	75 FR 67551–67583
11/4/2010	12–Month Finding on a Petition to List Cirsium wrightii (Wright's Marsh Thistle) as Endangered or Threatened.	Notice of 12-month petition finding, Warranted but precluded.	75 FR 67925–67944

FY 2011 COMPLETED LISTING ACTIONS—Continued

Publication date	Title	Actions	FR pages
12/14/2010	Endangered Status for Dunes Sagebrush Lizard	Proposed Listing Endangered	75 FR 77801–77817
12/14/2010	12-month Finding on a Petition to List the North American Wolverine as Endangered or Threatened.	Notice of 12-month petition finding, Warranted but precluded.	75 FR 78029–78061
12/14/2010	12-Month Finding on a Petition to List the Sonoran Population of the Desert Tortoise as Endangered or Threatened.	Notice of 12-month petition finding, Warranted but precluded.	75 FR 78093–78146
12/15/2010	12-Month Finding on a Petition to List *Astragalus microcymbus* and *Astragalus schmolliae* as Endangered or Threatened.	Notice of 12-month petition finding, Warranted but precluded.	75 FR 78513–78556
12/28/2010	Listing Seven Brazilian Bird Species as Endangered Throughout Their Range.	Final Listing Endangered	75 FR 81793–81815
1/4/2011	90-Day Finding on a Petition to List the Red Knot subspecies *Calidris canutus roselaari* as Endangered.	Notice of 90-day Petition Finding, Not substantial.	76 FR 304–311
1/19/2011	Endangered Status for the Sheepnose and Spectaclecase Mussels.	Proposed Listing Endangered	76 FR 3392–3420

Our expeditious progress also includes work on listing actions that we funded in FY 2010 and FY 2011, but have not yet been completed to date. These actions are listed below. Actions in the top section of the table are being conducted under a deadline set by a court. Actions in the middle section of the table are being conducted to meet statutory timelines, that is, timelines required under the Act. Actions in the bottom section of the table are high-priority listing actions. These actions include work primarily on species with an LPN of 2, and, as discussed above, selection of these species is partially based on available staff resources, and when appropriate, include species with a lower priority if they overlap geographically or have the same threats as the species with the high priority. Including these species together in the same proposed rule results in considerable savings in time and funding compared to preparing separate proposed rules for each of them in the future.

ACTIONS FUNDED IN FY 2010 AND FY 2011 BUT NOT YET COMPLETED

Species	Action
Actions Subject to Court Order/Settlement Agreement	
Flat-tailed horned lizard	Final listing determination.
Mountain plover[4]	Final listing determination.
Solanum conocarpum	12-month petition finding.
Thorne's Hairstreak butterfly[3]	12-month petition finding.
Hermes copper butterfly[3]	12-month petition finding.
4 parrot species (military macaw, yellow-billed parrot, red-crowned parrot, scarlet macaw)[5]	12-month petition finding.
4 parrot species (blue-headed macaw, great green macaw, grey-cheeked parakeet, hyacinth macaw)[5]	12-month petition finding.
4 parrot species (crimson shining parrot, white cockatoo, Philippine cockatoo, yellow-crested cockatoo)[5]	12-month petition finding.
Utah prairie dog (uplisting)	90-day petition finding.
Actions With Statutory Deadlines	
Casey's june beetle	Final listing determination.
Southern rockhopper penguin—Campbell Plateau population	Final listing determination.
6 Birds from Eurasia	Final listing determination.
5 Bird species from Colombia and Ecuador	Final listing determination.
Queen Charlotte goshawk	Final listing determination.
5 species southeast fish (Cumberland darter, rush darter, yellowcheek darter, chucky madtom, and laurel dace)[4].	Final listing determination.
Ozark hellbender[4]	Final listing determination.
Altamaha spinymussel[3]	Final listing determination.
3 Colorado plants (*Ipomopsis polyantha* (Pagosa Skyrocket), *Penstemon debilis* (Parachute Beardtongue), and *Phacelia submutica* (DeBeque Phacelia))[4].	Final listing determination.
Salmon crested cockatoo	Final listing determination.
6 Birds from Peru & Bolivia	Final listing determination.
Loggerhead sea turtle (assist National Marine Fisheries Service)[5]	Final listing determination.
2 mussels (rayed bean (LPN = 2), snuffbox No LPN)[5]	Final listing determination.
Mt Charleston blue[5]	Proposed listing determination.
CA golden trout[4]	12-month petition finding.
Black-footed albatross	12-month petition finding.
Mount Charleston blue butterfly	12-month petition finding.
Mojave fringe-toed lizard[1]	12-month petition finding.
Kokanee—Lake Sammamish population[1]	12-month petition finding.
Cactus ferruginous pygmy-owl[1]	12-month petition finding.
Northern leopard frog	12-month petition finding.
Tehachapi slender salamander	12-month petition finding.

