8.0 OTHER MARINE RESOURCES

The Bering Sea pollock fishery, and potential changes to the prosecution of the pollock fishery to reduce salmon bycatch under the alternatives, impacts marine mammals, seabirds, essential fish habitat, and ecosystem relationships. This chapter analyses the impacts to these other marine resources.

8.1 Marine Mammals

8.1.1 Status of Marine Mammals

The Bering Sea supports one of the richest assemblages of marine mammals in the world. Twenty-five species are present from the orders Pinnipedia (seals, sea lion, and walrus), other Carnivora (sea otter and polar bear), and Cetacea (whales, dolphins, and porpoises). Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, the continental shelf (Lowry et al. 1982), sea ice, shores and rocks, and nearshore waters. The PSEIS (NMFS 2004) describes the range, habitat, diet, abundance, and population status for marine mammals.

The most recent marine mammal stock assessment reports (SARs) for strategic BSAI marine mammals stocks (Steller sea lions, northern fur seals, harbor porpoise, North Pacific right whales, humpback whales, sperm whales, fin whales and bowhead whales) were completed in 2008 based on a review of data available through 2006 (Angliss and Outlaw 2008). Northern elephant seals, and marine mammals under U. S. Fish and Wildlife Service (USFWS) jurisdiction (polar bear, walrus, and sea otters), were assessed in 2002 (Angliss and Outlaw 2008). The most recent stock assessment of Pacific walrus was completed in May 2009 (URL: http://alaska.fws.gov/fisheries/mmm/stock/DraftPacificWalrusSAR.pdf). The information from NMFS 2004 and Angliss and Outlaw 2006, 2007, and 2008 and the walrus stock assessment is incorporated by reference to this EIS. The SARs provide population estimates, population trends, and estimates of the potential biological removal (PBR) levels for each stock. The SARs also identify potential causes of mortality and whether the stock is considered a strategic stock under the MMPA. The SARs are available on the Protected Resources Division web site at http://www.nmfs.noaa.gov/pr/sars/region.htm.

The Alaska Groundfish Harvest Specifications EIS provides information on the effects of the groundfish fisheries on marine mammals (NMFS 2007a). Direct and indirect interactions between marine mammals and groundfish fishing vessels may occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important marine mammal prey, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. This discussion focuses on those marine mammals that may interact or be affected by the pollock pelagic trawl fishery in the Bering Sea. These species are listed in Table 8-1 and Table 8-2. Marine mammals species listed in Table 8-3 and bearded and ringed seals are taken incidentally in the BSAI pollock trawl fishery based on the List of Fisheries (LOF) for 2008 (72 FR 66048, November 27, 2007) and based on information from the National Marine Mammal Laboratory. No changes in species taken by Alaska fisheries are proposed in the LOF for 2009 (73 FR 33760, June 13, 2008).

Table 8-1 Status of Pinniped stocks potentially affected by the Bering Sea pollock fishery

Pinnipedia species and stock	***Status under the ESA***	***Status under the MMPA***	***Population Trends***	***Distribution in action area***
Steller sea lion - Western and Eastern Distinct Population Segment (DPS)	Endangered (W) Threatened (E)	Depleted & a strategic stock	For the western DPS, regional increases in counts in trend sites of some areas have been offset by decreased counts in other areas so that the overall population of the western DPS appears to have stabilized (Fritz et al. 2008). The eastern DPS is steadily increasing and has been recommended to delisting consideration (NMFS 2008).	Western DPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. Eastern DPS inhabit waters east of Prince Williams Sound to Dixon Entrance. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Is., Aleutian Is., St. Lawrence Is. And off mainland. Use marine areas for foraging. Critical habitat designated around major rookeries and haulouts and foraging areas.
Northern fur seal – Eastern Pacific	None	Depleted & a strategic stock	Recent pup counts show a continuing decline in the number of pups surviving in the Pribilof Islands. NMFS researchers found an approximately 9% decrease in the number of pups born between 2004 and 2006. The pup estimate decreased most sharply on Saint Paul Island.	Fur seals occur throughout Alaska waters, but their main rookeries are located in the Bering Sea on Bogoslof Island and the Pribilof Islands. Approximately 55% of the worldwide abundance of fur seals is found on the Pribilof Islands (NMFS 2007b). Forages in the pelagic area of the Bering Sea during summer breeding season, but most leave the Bering Sea in the fall to spend winter an spring in the N. Pacific.
Harbor seal – Gulf of Alaska Bering Sea	None	None	Moderate to large population declines have occurred in the Bering Sea and Gulf of Alaska stocks.	GOA stock found primarily in the coastal waters and may cross over into the Bering Sea coastal waters between islands. Bering Sea stock found primarily around the inner continental shelf between Nunivak Island and Bristol Bay and near the Pribilof Islands.
Ringed seal – Alaska	Status under review	None	Reliable data on population trends are unavailable.	Found in the northern Bering Sea from Bristol Bay to north of St. George Island and occupy ice (Fig. 8-3).
Bearded seal – Alaska	Status under review	None	Reliable data on population trends are unavailable.	Found in the northern Bering Sea from Bristol Bay to north of St. George Island and inhabit areas of water less than 200 m that are seasonally ice covered (Fig. 8-3).
Ribbon seal – Alaska	None	None	Reliable data on population trends are unavailable.	Found throughout the offshore Bering Sea waters (Fig. 8-3).

Pinnipedia species and stock	*Status under the ESA*	*Status under the MMPA*	*Population Trends*	*Distribution in action area*
Spotted seal - Alaska	Status under review	None	Reliable data on population trends are unavailable.	Found throughout the Bering Sea waters (Fig. 8-3).
Pacific Walrus	Status under review	Strategic	Population trends are unknown. Population size estimated from a 2006 ice survey is 15,164 animals, but this is considered a low estimate. Further analysis is being conducted on the 2006 survey to refine the population estimate.	Occur primarily is shelf waters of the Bering Sea. Primarily males stay in the Bering Sea in the summer. Major haulout sites are in Round Island in Bristol Bay and on Cape Seniavan on the north side of the Alaska Peninsula.
Source: Angliss and Outlaw 2008 and List of Fisheries for 2008 (72 FR 66048). Northern fur seal pup data available from http://www.fakr.noaa.gov/newsreleases/2007/fursealpups020207.htm. Pacific Walrus information available from http://alaska.fws.gov/fisheries/mmm/stock/DraftPacificWalrusSAR.pdf.				

Table 8-2 Status of Cetacea stocks potentially affected by the Bering Sea pollock fishery.

Cetacea species and stock	*Status under the ESA*	*Status under the MMPA*	*Population Trends*	*Distribution in action area*
Killer whale – AT1 Transient; Eastern North Pacific GOA, AI, and BS transient; West Coast transient; and Eastern North Pacific Alaska Resident	None	AT1 Transient – Depleted & a strategic stock	AT1 group has been reduced to at least 50% of its 1984 level of 22 animals, and has likely been reduced to 32% of its 1998 level of 7 animals. Unknown abundance for the eastern North Pacific Alaska resident; West Coast transient; and Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea transient stocks. The minimum abundance estimates for the Eastern North Pacific Alaska Resident and West coast transient stocks are likely underestimated because researchers continue to encounter new whales in the Alaskan waters.	Transient-type killer whales from the Aleutian Islands and Bering Sea are considered to be part of a single population that includes Gulf of Alaska transients. Killer whales are seen in the northern Bering Sea and Beaufort Sea, but little is known about these whales.
Dall's porpoise – Alaska	None	None	Reliable data on population trends are unavailable.	Found in the offshore waters from coastal western Alaska to Bering Sea.
Humpback whale- Western North Pacific Central North Pacific	Endangered	Depleted & a strategic stock	Reliable data on population trends are unavailable for the western North Pacific stock. Central North Pacific stock thought to be increasing. The status of the stocks in relation to optimal sustainable population (OSP) is unknown.	W. Pacific and C. North Pacific stocks occur in Alaskan waters and may mingle in the North Pacific feeding area shown in Fig. 8-2. Humpback whales in the Bering Sea (Moore et al. 2002) cannot be conclusively identified as belonging to the western or Central North Pacific stocks, or to a separate, unnamed stock.

Cetacea species and stock	*Status under the ESA*	*Status under the MMPA*	*Population Trends*	*Distribution in action area*
North Pacific right whale Eastern North Pacific	Endangered	Depleted strategic stock	Abundance not known, but this stock is considered to represent only a small fraction of its precommercial whaling abundance and is arguably the most endangered stock of large whales in the world.	See Fig. 8-4 for distribution and designated critical habitat.
Fin whale – Northeast Pacific	Endangered	Depleted & a strategic stock	Abundance may be increasing but surveys only provide abundance information for portions of the stock in the central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula, and much of the North Pacific range has not been surveyed.	Found in the Bering Sea and coastal waters of the Aleutian Islands and Alaska Peninsula. Most sightings in the central-eastern Bering Sea occur in a high productivity zone on the shelf break (Fig. 8-1).
Minke whale - Alaska	None	None	Considered common but abundance not known and uncertainty exists regarding the stock structure.	Common in the Bering and Chukchi Seas and in the inshore waters of the GOA.
Sperm Whale – North Pacific	Endangered	Depleted & a strategic stock	Abundance and population trends in Alaska waters are unknown.	Inhabit waters 600 m or more depth, south of 62°N lat. Males inhabit Bering Sea in summer.
Gray Whale – Easter North Pacific	None	None	Minimum population estimate is 17,752 animals. Increasing populations in the 1990's but below carrying capacity.	Most spend summers in the shallow waters of the northern Bering Sea and Arctic Ocean. Winters spent along the Pacific coast near Baja California.
Beluga Whale – Bristol Bay, Eastern Bering Sea, Cook Inlet, and eastern Chukchi Sea	None for all stocks except Cook Inlet, which are endangered	None	Abundance estimate is 3,710 animals and population trend is not declining for the eastern Chuckchi Sea stock. Minimum population estimate for the eastern Bering Sea stock is 14,898 animals and population trend is unknown. The minimum population estimate for the Bristol Bay stock is 1,619 animals and the population trend is stable and may be increasing. For Cook Inlet Belugas, estimated decline of 71 percent in 30 years with 375 animals estimated in 2008.	Summer in the Arctic Ocean and Bering Sea coastal waters, and winter in the Bering Sea in offshore waters associated with pack ice. Cook Inlet belugas remain in Cook Inlet year round, but eat salmon that occur in the Bering Sea and are taken as bycatch.
Source: Angliss and Outlaw 2008 and List of Fisheries for 2008 (72 FR 66048). North Pacific right whale included based on NMFS 2006 and Salveson 2008 http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm				

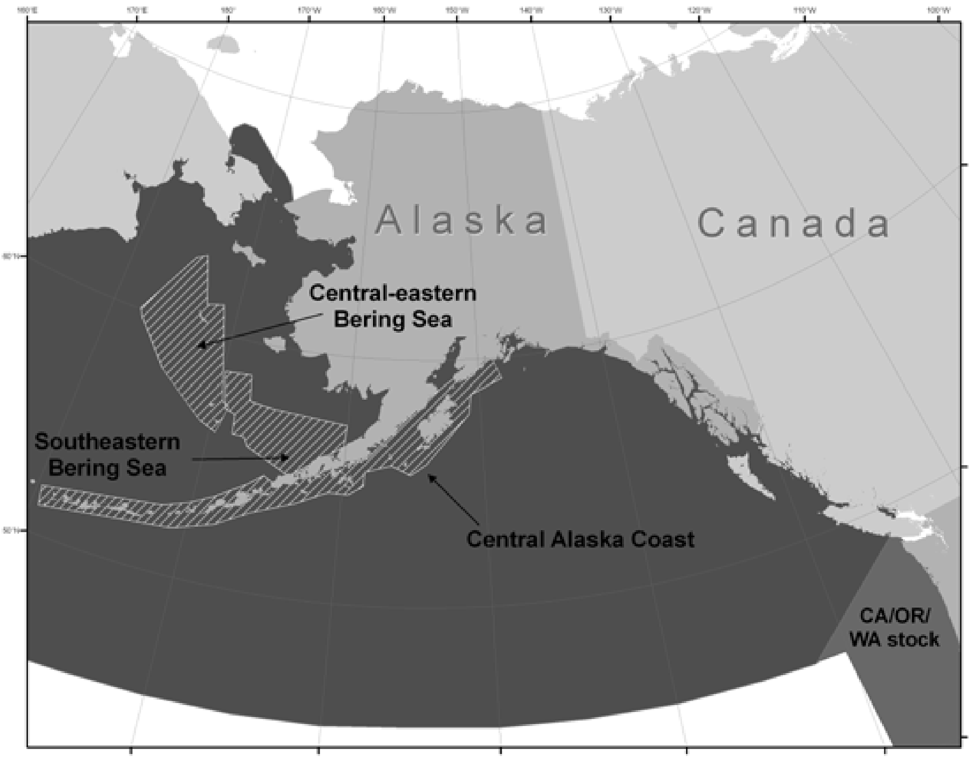

Fig. 8-1 Fin whale distribution and survey areas in lined locations (Angliss and Outlaw 2008)

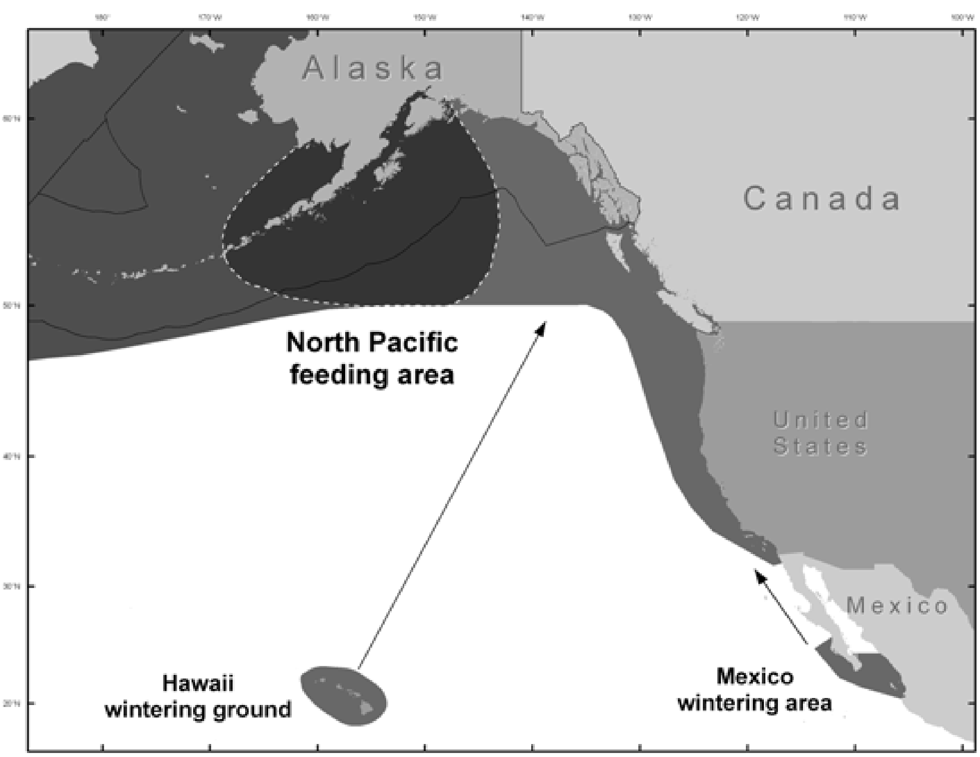

Fig. 8-2 Feeding area of humpback whales (Angliss and Outlaw 2008). Shaded area shows overlap of Central and western North Pacific humpback whale stocks.

8.1.2 ESA Consultations for Marine Mammals

The Alaska Groundfish Harvest Specifications EIS provides a detailed description of the status of ESA Section 7 consultations through December 2006 (Section 8.2 of NMFS 2007a). This section provides recent Section 7 consultation information since that document was published.

For Bering Sea marine mammals, ESA Section 7 consultation has been completed for all ESA-listed marine mammals (NMFS 2000 and NMFS 2001). NMFS is currently consulting on the effects of the groundfish fisheries on sperm whales, humpback whales, and Steller sea lions and their designated critical habitat (NMFS 2006) and on Cook Inlet beluga whales. A draft biological opinion on the status quo groundfish fishery in the BSAI and GOA is expected to be available in spring 2010.

8.1.2.1 Ice Seals

In December 2007, NMFS was petitioned by the Center for Biological Diversity (CBD) to list ribbon seals as endangered or threatened under the ESA (CBD 2007). This petition is based on the dependence of this species on sea ice and the loss of sea ice due to global climate change. The petition presents information on (1) global warming which is resulting in the rapid melt of the seals' sea-ice habitat; (2) high harvest levels allowed by the Russian Federation; (3) current oil and gas development; (4) rising contaminant levels in the Arctic; and (5) bycatch mortality and competition for prey resources from commercial fisheries. NMFS determined that the petition presented substantial information that a listing may be warranted and started a status review of the species to determine whether listing is warranted (73 FR 16617, March 28, 2008). Detailed information on the biology, distribution and potential threats on ribbon seals is contained in CBD 2007.

NMFS determined that the listing is not warranted at this time due to modeling of future sea ice extent and population estimates (73 FR 79822, December 30, 2008). On March 31, 2009, the CBD and Greenpeace filed a 60 day notice of intent to sue NMFS for failing to propose listing ribbon seals under the ESA. The CBD and Greenpeace filed a complaint for declaratory and injunctive relief on September 3, 2009, asking for the 12 month finding to be remanded.

On May 28, 2008, the CBD petitioned NMFS to list ringed, bearded, and spotted seals under the ESA due to threats to the species from (1) global warming, (2) high harvest levels allowed by the Russian Federation, (3) oil and gas exploration and development, (4) rising contaminant levels in the Arctic, and (5) bycatch mortality and competition for prey resources from commercial fisheries (CBD 2008a). NMFS has initiated the status review for ringed, bearded, and spotted seals (73 FR 51615, September 4, 2008). Pursuant to a court settlement, NMFS completed the status review and issued a 12-month finding on October 15, 2009 for the spotted seal (74 FR 53683, October 20, 2009) and is scheduled to complete the status reviews and 12-month findings on November 1, 2010 for the ringed and bearded seals. NMFS determined that the status of the stocks of spotted seals occurring in Alaska indicated that no listing was needed. Listing of ringed or bearded seals would require ESA consultation on federal actions that may adversely affect them or any designated critical habitat.

The National Marine Mammal Laboratory surveyed ice seals during April through June 2007 from the USGC vessel Healy in the Bering Sea. Fig. 8-3 shows the abundance and distribution of bearded, ribbon, and spotted seals over the survey area. Satellite tagged ribbon and spotted seals from late spring through July showed that the animals mostly stayed in the Bering Sea south and west of St. Matthews Island with a few animals traveling north through the Bering Strait (Boveng, et. al. 2008).

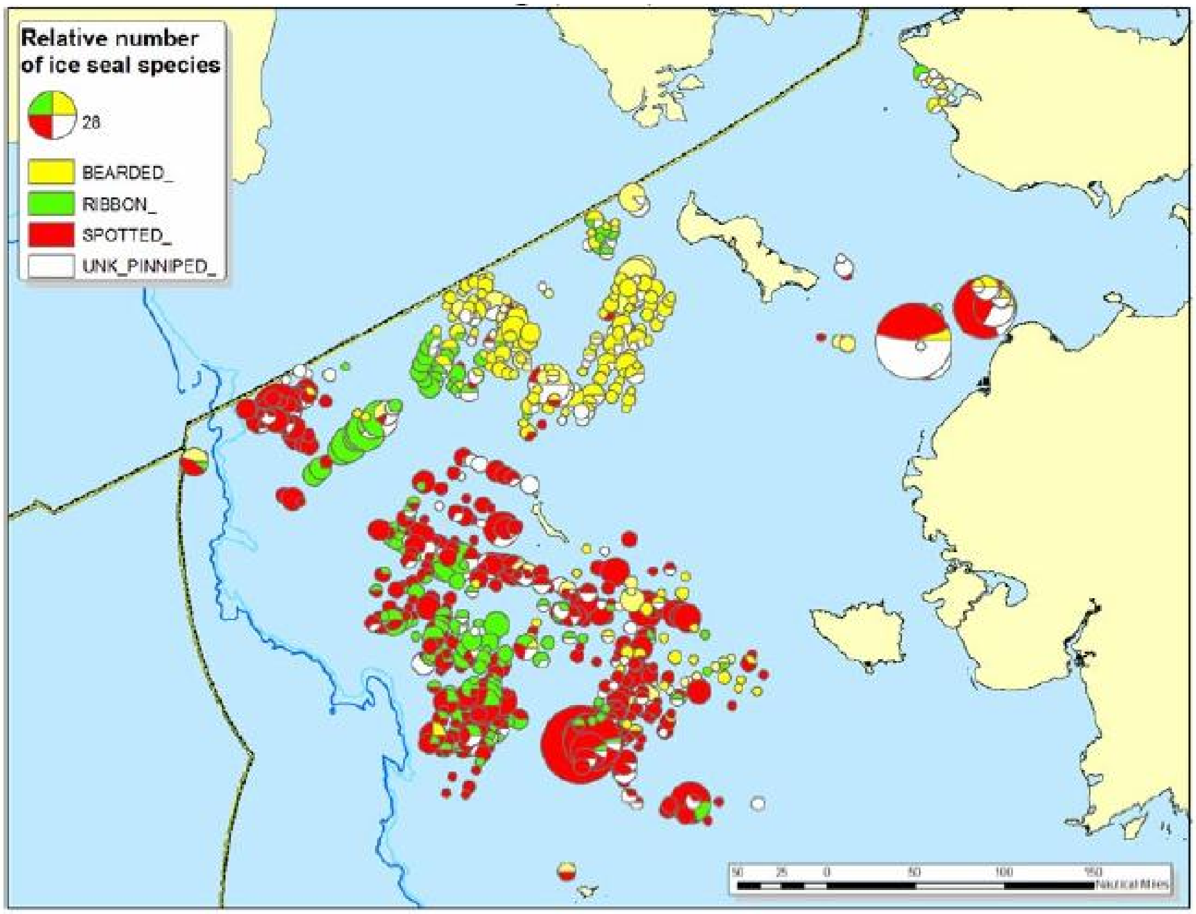

Fig. 8-3 Ice seal survey during Healy cruises in summer in Bering Sea 2007 (Cameron and Boveng 2007)