ACTIONS FUNDED IN FY 2010 AND FY 2011 BUT NOT YET COMPLETED—Continued

Species	Action
Coqui Llanero	12-month petition finding/Proposed listing.
Dusky tree vole	12-month petition finding.
3 MT invertebrates (mist forestfly (*Lednia tumana*), *Oreohelix* sp. 3, *Oreohelix* sp. 31) from 206 species petition.	12-month petition finding.
5 UT plants (*Astragalus hamiltonii, Eriogonum soredium, Lepidium ostleri, Penstemon flowersii, Trifolium friscanum*) from 206 species petition.	12-month petition finding.
5 WY plants (*Abronia ammophila, Agrostis rossiae, Astragalus proimanthus, Boechere* (*Arabis*) *pusilla, Penstemon gibbensii*) from 206 species petition.	12-month petition finding.
Leatherside chub (from 206 species petition)	12-month petition finding.
Frigid ambersnail (from 206 species petition)[3]	12-month petition finding.
Platte River caddisfly (from 206 species petition)[5]	12-month petition finding.
Gopher tortoise—eastern population	12-month petition finding.
Grand Canyon scorpion (from 475 species petition)	12-month petition finding.
Anacroneuria wipukupa (a stonefly from 475 species petition)[4]	12-month petition finding.
Rattlesnake-master borer moth (from 475 species petition)[3]	12-month petition finding.
3 Texas moths (*Ursia furtiva, Sphingicampa blanchardi, Agapema galbina*) (from 475 species petition)	12-month petition finding.
2 Texas shiners (*Cyprinella* sp., *Cyprinella lepida*) (from 475 species petition)	12-month petition finding.
3 South Arizona plants (*Erigeron piscaticus, Astragalus hypoxylus, Amoreuxia gonzalezii*) (from 475 species petition).	12-month petition finding.
5 Central Texas mussel species (3 from 475 species petition)	12-month petition finding.
14 parrots (foreign species)	12-month petition finding.
Berry Cave salamander[1]	12-month petition finding.
Striped Newt[1]	12-month petition finding.
Fisher—Northern Rocky Mountain Range[1]	12-month petition finding.
Mohave Ground Squirrel[1]	12-month petition finding.
Puerto Rico Harlequin Butterfly[3]	12-month petition finding.
Western gull-billed tern	12-month petition finding.
Ozark chinquapin (*Castanea pumila* var. *ozarkensis*)[4]	12-month petition finding.
HI yellow-faced bees	12-month petition finding.
Giant Palouse earthworm	12-month petition finding.
Whitebark pine	12-month petition finding.
OK grass pink (*Calopogon oklahomensis*)[1]	12-month petition finding.
Ashy storm-petrel[5]	12-month petition finding.
Honduran emerald	12-month petition finding.
Southeastern pop snowy plover & wintering pop. of piping plover[1]	90-day petition finding.
Eagle Lake trout[1]	90-day petition finding.
Smooth-billed ani[1]	90-day petition finding.
32 Pacific Northwest mollusks species (snails and slugs)[1]	90-day petition finding.
42 snail species (Nevada & Utah)	90-day petition finding.
Peary caribou	90-day petition finding.
Plains bison	90-day petition finding.
Spring Mountains checkerspot butterfly	90-day petition finding.
Spring pygmy sunfish	90-day petition finding.
Bay skipper	90-day petition finding.
Unsilvered fritillary	90-day petition finding.
Texas kangaroo rat	90-day petition finding.
Spot-tailed earless lizard	90-day petition finding.
Eastern small-footed bat	90-day petition finding.
Northern long-eared bat	90-day petition finding.
Prairie chub	90-day petition finding.
10 species of Great Basin butterfly	90-day petition finding.
6 sand dune (scarab) beetles	90-day petition finding.
Golden-winged warbler[4]	90-day petition finding.
Sand-verbena moth	90-day petition finding.
404 Southeast species	90-day petition finding.
Franklin's bumble bee[4]	90-day petition finding.
2 Idaho snowflies (straight snowfly & Idaho snowfly)[4]	90-day petition finding.
American eel[4]	90-day petition finding.
Gila monster (Utah population)[4]	90-day petition finding.
Arapahoe snowfly[4]	90-day petition finding.
Leona's little blue[4]	90-day petition finding.
Aztec gilia[5]	90-day petition finding.
White-tailed ptarmigan[5]	90-day petition finding.
San Bernardino flying squirrel[5]	90-day petition finding.
Bicknell's thrush[5]	90-day petition finding.
Chimpanzee	90-day petition finding.
Sonoran talussnail[5]	90-day petition finding.
2 AZ Sky Island plants (*Graptopetalum bartrami* & *Pectis imberbis*)[5]	90-day petition finding.
I'iwi[5]	90-day petition finding.