8.1.2.2 North Pacific Right Whale

Due to the recent revision of the species designation for the northern right whale (73 FR 12024, March 6, 2008) and designation of critical habitat (73 FR 19000, April 8, 2008), the NMFS Alaska Region Sustainable Fisheries Division reinitiated ESA section 7 consultation on the effects of the Alaska groundfish fisheries on the North Pacific right whale (*Eubalaena japonica)*, and its designated critical habitat, as required by 50 CFR 402.16 (Salveson 2008). The new species designation is effective April 7, 2008, and the new critical habitat designation is effective May 8, 2008. Groundfish fisheries are conducted in the North Pacific right whale designated critical habitat areas in the Bering Sea and Gulf of Alaska (Fig. 8-4). Details of the potential impact analysis for the North Pacific right whale are in the biological assessment (NMFS 2006). The recent species and critical habitat designations are necessary to address the recognition of two northern hemisphere right whale species, the North Atlantic and the North Pacific. These new designations do not change the expected impacts of fisheries on the right whales occurring in the Pacific. The previous finding that Alaska fisheries are not likely to adversely affect the species or designated critical habitat (Brix 2006) is not likely to change for the status quo fishery. The consultation concluded that the Alaska groundfish fisheries were not likely to adversely affect north Pacific right whales or their designated critical habitat.

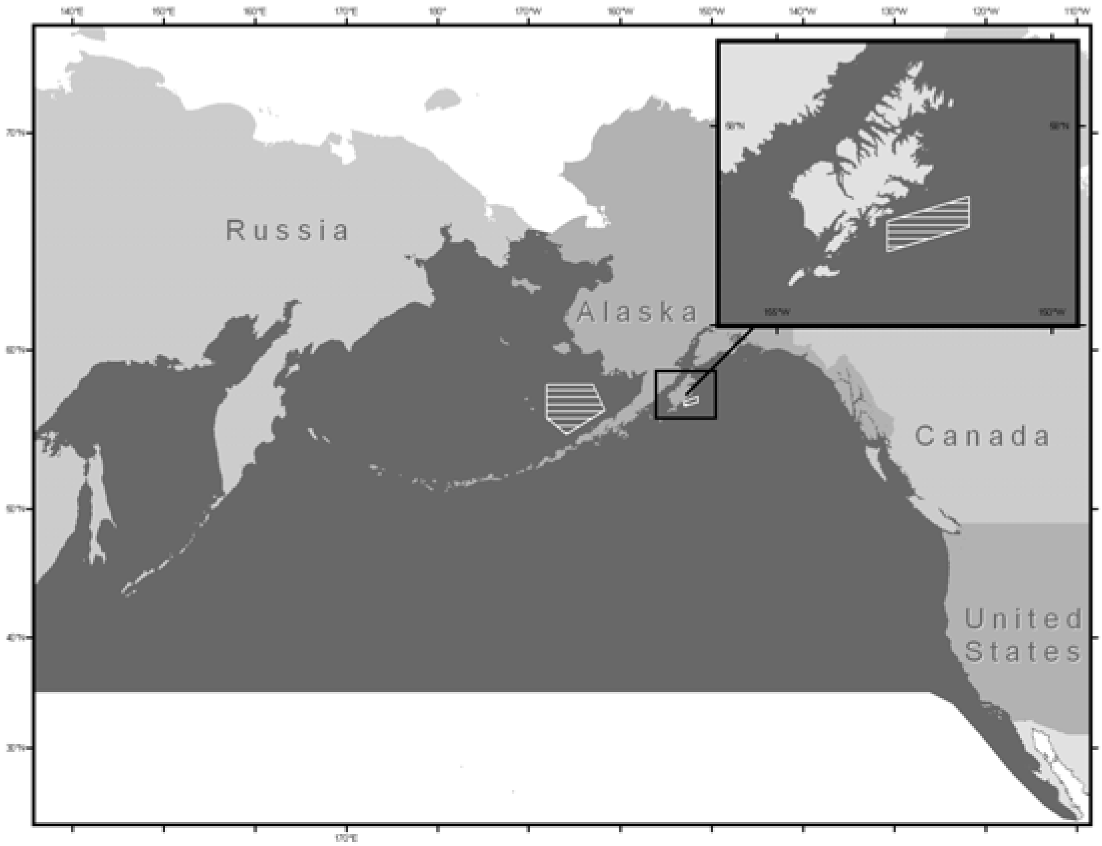

Fig. 8-4 North Pacific right whale distribution and critical habitat shown in lined boxes. (Angliss and Outlaw 2008)

8.1.2.3 Pacific Walrus

Management of the Pacific walrus is under the jurisdiction of the USFWS. They occur in the shelf waters of the Bering and Chukchi Sea and some attempts at population estimates range from 200,000 to 246,000 animals (USFWS 2002a). No reliable population estimates or trends are available. In April 2006, federal and state agencies conducted satellite tagging and aerial surveys of walrus in the Bering Sea to develop an abundance estimate (http://alaska.usgs.gov/science/biology/walrus/2006_tagging.html). The shallow productive waters of the Northern Aleutian Basin support some of the largest concentrations of Pacific walruses in the world. Large breeding aggregations form in late winter in the broken pack ice of northern Bristol Bay. Females and dependent young migrate out of the region in spring, following the retreating pack-ice to summer feeding areas in the Chukchi Sea. Thousands of primarily adult male walruses remain in the Bristol Bay region through the ice free season, foraging on rich beds of benthic invertebrates and resting at isolated coastal haulout sites. The most heavily used coastal haulouts in Bristol Bay are located at Round Island (Walrus Islands State Game Sanctuary), Cape Peirce and Cape Newenham (Togiak National Wildlife Refuge), and Cape Seniavin on the Alaska Peninsula. Less consistently used haulout sites are found at Cape Constantine, Amak Island, Big Twin Island, Crooked Island, High Island, and Hagemister Island. Walruses have also occasionally been observed at isolated beaches near Port Moller, Port Heiden, and Egegik Bay. In summer 1982, adult male walruses were observed using haulouts and foraging areas on the east end of St. Matthew Island (Irons 1983). Hauling out and foraging at St. Matthew Island by adult males has not been observed in the past 15 to 20 years (Dr. Chadwick Jay, personal communication, U.S. Geological Survey, June 10, 2009). Adult males may transit through areas near St. Matthew Island in the fall as they move north towards the females, but the concentration of migration is generally further east (Dr. Chadwick Jay, personal communication, U.S. Geological Survey, June 10, 2009). Females and juveniles may forage near St. Matthew Island in the winter depending on the extent of sea ice and open leads or polynyas.

The number of walruses attending coastal haulout sites in northern Bristol Bay (Round Island, Cape Peirce, and Cape Newenham) has declined in recent years, while the number of animals using haulouts along the Alaska Peninsula (principally at Cape Seniavin) has increased. On February 7, 2008, the Center for Biological Diversity petitioned the USFWS to list Pacific walrus under the ESA because of the impact of global warming in the sea ice habitat (CBD 2008). On December 3, 2008, the CBD filed suit against the USFWS for failing to act on the petition (http://www.biologicaldiversity.org/news/press_releases/2008/pacific-walrus-12-03-2008.html). On May 18, 2009 the USFWS agreed to complete the review of the petition by September 10, 2009, in a settlement with the CBD. On September 8, 2009, the USFWS announced that the CBD petition presents substantial scientific or commercial information indicating that adding Pacific walrus to the federal list of threatened and endangered species may be warranted. The USFWS has opened a 60 day public comment period and initiated the status review, which is scheduled for completion by September 10, 2010. (http://alaska.fws.gov/fisheries/mmm/walrus/pdf/press_release.pdf)

8.1.3 Existing Management Measures to Mitigate Fishing Impacts on Marine Mammals

The most recent action that will provide protection to some marine mammals in the Bering Sea is the approval of the Fishery Management Plan for Fish Resources of the Arctic Management Area. This plan was approved on August 17, 2009 and implementing regulations are scheduled by the end of 2009. This plan initially prohibits commercial fishing in the Arctic Management Area until information is available to support sustainable fisheries management. This action would prevent the potential adverse effects of unregulated commercial fishing activities on marine mammal species. Several of these species occur in both the Arctic Management Area and in the Bering Sea (e. g., bowhead whales, gray whales, walrus, and ice seals).

Throughout the 1990s, particularly after Steller Sea lion critical habitat was designated, various closures of areas around rookeries and haulouts and some offshore foraging areas affected commercial harvest of pollock, an important component of the western DPS of Steller sea lions' diet. The Bering Sea subarea has several pollock fishery closures in place for Steller sea lion protection including no transit zones, closures around rookeries and haulouts, the Bogoslof foraging area closure, and the Steller Sea Lion Conservation Area (Fig. 8-5). The proposed action would not change the closures associated with the five Bering Sea Steller sea lion sites located at Sea lion Rock, Bogoslof Island/Fire Island, Adugak Island, Pribilof Islands, and Walrus Islands and with the Bogoslof Foraging Area. The harvest of pollock in the Bering Sea subarea is temporally dispersed (§§ 679.20 and 679.23) and spatially dispersed through area closures (§ 679.22). Based on the most recent completed biological opinion, these harvest restrictions on the pollock fishery decrease the likelihood of disturbance, incidental take, and competition for prey to ensure the groundfish fisheries do not jeopardize the continued existence or adversely modify the designated critical habitat of Steller sea lions (NMFS 2000 and NMFS 2001). A detailed analysis of the effects of these protection measures is provided in the Steller Sea Lion Protection Measures Supplemental EIS (NMFS 2001).

Fig. 8-5 also shows the other areas closed to pollock fishing. The Nearshore Bristol Bay Trawl Closure prohibits pollock vessels from fishing in Bristol Bay. The Pribilof Island Area Habitat Conservation Zone prevents pollock trawling at all times in the area around the Pribilof Islands. The walrus protection areas around Round Island and The Twins, are closed from April 1 through September 30 to pollock vessels.

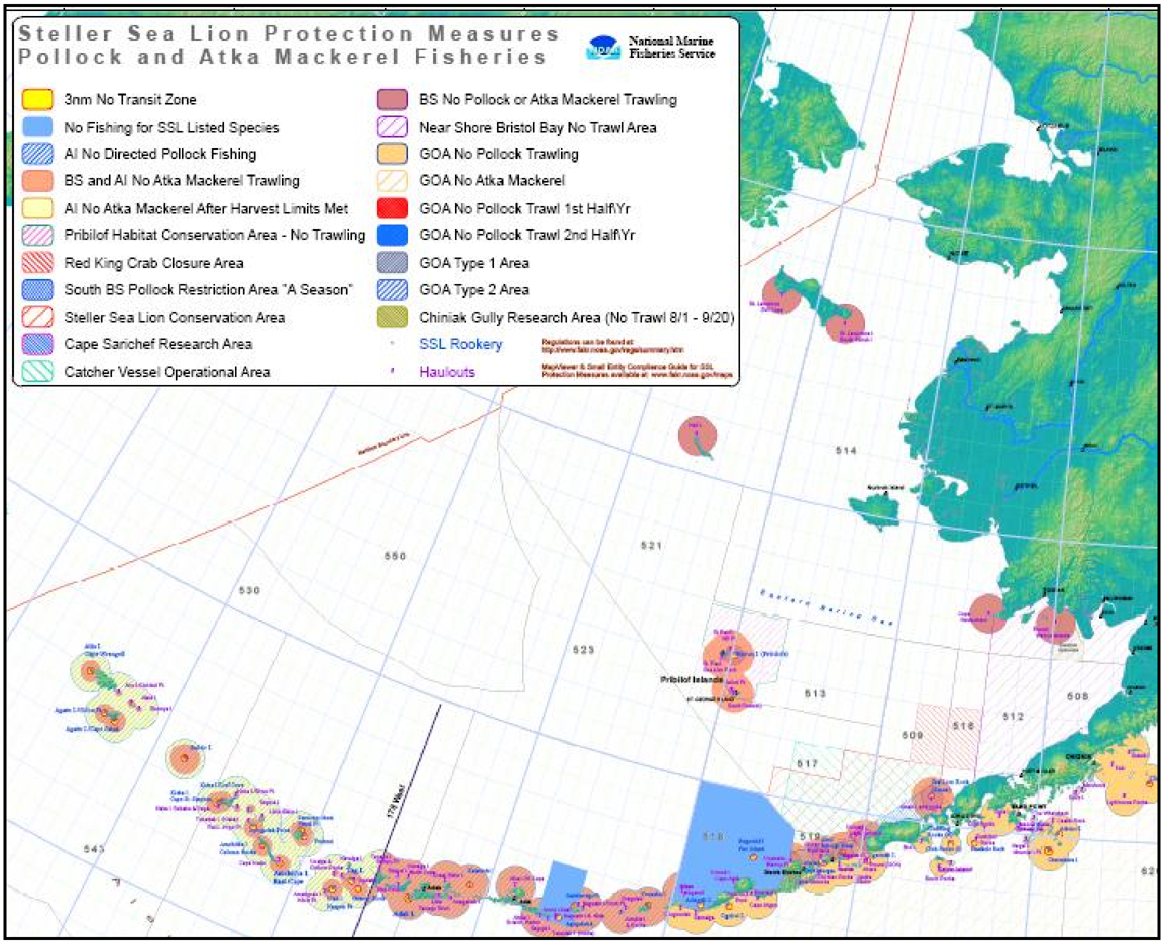

Fig. 8-5 Pollock Fishery Restrictions Including Steller Sea Lion Protection Areas of the Bering Sea Subarea. (Details of these closures are available through the NMFS Alaska Region website at http://alaskafisheries.noaa.gov/protectedresources/stellers/maps/Pollock_Atka0105.pdf).

8.1.4 Incidental Take Effects

The Alaska Groundfish Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on marine mammals (Chapter 8 of NMFS 2007a) and is incorporated by reference. Potential take in the groundfish fisheries is well below the potential biological removal (PBR) for all marine mammals which have a PBR determined, except killer whales and humpback whales. This means that predicted take would be below the maximum number of animals that may be removed from these marine mammal stocks while allowing the stocks to reach or maintain their OSP. Table 8-3 lists the species of marine mammals taken in the BSAI pollock fishery as published in the List of Fisheries for 2008. Table 8-3 provides more detail on the levels of take based on the most recent SARs (Angliss and Outlaw 2008, 2007, and 2006). The BSAI pollock fishery is a Category II fishery because it has annual mortality and serious injury of a marine mammal stock greater than 1% and less than 50% of the PBR level (72 FR 66048, November 27, 2007 and 73 FR 33760, June 13, 2008). Overall, very few marine mammals are reported taken in the Bering Sea pollock fishery.

Table 8-3 Category II BSAI Pollock Fishery with documented marine mammal takes from the List of Fisheries for 2008 (72 FR 66048, November 27, 2007)

Fishery	Marine Mammal Stocks Taken
Category II	
BSAI pollock trawl	Dall's porpoise, AK Harbor seal, Bering Sea Killer whale, Eastern North Pacific, GOA, Aleutian Islands, and Bering Sea transient Steller sea lions, western U. S Humpback whale, Central and western N. Pacific Minke whale, AK Ribbon seal, AK Spotted seal, AK

Based on the most recent information, the potential incidental take of marine mammals is limited to the species taken by the BSAI pollock trawl fishery listed in Table 8-3, plus bearded and ringed seals. Bearded seals have experienced recent incidental take (NMML, James Thomason, pers. comm., April 28, 2008). Northern fur seals, spotted seals, harbor seals, resident killer whales, humpback whales, and fin whales have not been reported taken in the BSAI pollock trawl fishery between 2000 and 2004; and therefore, these species have zero mortality as show in Table 8-4. Perez unpublished report documents bearded seal and a fin whale take in 2006. Perez (2007) reports takes of bearded seal in 1999. Table 8-3 is based on the List of Fisheries for 2008, which is based on all previously reported injury or mortality. Table 8-4 is based on the 2007 stock assessment reports (SARs), which use the previous 5 years of reported serious injury or mortality. Due to an error, ringed seals should be listed in the List of Fisheries for 2008 and will be added in the next version (Robyn Angliss, National Marine Mammal Laboratory, personal communication 4/28/08). Because the List of Fisheries includes all reported listings of injury, several species appear on the 2008 List of Fisheries as taken in the pollock fishery even though the recent SARs show these species are not reported taken in the pollock fishery. These species include humpback whales, harbor seals, Eastern North Pacific Alaska resident killer whales, and spotted seal. Bearded seals and a fin whale were taken in the pollock fishery in 2006, and this information has not yet been added to the List of Fisheries or the SAR report for this species (Table 8-5).

Table 8-4 Estimated mean annual mortality of marine mammals from observed BSAI pollock fishery compared to the total mean annual human-caused mortality and potential biological removal. Mean annual mortality is expressed in number of animals and includes both incidental takes and entanglements. The averages are from the most recent 5 years of data since the last SAR update, which may vary by stock. Groundfish fisheries mortality calculated based on Angliss and Outlaw (2008).

Marine Mammal Species and Stock	5 years of data used to calculate total mean annual human-caused mortality	Mean annual mortality, from BSAI pollock fishery	Total mean annual human-caused mortality*	Potential Biological Removal (PBR)
**Steller sea lions (western)	2001-2005	2.58	215.6	234
Northern fur seal	2001-2005	0.21	704	15,262
Harbor seal (BS)	2000-2004	0	176.2	603
Harbor seal (AI)	2000-2004	0	820	1334
Spotted seal	2000-2004	0	5,265	Undetermined
Ringed seal	2000-2004	0.71	9,568	Undetermined
Ribbon seal	2000-2004	0.2	194	Undetermined
Killer whale Eastern North Pacific AK resident	2000-2004	0	1.5	11.2
Killer whale, Eastern North Pacific Northern resident	2000-2004	0	0	2.16
Killer whale, GOA, BSAI transient	2000-2004	0.41	0.4	3.1
Dall's porpoise	2000-2004	1.89	30	Undetermined
**Humpback whale, Western North Pacific	2001-2005	0	0.2	1.3
**Humpback whale, Central North Pacific	2001-2005	0	5.0	12.9
Minke whale, Alaska	2000-2004	0.3	0.3	Undetermined
**Fin whale, Northeast Pacific	2001-2005	0	0	11.4
Pacific walrus	2002-2006	2.66	4,963-5,460	

* Does not include research mortality. Other human-caused mortality is predominantly subsistence harvests for seals and sea lions.
** ESA-listed stock

Table 8-5 shows the months and locations when incidental takes of marine mammals occurred in 2003, 2004, 2005, and 2006. It is not possible to determine any seasonality to the incidental takes of killer whales, fur seals, or fin whales since only one occurrence for each is reported during this time period. It appears that Dall's porpoise may be more likely taken in July and bearded seals may be more likely taken in September and October. Steller sea lions appear to be taken in the A and B pollock fishing seasons, mostly in January through March and in September. Based on the very limited data in Table 8-5, bearded seals were primarily taken in the northern portion of the eastern Bering Sea. Killer whale, Dall's porpoise, and fin whale appear to be taken in the area along the shelf break. Steller sea lions appear to be taken primarily in the southern portion of the eastern Bering Sea and northwest of the Pribilof Islands.

Table 8-5 Marine Mammals taken in the pollock fishery in 2003, 2004, 2005, and 2006. Locations correspond to the areas depicted in Fig. 8-5 (Sources: National Marine Mammal Laboratory 4-28-08 and the North Pacific Groundfish Observer Program 10-31-08)

SPECIES	DATE	LOCATION
Killer whale	20-Mar-03	Area 521
Dall's porpoise	20-Jul-04	Area 521
Steller sea lion	15-Jul-04	Area 513
Steller sea lion	3-Feb-05	Area 509
Steller sea lion	3-Mar-05	Area 521
Steller sea lion	5-Mar-05	Area 521
Steller sea lion	5-Sep-05	Area 521
Northern fur seal	29-Jun-05	Area 521
Steller sea lion	27-Jan-06	Area 509
Steller sea lion	30-Jan-06	Area 509
Steller sea lion	5-Feb-06	Area 509
Steller sea lion	6-Mar-06	Area 509
Steller sea lion	15-Sep-06	Area 521
Steller sea lion	18-Sep-06	Area 509
Bearded seal	6-Sep-06	Area 524
Bearded seal	18-Oct-06	Area 524
Fin whale	16-Aug-06	Area 521
Dall's porpoise	26-Jul-06	Area 517

8.1.4.1 Alternative 1: Status Quo

The effects of the status quo fisheries on the incidental takes of marine mammals are detailed in the 2007 harvest specifications EIS (NMFS 2007a). Except for minke whales, the potential take of marine mammals in the pollock fishery is well below the PBRs or a very small portion of the overall human caused mortality for those species without a PBR determination (Table 8-4). A PBR for bearded seals is not available, but human caused mortality through hunting is estimated at 6,788 animals per year (Angliss and Outlaw 2007). The take of minke whales appears to be a very rare event considering no takes are reported for the pollock fishery in Table 8-5. Because of the broad distribution and common occurrence of minke whales in the Bering Sea, it is not likely that the potential incidental take by pollock fishery would have a large impact on this stock.