ACTIONS FUNDED IN FY 2010 AND FY 2011 BUT NOT YET COMPLETED—Continued

Species	Action
High-Priority Listing Actions	
19 Oahu candidate species[2] (16 plants, 3 damselflies) (15 with LPN = 2, 3 with LPN = 3, 1 with LPN = 9)	Proposed listing.
19 Maui-Nui candidate species[2] (16 plants, 3 tree snails) (14 with LPN = 2, 2 with LPN = 3, 3 with LPN = 8).	Proposed listing.
2 Arizona springsnails[2] (*Pyrgulopsis bernadina* (LPN = 2), *Pyrgulopsis trivialis* (LPN = 2))	Proposed listing.
Chupadera springsnail[2] (*Pyrgulopsis chupaderae* (LPN = 2)	Proposed listing.
8 Gulf Coast mussels (southern kidneyshell (LPN = 2), round ebonyshell (LPN = 2), Alabama pearlshell (LPN = 2), southern sandshell (LPN = 5), fuzzy pigtoe (LPN = 5), Choctaw bean (LPN = 5), narrow pigtoe (LPN = 5), and tapered pigtoe (LPN = 11))[4].	Proposed listing.
Umtanum buckwheat (LPN = 2) and white bluffs bladderpod (LPN = 9)[4]	Proposed listing.
Grotto sculpin (LPN = 2)[4]	Proposed listing.
2 Arkansas mussels (Neosho mucket (LPN = 2) & Rabbitsfoot (LPN = 9))[4]	Proposed listing.
Diamond darter (LPN = 2)[4]	Proposed listing.
Gunnison sage-grouse (LPN = 2)[4]	Proposed listing.
Miami blue (LPN = 3)[3]	Proposed listing.
4 Texas salamanders (Austin blind salamander (LPN = 2), Salado salamander (LPN = 2), Georgetown salamander (LPN = 8), Jollyville Plateau (LPN = 8))[3].	Proposed listing.
5 SW aquatics (Gonzales Spring Snail (LPN = 2), Diamond Y springsnail (LPN = 2), Phantom springsnail (LPN = 2), Phantom Cave snail (LPN = 2), Diminutive amphipod (LPN = 2))[3].	Proposed listing.
2 Texas plants (Texas golden gladecress (*Leavenworthia texana*) (LPN = 2), Neches River rose-mallow (*Hibiscus dasycalyx*) (LPN = 2))[3].	Proposed listing.
FL bonneted bat (LPN = 2)[3]	Proposed listing.
21 Big Island (HI) species[5] (includes 8 candidate species—5 plants & 3 animals; 4 with LPN = 2, 1 with LPN = 3, 1 with LPN = 4, 2 with LPN = 8).	Proposed listing.
12 Puget Sound prairie species (9 subspecies of pocket gopher (*Thomomys mazama* ssp.) (LPN = 3), streaked horned lark (LPN = 3), Taylor's checkerspot (LPN = 3), Mardon skipper (LPN = 8))[3].	Proposed listing.
2 TN River mussels (fluted kidneyshell (LPN = 2), slabside pearlymussel (LPN = 2))[5]	Proposed listing.
Jemez Mountain salamander (LPN = 2) [5]	Proposed listing.

[1] Funds for listing actions for these species were provided in previous FYs.
[2] Although funds for these high-priority listing actions were provided in FY 2008 or 2009, due to the complexity of these actions and competing priorities, these actions are still being developed.
[3] Partially funded with FY 2010 funds and FY 2011 funds.
[4] Funded with FY 2010 funds.
[5] Funded with FY 2011 funds.

We have endeavored to make our listing actions as efficient and timely as possible, given the requirements of the relevant law and regulations and constraints relating to workload and personnel. We are continually considering ways to streamline processes or achieve economies of scale, such as by batching related actions together. Given our limited budget for implementing section 4 of the Act, these actions described above collectively constitute expeditious progress.

The Pacific walrus will be added to the list of candidate species upon publication of this 12-month finding. We will continue to monitor the status of this population as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency-listing procedures.

We intend that any proposed listing determination for the Pacific walrus will be as accurate as possible. Therefore, we will continue to accept additional information and comments from all concerned governmental agencies, the scientific community, the subsistence community, industry, or any other interested party concerning this finding.

References Cited

A complete list of references cited is available on the Internet at *http://www.regulations.gov* and upon request from the Alaska Marine Mammals Office (*see* **ADDRESSES** section).

Author(s)

The primary authors of this notice are the staff members of the Marine Mammals Management Office and the Fisheries and Ecological Services Division of the Alaska Regional Office.

Authority

The authority for this section is section 4 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*).

Dated: January 21, 2011.

Rowan W. Gould,

Acting Director, Fish and Wildlife Service.

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