8.1.4.2 Alternative 2: Hard Cap

The range of hard caps under Alternative 2 may result in different potentials for incidental takes of marine mammals. The lower hard caps may result in stopping the pollock fishery in the Bering Sea earlier which would reduce the potential for incidental takes in fishing areas where marine mammals may interact with pollock fishing vessels. The higher hard caps would allow for more pollock fishing and more potential for interaction and incidental takes of marine mammals than the smaller caps.

The options to seasonally distribute the hard cap would seasonally limit the amount of fishing which would likely lead to less overall potential for incidental takes. Whether the overall annual takes of marine mammals would be affected would depend on whether there is a seasonal trend for certain species in incidental takes in the pollock fishery. If incidental takes are concentrated in a season and that season's fishing is limited by the seasonal hard cap, there would likely be less overall incidental take for that species. Having a low B season cap as in option 1-1 to Component 1, or reaching the B season cap early in the B season may result in closing the pollock fishery before the end of the B season. This may be beneficial to bearded seals, which appear to be incidentally taken in the later part of the B season (Table 8-5).

The options for sector allocations and transfers, and cooperative provisions affect the management and distribution of the cap across the sectors. These options are not likely to have any effect on pollock fishing in a manner that would change the potential for incidental takes of marine mammals since the overall quantity of pollock fishing and potential for interaction with marine mammals is not changed by the allocations, transfers, and cooperative provisions.

8.1.4.3 Alternative 3: Triggered Closures

A closure of an area where marine mammals are likely to interact with pollock fishing vessels would likely reduce the potential for incidental takes. The potential reduction would depend on the location and marine mammal species. A number of marine mammal species have been taken in northern waters of the Bering Sea (Table 8-5). Fishing under any of the alternatives and options would require vessels to comply with Steller sea lion protection measures and the Pribilof Island Area Habitat Conservation Zone, reducing the potential for interaction with Steller sea lions and northern fur seals in these areas. A large portion of the closures in the A and B season are located in the southern part of the Bering Sea where Steller sea lions are more likely to be encountered. These closures for salmon also may reduce the potential for incidental takes of Steller sea lions in the closure locations.

Any northward shift of the pollock fishery could potentially increase the risk of incidental takes of ringed, ribbon, spotted, and bearded seals, killer whales, Dall's porpoise, and fin whales based on incidental takes shown in Table 8-5, history of incidental takes in the pollock fishery, and Fig. 8-3. Closure of the salmon area during the A and B season is likely to shift the pollock fishery northward. In the B season, the two northern portions of the salmon closure areas would provide some locations where incidental takes of these marine mammals would be prevented, but the overall effect on the incidental takes is unknown without more specific information on marine mammal locations and pollock fishery locations. Because Steller sea lions are taken in the both the northern and southern portions of the Bering Sea, a northward shift of the pollock fishery due to the salmon area closures is not likely to change the potential for incidental takes of Steller sea lions. Due to the small number of incidental takes (Table 8-5) and the lack of data on the specific location where the takes occurred, it is not possible to quantify how the moving of the pollock fishery with the trigger closures may impact the potential for incidental takes of specific species of marine mammals.

8.1.4.4 Alternatives 4 and 5

Because Alternatives 4 and 5 are a variation on the hard caps and seasonal and sector splits under Alternative 2, the effects of Alternatives 4 and 5 on incidental takes would be the same as under Alternative 2. The 47,591 Chinook salmon cap under Alternatives 4 and 5 may result in less pollock fishing which may result in less potential interaction between fishing vessels and marine mammal and less incidental takes than the higher cap under the ICA or IPA scenario. Seasonal apportionments that result in less fishing in the B season may result in less interaction with bearded seals or other ice seals and less potential for incidental takes.

8.1.5 Prey Species Effects

Table 8-6 shows the Bering Sea marine mammals that may be impacted by the pollock fishery and their prey species. Pollock and salmon prey are in **bold**.

Table 8-6 Bering Sea Marine Mammal Prey

Species	Prey
Fin whale	Zooplankton, squid, fish (herring, cod, capelin, and **pollock**), and cephalopods
Humpback whale	Zooplankton, schooling fish (**pollock**, herring, capelin, saffron cod, sand lance, Arctic cod, and **salmon** species)
Gray whale	Benthic invertebrates
Sperm whale	Mostly squid, some fish, shrimp, sharks, skates, and crab (up to 1,000 m depth)
Minke whale	Pelagic schooling fish (herring and **pollock**)
Beluga whale	Wide variety invertebrates and fish including **salmon and pollock**
Killer whale	(transient) Marine mammals and (resident) fish (including herring, halibut, **salmon,** and cod)
Dall's porpoise	hake, squid, lanternfish, anchovy, sardines, and small schooling fish.
Pacific walrus	Benthic invertebrates (primarily mollusks), occasionally seals and birds
Bearded seal	Primarily crab, shrimp, and mollusks; some fish (Arctic cod, saffron cod, sculpin, and **pollock**)
Spotted seal	Primarily pelagic and nearshore fish (**pollock and salmon**), occasionally cephalopods and crustaceans
Ringed seal	Primarily Arctic cod, saffron cod, herring and smelt in fall in winter and fish and fish and crustaceans in summer and spring
Ribbon seal	Arctic and saffron cods, **pollock**, capelin, eelpouts, sculpin and flatfish, crustaceans and celphalopods
Northern fur seal	**Pollock**, squid, and bathylagid fish (northern smoothtongue*)*, herring, **salmon,** and capelin. (Females at Bogoslof eat primarily squid and bathylagid fish and less pollock than in the Pribilofs, and salmon irregularly.)
Harbor seal	crustaceans, squid, fish, and mollusks
Steller sea lion	**pollock**, Atka mackerel, Pacific herring, Capelin, Pacific sand lance, Pacific cod, and **salmon**

Sources: NOAA 1988; NMFS 2004; NMFS 2007b; Nemoto 1959; Tomilin 1957; Lowry et al. 1980; Kawamura 1980; http://www.afsc.noaa.gov/nmml/education/cetaceans/sperm.php; Rolf Ream, NMML personal communication, September 26, 2008; and http://www.adfg.state.ak.us/pubs/notebook/marine/orca.php

Nine of the 16 species listed in Table 8-6 are documented to eat pollock, and six of the marine mammals listed eat salmon. Salmon is primarily a summer prey species for Steller sea lions (NMFS 2001), resident killer whales (NMFS 2004), spotted seals (CBD 2008a), beluga whales (NMFS 2008), and northern fur seals (NMFS 2007b). Steller sea lions, ribbon seals, and northern fur seals depend on pollock as a principal prey species (NMFS 2007a, 2007b and http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php). Spotted seals eat pollock mainly in the winter and spring, and eat salmon in the summer (CBD 2008).

Several marine mammals do not primarily depend on pollock or salmon but may be impacted indirectly by any effects that the pelagic trawl gear may have on the benthic habitat where marine mammals are dependent on benthic prey. These species include gray, beluga, and sperm whales; bearded, spotted, ringed, ribbon, and harbor seals; and walrus. Whether the benthic prey dependent species are indirectly affected by pollock fishing will depend on the effects of the pollock fishing on the benthos and whether the marine mammal forages on benthic species in the impacted area and their dependence on the benthic prey. The EFH EIS provides a description of the effects of pollock fishing on bottom habitat in the Appendix (NMFS 2005a), including the effects of the pollock fishery on the Bering Sea slope and shelf. Pollock trawl gear is known to contact the bottom and may impact benthic habitat. The fisheries effects analysis in the EFH EIS determined that the long term effects indices for pollock fishing on sand/mud and slope biostructure in the Bering Sea were much larger than the effects from other fisheries conducted in the Bering Sea, especially on the slope (Table 8.2-10 in NMFS 2005a)

Table 8-9 shows the marine mammals that may depend on benthic prey and the known depths of diving and Bering Sea locations. Most pollock fishing is conducted in waters greater than 50 m and less than 200 m (Fig.8-8). Diving activity may be associated with foraging.

Table 8-7 Listing of Benthic Dependent Marine Mammals and Location and Diving Depths in the Bering Sea

Species	**Depth of Diving and location**
Bearded seal	Occur in waters < 200 m, at least 20 nm from shore during spring and summer (Fig. 8-4)
Ringed seal	Usually shallow but can dive up to 500 m. Throughout pack ice.
Ribbon seal	Mostly dive < 150 m on shelf, deeper off shore. Shelf and slope areas
Spotted seal	Up to 300 m. Coastal habitats in summer and fall and ice edge in winter
Harbor seal	Up to 183 m. Generally coastal
Pacific walrus	Usually in waters < 100 m. Shelf area, concentrated SW of St. Lawrence Island and in Nunivak Island/Bristol Bay area
Gray whale	< 60 m waters, coastal and shelf area.
Beluga whale	6-30 m, shelf area and nearshore estuaries and river mouths
Sperm whale	Up to 1,000 m, but generally in waters > 600 m

Sources: http://www.adfg.state.ak.us/pubs/notebook/marine/harseal.php, http://www.afsc.noaa.gov/nmml/species/species_ribbon.php, http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php, Burns et al. 1981, Angliss and Outlaw 2008, Angliss and Outlaw 2007, http://www.adfg.state.ak.us/pubs/notebook/marine/gray.php, http://alaska.fws.gov/fisheries/mmm/walrus/nhistory.htm, and http://www.adfg.state.ak.us/pubs/notebook/marine/beluga.php

Fig.8-8 shows the location of 2006-2008 observed pollock harvest in relation to the bathymetry of the Bering Sea.

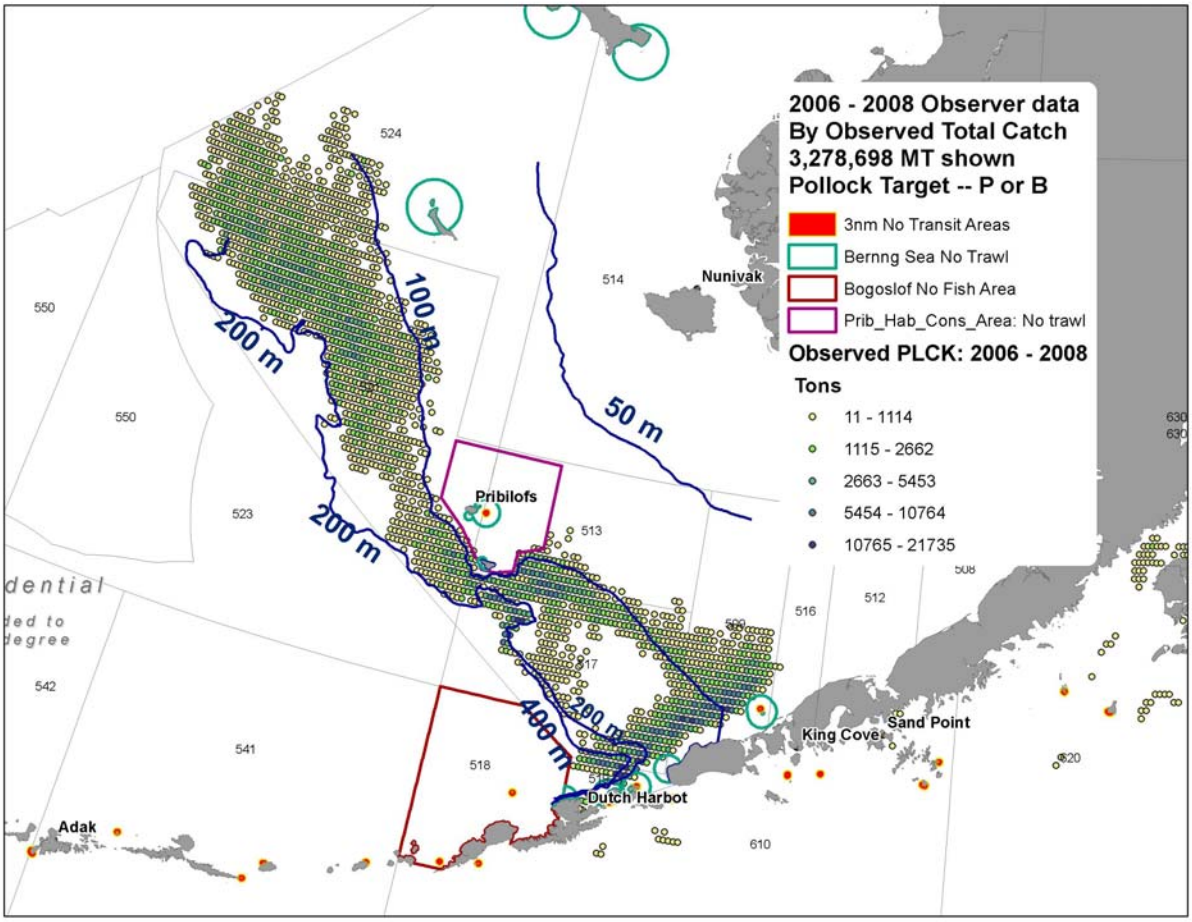

Fig. 8-6 2006-2008 Observed pollock harvest and bathymetry of the Bering Sea (Steve Lewis, NMFS Analytical Team, October 5, 2008)

Sperm whales are not likely to be affected by any potential impacts on the benthic habitat from pollock fishing because they generally occur in deeper waters than where the pollock fishery is conducted (Table 8-8 and Fig. 8-6). Harbor seals also are less likely to have any benthic habitat affected by the pollock fishery because they occur primarily along the coast where pollock fishing is not conducted. Pacific walrus are unlikely to have benthic habitat affected by the pollock fishery because they occur in shelf waters to the west of slope and out of the area where pollock fishing occurs. Beluga whales are not likely to have benthic habitat supporting prey species affected by the pollock fishery because they generally dive shallower than the locations where pollock fishing occurs. The pollock fishery in the SE Bering Sea occurs in an area between 100 m and 50 m deep which may overlap with a portion of gray whale feeding area. Gray whales feed primarily in the northern and western area of the Bering and Chukchi Seas in the summer toward St. Lawrence Island after traveling along the coast past Nunivak Island (http://www.adfg.state.ak.us/pubs/notebook/marine/gray.php). Pollock fishing is not likely to have much of an impact on gray whales considering the extensive area of the Bering Sea under 60 m depth that is not fished for pollock and the areas of pollock fishing compared to the areas of gray whale migration and feeding.

Ice seals are most likely of the marine mammals listed in Table 8-7 to potentially have benthic prey affected by the pollock fishery because of their overlap with the pollock fishery location and depth for diving. Ice seals use ice in areas of the Bering Sea where fishing is conducted during ice free conditions. It is not know what the affects of the pollock fishing may be on the benthic habitat supporting prey and the recovery time for the prey species. Bearded seals have been incidentally taken in area 524 by the pollock fishery (Table 8-5) and may use benthic habitat for feeding in locations where pollock fishing have occurred. Ribbon and spotted seals are probably less likely to be affected by any benthic prey disturbance compared to the other ice seals due to pollock being their primary prey.

8.1.5.1 Alternative 1: Status Quo

The Alaska Groundfish Harvest Specifications EIS determined that competition for key prey species under the status quo fishery is not likely to constrain foraging success of marine mammal species or cause population declines (NMFS 2007a). The exceptions to this are northern fur seals and Steller sea lions which potentially compete for principal prey with the groundfish fisheries (NMFS 2001, 2007b). The introduction to this section reviewed the marine mammal species prey and the potential impacts of the pollock fishery on benthic habitat that support marine mammal prey. Ice seals were the only species that may depend on benthic habitat for prey that could be potentially impacted by the pollock fishery. The following provides additional information regarding Steller sea lions and northern fur seals potential competitions with the pollock fishery.

Northern Fur Seals

The Northern Fur Seal Conservation Plan recommends gathering information on the effects of the fisheries on fur sea prey, including measuring and modeling effects of fishing on prey (both commercial and noncommercial) composition, distribution, abundance, and schooling behavior, and evaluate existing fisheries closures and protected areas (NMFS 2007b). The Alaska Groundfish Harvest Specifications EIS analyzed the effects of the groundfish fisheries on fur seal prey (Section 8.3.2 of NMFS 2007a). The EIS for the annual subsistence harvest of fur seals determined that the groundfish fisheries in combination with the subsistence harvest may have a conditional cumulative effect on prey availability if the fisheries were to become further concentrated spatially or temporally in fur seal habitat, especially during June through August (NMFS 2005b).

Migration of fur seals is described in detail in the Conservation Plan for the Eastern Pacific stock of Northern Fur Seal (NMFS 2007b). Northern fur seals begin to return to the breeding islands from their pelagic winter foraging in the spring of each year. Adult males arrive first and establish territories on the breeding rookeries. On the Pribilof Islands they arrive in descending order by age, beginning in early May. The youngest males may not return to the breeding areas until mid-August or later. Some yearlings arrive as late as September or October; however, most remain at sea. The older pregnant females arrive about mid-June; the peak of pupping occurs in early July. Pups leave the islands in early November after the older animals have left. Fur seals migrate during early winter through the Eastern Aleutian Islands into the North Pacific Ocean then into the waters off the coasts of British Columbia, Washington, Oregon, and California.

Based on scat sampling of female fur seals in July through September, the hydrographic domains for salmon prey include inner, middle, and outer shelves; and the oceanic domain (Zeppelin and Ream 2006 and Fig. 8-7). Female fur seal foraging locations are dependent on the rookery location for animals using St. George and St. Paul Island rookeries (Zeppelin and Ream 2006). Fur seals from St. George appear to be more dependent on salmon than fur seals from St. Paul. Frequency of occurrence of salmon in scat samples from St. George is 10 to 19% of the samples, while salmon occurs in 3% to 12% of the samples from St. Paul, with only 2 of the 11 rookeries sampled having more than 10% frequency of occurrence (Zeppelin and Ream 2006). Because of this site specific salmon foraging behavior, any harvest of salmon by the pollock fishery that may compete with female fur seals is likely to have more of an impact on fur seals using St. George Island rookeries compared to fur seals using St. Paul Island. Competition with the pollock fishery is less likely for females using the Bogoslof Island rookery as these animals eat primarily squid and northern smooth tongue and are less likely to take foraging trips outside of the Bogoslof Foraging Area closure for the pollock fishery (Rolf Ream, NMML, pers. comm., September 26, 2008).

For northern fur seals, pollock is particularly important around the Pribilof Islands and other inshore areas from July to September and is their principal prey species based on scat and spew analyses (NMFS 2007b; Gundmundson et al. 2006; Zeppelin and Ream 2006). Adult pollock were most frequently found in the stomachs of fur seals collected over the outer domain of the continental shelf, while juvenile pollock were found in seals collected both over the midshelf and outer domain (NMFS 2005b) (Fig. 8-7). Based on female fur seal scat samples from St. George and St. Paul Islands, pollock prey for fur seals from July through September come from the hydrographic domains of the middle and outer shelf regions (Zeppelin and Ream 2006). Pollock occurred in 64% to 84% of the fur seal scat samples from St. Paul Island, and in 43% to 70% of the samples from St. George Island (Zeppelin and Ream 2006). In the summer of 1999 and 2000, spew samples from St. George showed a frequency of occurrence for pollock in 36.8% of the samples compared to 60% occurrence in the scat samples (Gudmundson et al. 2006). No difference was seen for the frequencies of occurrence for pollock in scat and spew samples from St. Paul Island which were both around 70%.

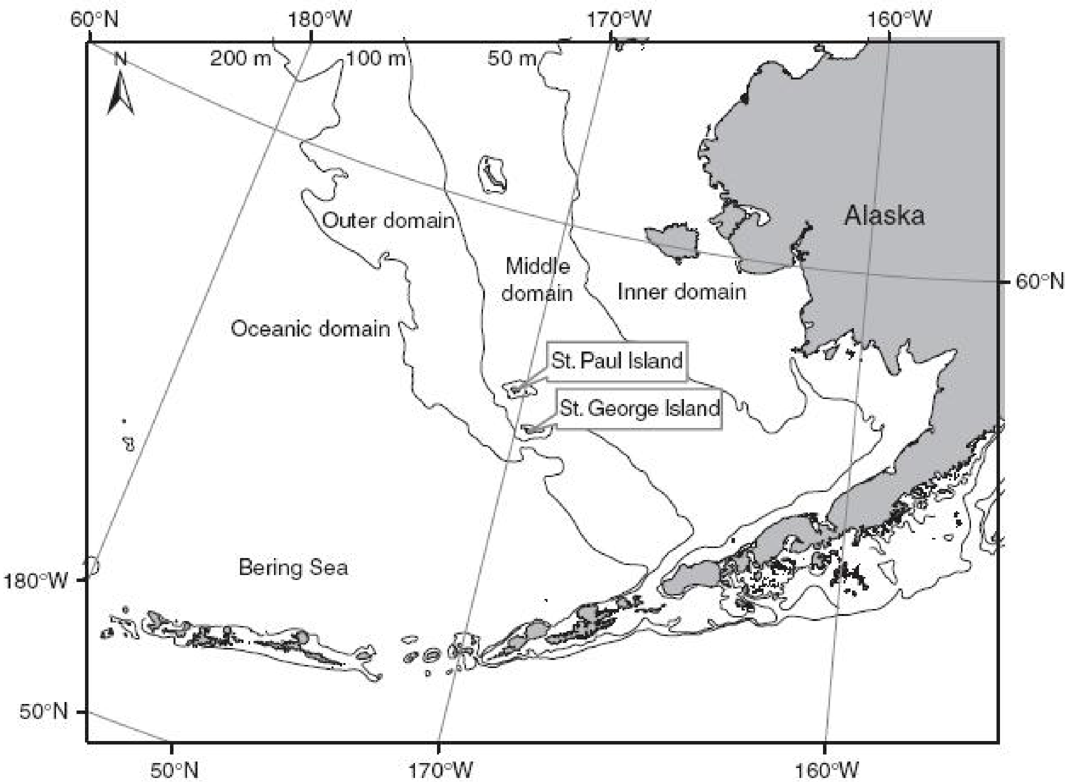

Fig. 8-7 Bering Sea Hydrographic Domains. Represents the Bering Sea areas where fur seal prey may occur (Zeppelin and Ream 2006)

Lactating female fur seals from St. Paul Island dispersed in all directions except southeast where females from St. George Island foraged (Robson 2001). Harvesting pollock near these locations when nursing females are not able to forage at locations where pollock has not been removed by commercial fishing may have an effect on the reproductive capability and possibly the population.

Fur seal use of pelagic habitat across years or seasons is not clearly understood, but is beginning to be investigated (NMFS 2007b). The subpolar continental shelf and shelf break from the Bering Sea to California are known feeding grounds for fur seals while at sea. It has been suggested that the highest fur seal densities in the open ocean occur in association with major oceanographic frontal features such as sea mounts, valleys, canyons, and along the continental shelf break (Lander and Kajimura 1982; Kajimura 1984; Loughlin et al. 1999). This area overlaps with the location of the pollock fishery (Fig. 8-7).

Steller sea lions

Analysis of diet data for Steller sea lions in the Bering Sea includes scats collected at haulouts and rookeries along the eastern portion of the Aleutian Island chain and Bogoslof/Fire Island. Pollock appear to be a major component of the Steller sea lion diet for animals using Bogoslof/Fire Island and the Akutan sites, present in 54% of the samples collected in the summer and 59% winter samples (Sinclair and Zeppelin 2002). Based on diet analysis, Steller sea lions at Akutan sites appear to depend on pollock more in the winter than the summer (Fig. 3 in Trites et al. 2007). No Steller sea lion diet analysis is available from haulouts in the northern Bering Sea. Pollock occurred in more than 36% of the stomach samples taken from Steller sea lion on the Pribilof Islands in the 1980s (NMFS 2008). Pollock occurred in 100% of the samples from Steller sea lions taken at sea in the winter of 1981 in an area between the Pribilof and St. Matthew Islands (Caulkins 1998).

Sea lions eat salmon primarily in May where salmon congregate for migration (Lowell Fritz, National Marine Mammals Laboratory, pers. comm. February 14, 2008). Diet analysis from the Akutan area indicated that Steller sea lions may be more dependent on salmon in the summer than in the winter (Fig. 3 in Trites et al. 2007). Scat and spew samples of fur seals collected between July and September on St. George and St. Paul Islands show salmon as part of the diet (Gudmundson et al. 2006; and Zeppelin and Ream 2006). Spew samples show a greater frequency of occurrence of salmon than scat samples for both islands (Gudmundson et al. 2006) so the use of scat samples for salmon occurrence in fur seals may underestimate the importance of salmon for prey.

Other direct impacts on marine mammal prey

Killer whales eat salmon that are migrating to spawning streams in nearshore waters (NMFS 2004). The impact of the pollock fishery on prey for resident killer whales would be only in the interception of salmon that would have been eaten by killer whales. Data to determine this is not available.

Spotted seals forage on pelagic fish and nearshore species, including pollock and salmon. Sampling of spotted seals in the Bering Sea coastal area in September through October showed salmon in the diet (Lowry et al. 2000). Juvenile pollock are important prey species for ribbon seals. Pollock occurred in approximately 80% of the scat samples collected from ribbon seals in 2006 and 2007 (Ziel et al. 2008). Juvenile pollock are also important prey species for spotted seals. Pollock occurred in approximately 40% of the scat samples collected from spotted seals in 2006 and 2007 (Ziel et al. 2008).

Of the ice seals, ribbon seals appear to be more dependent on pollock and may be directly impacted by pollock harvests in locations where ribbon seals may forage during summer months. Bearded seals feed primarily on benthic invertebrates (Lowry et al. 1980a) and schooling fish and invertebrates in the vicinity of St. Matthew Island (Antonelis et al. 1994). Ringed seals eat primarily Arctic and saffron cod and epibenthic and pelagic crustaceans (Lowry et al. 1980b).

Beluga whales are not likely to compete with the pollock fishery for pollock because their occurrence does not overlap with pollock fishery locations (Fig. 8-7 and Table 8-7). Any competition with the pollock fishery for salmon would depend on the stream where beluga may feed and the interception of salmon that would have returned to that stream. Data are not available to evaluate this. Even though the pollock fishery takes Cook Inlet salmon as bycatch, it is not likely the number of salmon taken under the alternatives would have a measurable effect on Cook Inlet beluga whales. As shown in Table 5-48 through Table 5-52, the AEQs for Cook Inlet Chinook salmon taken in the pollock fishery range from 431 fish in 2003 to 1,639 fish in 2007, the historically highest bycatch year. The overall returns of Chinook salmon are in the thousands of fish based on the number of river systems in the inlet with Chinook salmon runs. Because the AEQs of Chinook salmon taken in the Bering Sea pollock fishery are likely a small proportion of overall Cook Inlet Chinook salmon returns, it is not likely that the Chinook salmon bycatch in the Bering Sea pollock fishery would have a measurable effect on prey availability for Cook Inlet beluga whales.

Minke, fin, and humpback whales potentially compete with the pollock fishery for pollock because of the overlap of their occurrence with the location of the pollock fishery in the Bering Sea. Fin and humpback whales have a more diverse diet than minke whales and therefore may have less potential to be affected by any competition (Table 8-6). An area of overlap for feeding humpback whale stocks occurs in the southeastern Bering Sea where the pollock fishery occurs (Fig. 8-3). This overlap in stocks and pollock fishing increases the potential for prey competition between humpback whale stocks and the pollock fishery. The area of distribution and surveys for fin whales is in the same slope area as the pollock fishery, which may lead to more potential for competition for pollock (Fig. 8-2).

8.1.5.2 Alternative 2: Hard Caps

A hard cap on the amount of salmon taken in the pollock fishery could benefit Steller sea lions, resident killer whales, spotted seals, ribbon seals, and northern fur seals if the cap prevents harvest of salmon and pollock that these species prey upon. If the hard cap results in additional fishing effort in less productive pollock areas with less salmon bycatch, the shifting of the fleet may allow for additional pollock being available as prey in those areas where salmon is concentrated, if these areas are also used by Steller sea lions, spotted seals, ribbon seals, and northern fur seals for foraging. The higher hard cap would be less constraining on the fishery and would likely result in effects on prey availability similar to the status quo. Lower hard caps would be more constraining on the fishery, making more salmon available for prey for Steller sea lions, northern fur seals, spotted seals, and resident killer whales, and may allow for more pollock prey if the fishery is closed before reaching its pollock TAC.

The more restrictive caps may result in smaller pollock being taken by the pollock fishery, as described in Chapter 4. It is not clear how much smaller the pollock would be. Since 2003, the pollock fishery tends to harvest pollock that are less than 60 cm and greater than 30 cm in the Bering Sea (NPFMC 2007). Steller sea lions and northern fur seals tend to prey on whatever size of pollock is most abundant at the time of foraging (Fritz et al. 1995). In years with one or more large recently spawned year classes, Steller sea lions and fur seals consume primarily juvenile pollock (Pitcher 1981, Calkins 1998, Zeppelin et al. 2004, and Sinclair et al. 1994). As large year classes of pollock age and grow, they will continue to be targeted by sea lions and fur seals particularly if the size of subsequent year classes is small. As a consequence, overlap between fisheries (that generally take large pollock) and pinnipeds in the size of pollock consumed will change depending on the age structure of pollock. Juvenile Steller sea lions are more likely to successfully forage on smaller rather than larger pollock. Taking smaller pollock may increase the potential for the fishery to compete with juvenile Steller sea lions for pollock, and may increase the estimated overlap between the fishery and juvenile Steller sea lions for pollock prey size. Whether competition would occur depends on the abundance of the size of prey targeted by the sea lions. Steller sea lions tend to prey more on juvenile pollock in the summer on haulouts than in the winter or in the summer on rookeries (Zeppelin et al. 2004). For the year of data analyzed, the overlap between the size of pollock taken in the fishery and those used as prey by Steller sea lions in the winter and summer is 56% and 61%, respectively (Zeppelin et al. 2004). Harvesting smaller pollock in the early B season may have more of a potential for competition for juvenile Steller sea lions using haulouts in the summer compared to animals at rookeries and in the winter.

All pollock recovered from the scat sampling for spotted and ribbon seals in 2006 and 2007 were well below 20 cm in length (range 5-22.7 cm) (Ziel et al. 2008). It is not clear if this size of pollock was eaten because it was the size that could easily be captured or it was the most abundant size available for foraging. It is not likely the shifting of the pollock fishery to smaller fish would result in fish less than 20 cm in length being taken and therefore, competition with ribbon and spotted seals is not likely if they are targeting these smaller fish, regardless of abundance.

The options for sector allocations, sector transfers, and cooperative provisions affect the management and distribution of the cap across the sectors and are not likely to have any overall effect on pollock fishing that would change the potential competition for prey species between the pollock fishery and marine mammals. Options that allocate more Chinook salmon bycatch to the CV sector compared to the offshore sector would result in more harvest of pollock in the southern part of the Bering Sea where more Steller sea lions are located compared to the northern Bering Sea where northern fur seals and spotted seals may be foraging. This may result in more potential for competition for salmon and pollock prey for Steller sea lions than for northern fur seals or spotted seals. The Steller sea lion protection measures were designed to mitigate competition between the fisheries and Steller sea lions. This may reduce any potential for increased competition for prey if allocating higher portions of the salmon caps to the CV sector would result in more fishing in the southern Bering Sea.

8.1.5.3 Alternative 3: Triggered Closures

A pollock fishery closure of an area where Steller sea lions, humpback whales, spotted seals, or northern fur seals are likely to compete with pollock fishing vessels would likely reduce the potential for competition for prey resources (pollock and salmon). Occurrences of fin and minke whales are more widespread in the Bering Sea and therefore, they are less likely to be affected by the triggered closures. The potential reduction in competition would depend on the foraging locations and prey species for Steller sea lions, humpback whales, spotted seals, and northern fur seals and on the timing of the foraging activity and fishing. The closures proposed for the A season would likely shift the fleet north into areas that may contain spotted and northern fur seal prey (pollock and salmon for northern fur sea and pollock for spotted seals). The closures in the B season in the northern portion of the Bering Sea may provide some protection of salmon prey resources for fur seals from St. George Island which are more likely to forage for salmon in these northern areas compared to fur seals from St. Paul. St Paul fur seals forage more on the continental shelf than fur seals from St. George and appear to have less dependence on salmon (Zeppelin and Ream 2006). Limited sampling from spotted seals indicates that the salmon prey used is located primarily along the coast in September and October. Pollock is used by spotted seals in the Central and southern Bering Sea (CBD 2008a) and the humpback whale feeding area is located in the southeastern Bering Sea so both A season and B season closures would potentially protect pollock prey for spotted seals and humpback whales.

Based on stomach samples collected in the 1980s, Steller sea lions may not depend on salmon as prey in the areas of the Pribilof Islands and northern Bering Sea (NMFS 2008). No salmon was detected in stomach samples from these areas. Steller sea lions appear to use salmon resources in the southern portion of the Bering Sea based on scat sampling near Akutan and Bogoslof Island (Fig. 3 in Trites et al. 2007). The triggered closure in the southern portion of the Bering Sea is more likely to benefit Steller sea lions in the summer by protecting both pollock and salmon resources in this area. Salmon area closures in the northern portion of the Bering Sea during the B season is not likely to have any effect on salmon prey resources for Steller sea lions and spotted seals, because there is no evidence of the sea lions or spotted seals eating salmon in the northern portion of the Bering Sea.

For fur seals, spotted seals, and Steller sea lions, closing the salmon areas in the northern portion of the Bering Sea in the B season may only provide a localized benefit for reducing competition for pollock in the closure area. The overall availability of pollock as prey is not likely to change given the existing closure areas and the pollock fleet's likely ability to still harvest its TAC. As previously mentioned from NMFS (2005b), shifting of the pollock fishery northward with the closure of the southern area of the Bering Sea may be more of a concern in the B season as more harvest is likely to take place in the area where fur seals are likely to forage.

8.1.5.4 Alternatives 4 and 5

Alternatives 4 and 5 would have similar effects on the harvest of prey species as Alternative 2. Overall less prey may be harvested if 47,591 Chinook salmon cap is implemented, resulting in less competition for prey with marine mammals. Under the 68,392 or 60,000 Chinook salmon caps, the CV sector would likely fish more in the southern portion of the Bering Sea, reducing the potential for competition with spotted seals and northern fur seals. Competition between the CV sector in the southern portion of the Bering Sea with Steller sea lions may be mitigated by the Steller sea lion protection measures and for any humpback whales that may feed in the closure area. The 47,591 Chinook salmon cap may increase the potential for competition for pollock among the offshore CP fleet and northern fur seals and spotted seals and for salmon between the fleet and northern fur seals primarily from St. George Island and to a lesser extant from St. Paul Island compared to the 47,591 Chinook salmon cap or the backstop cap under either alternative.

8.1.6 Disturbance Effects

8.1.6.1 Alternative 1: Status Quo

The Alaska Groundfish Harvest Specifications EIS analyzed the potential disturbance of marine mammals by the groundfish fisheries (Section 8.3.3 of NMFS 2007a). The EIS concluded that the status quo fishery does not cause disturbance to marine mammals that may cause population level effects, and fishery closures exist to limit the potential interaction between the fishing vessels and marine mammals.

8.1.6.2 Alternative 2: Hard Cap

The effects on the disturbance of marine mammals by the proposed hard caps would be similar to the effects of these hard caps on the potential for incidental takes. If the pollock fishery reduces fishing activity because of reaching a hard cap, then less potential exists for disturbance of marine mammals. If the pollock fishery increases the duration of fishing in areas with lower concentrations of pollock to avoid areas of high salmon bycatch, there may be more potential for disturbance if this increased fishing activity overlaps with areas used by marine mammals. Fishing under the higher hard cap is likely similar to status quo because it is less constraining than fishing under the lower caps and less likely to cause a change in fishing activities.

Seasonal distribution of the hard cap may impact the potential for disturbance of marine mammals depending on the seasonal distribution of the marine mammals and the overlap with fishing activities. The lower caps may reduce the potential for seasonal disturbance if less fishing occurs when the cap is reached and the fishery closes. If the fleet is moving to less productive pollock areas to avoid salmon bycatch, more fishing may occur where marine mammals are located; and therefore, the seasonal cap may not reduce the potential for disturbance during that season.

8.1.6.3 Alternative 3: Triggered Closures

The potential effects of the trigger closures depend on the presence of marine mammals in the closure area and the timing of the closure. The Bering Sea harbor seal stock is not likely to occur in most of the areas proposed for closure; and therefore, is not likely to be disturbed by the pollock fishery restrictions in these areas. The Gulf of Alaska stock of harbor seals may cross over into the Bering Sea within the southern waters and may experience less potential for disturbance if the salmon area closures occur in either the A or B season.

The A and B season closures would include portions of waters south of St. George Island, which are currently open to pollock fishing, exclusive of the Steller sea lion protection areas and the Pribilof Island Area Habitat Conservation Zone. Closure of these waters would reduce the potential for disturbance of Steller sea lions and fur seals located at St. George Island that may use waters south of St. George. The northern areas of the B season closures may reduce the potential for disturbance by pollock fishing vessels of northern fur seals in these closure areas.

The salmon closure for the A season and the southern portion of the salmon closures for the B season overlap with a portion of North Pacific right whale designated critical habitat (73 FR 19000, April 8, 2008 and Fig. 8-4). Any spring or summer closures of these areas that overlap with the right whale critical habitat may reduce the potential for disturbance from pollock fishing vessels to foraging whales.

Salmon area closures in the southern portion of the Bering Sea during the A and B seasons also may be beneficial to humpback whales and fin whales. If the southern portion of the salmon closure is triggered, pollock fishing vessels would not be present in the portion of this salmon closure area that overlaps with the humpback whale feeding area, therefore reducing the potential for disturbance of foraging humpback whales. The benefit is likely only during the summer when whales are likely to be foraging in the southern portion of the Bering Sea (Fig. 8-2). The A season closure and closure of the southern portion of the B season salmon closure areas appear to overlap with the central eastern Bering sea area where higher concentrations of fin whale were seen. These closures are likely to overlap with locations where larger numbers of fin whales have been seen on the shelf break; and therefore, may reduce the potential for pollock fishing vessel to disturb fin whales if the closures occur at the same time that fin whales are likely to be in these closure areas.

All the ice seals occur in the northern portion of the Bering Sea where the B season salmon closures would occur and may experience less potential for disturbance if the pollock fishery is closed out of these salmon closure areas at the same time ice seals may be present. Ribbon and spotted seals are more widely distributed in the Bering Sea and may experience less potential for disturbance by pollock fishing vessels if they occur in any of the salmon closure area when the pollock fishery is prohibited. Ribbon seals likely migrate into the Chukchi Sea in summer (Angliss and Outlaw 2008). Bearded and ringed seals are located in the northern portion of the Bering Sea (Angliss and Outlaw 2007), outside of the A season closure area and the B season southern closure area. Ringed seals remain in contact with the ice most of the year (Angliss and Outlaw 2007). Because of their distribution, the salmon area closures in the southern portion of the Bering Sea are not as likely to have an effect on bearded, ringed, and ribbon seals. These stocks may benefit from the northern closures in the B season by potentially less disturbance from pollock vessels where the closures occur and these seals may be present. Bearded, ribbon, and ringed seals are not likely to occur in the A season closure area or the southern portion of the B season closure area and are therefore not likely to be affected by these portions of salmon closures under Alternative 3.

During spring, spotted seals tend to prefer small ice floes (i.e., < 20 m in diameter), and inhabit mainly the southern margin of the ice, with movement to coastal habitats after the retreat of the sea ice (Fay 1974, Shaughnessy and Fay 1977, Simpkins et al. 2003). In summer and fall, spotted seals use coastal haulouts regularly, and may be found as far north as 69-72 degrees N latitude in the Chukchi and Beaufort Seas (Porsild 1945, Shaughnessy and Fay 1977). To the south, along the west coast of Alaska, spotted seals are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands (Angliss and Outlaw 2007). Spotted seals may occur in all of the areas considered for closing under Alternative 3 and may have less potential for disturbance by pollock fishing vessels if they occur in these areas when the pollock fishery is prohibited.

Dall's porpoise have been encountered by the pollock fishery mostly in the northern shelf break area of the Bering Sea (Table 8-5) and therefore are more likely to be affected by closures in the northern portion of the Bering Sea during the B season. If Dall's porpoise occur in these closure areas, then prohibiting the pollock fishery in the salmon closure areas under Alternative 3 may reduce the potential for disturbance.

Minke and killer whales occurring in the closure areas would have less potential for disturbance when the pollock fishery is prohibited in these areas. No information exists to understand any potential spatial or temporal nature of disturbance impacts on individual stocks for these species.

Humpback whales that use the feeding area in the southern portion of the Bering Sea may have less potential for disturbance by pollock vessels during the A season and B season closures. The A season and the southern portion of the B season closure areas under Alternative 3 overlap with the North Pacific feeding area identified in Fig. 8-2.

Fin whales appear to gather in the northern portion of the Bering Sea, overlapping with the B season salmon area closures (Fig. 8-1). Fin whales occurring in this northern area may encounter less disturbance by pollock fishing vessels if the whales are present in the closure areas when the pollock fishery is prohibited. The potential benefit to the stock of less disturbance is likely greater for whales in this northern area compared to whales in the southern portion of the Bering Sea, where they are less numerous (Angliss and Outlaw 2008).

Options that result in lower triggers for salmon area closures are more likely to result in less potential for disturbance of marine mammals in the closure areas than options with higher triggers.

8.1.6.4 Alternatives 4 and 5

The impacts of Alternatives 4 and 5 on the disturbance of marine mammals is similar to the impacts of Alternative 2. The 68,591 or 60,000 Chinook salmon high cap would allow for more pollock fishing than the 47,591 Chinook salmon cap and may result in more potential for disturbance if marine mammals are present in the locations where pollock fishing is occurring. The 47,591 Chinook salmon cap would likely result in less pollock fishing and less potential for disturbance of marine mammals.

8.1.7 Consideration of Future Actions

The following reasonably foreseeable future actions may have a continuing, additive, and meaningful relationship to the effects of the alternatives on marine mammals. Some of these actions are broadly based on the potential changes to the groundfish fisheries that may result in impacts on marine mammals. These actions are described in Chapter 3.

8.1.7.1 Ecosystem-sensitive management

Increased attention to ecosystem-sensitive management is likely to lead to more consideration for the impact of the pollock fishery on marine mammals and more efforts to ensure the ecosystem structure that marine mammals depend on is maintained, including prey availability. Increasing the potential for observers collecting information on marine mammals and groundfish fisheries interaction, and any take reduction plans, may lead to less incidental take and interaction with the groundfish fisheries, thus reducing the adverse effects of the groundfish fisheries on marine mammals.

Changes in the status of species listed under the ESA, the addition of new listed species or critical habitat, and results of future Section 7 consultations may require modifications to groundfish fishing practices to reduce the impacts of these fisheries on listed species and critical habitat. Listing any of the ice seals and designating critical habitat would require Section 7 consultation for the groundfish fisheries to determine if they are likely to adversely affect the listed species or designated critical habitat. Change to the fisheries may be required if it is determined that the fishery may pose jeopardy or adverse modification or destruction of critical habitat. Fishery measures would be needed to reduce that potential harm.

Modifications to Steller sea lion protection measures will result in Section 7 consultations. These changes may be a result of recommendations by the Council based on a review of the current protection measures, potential State actions, or recommendations from the draft FMP-level biological opinion which is scheduled for release in late 2009. Any change in protection measures likely would have insignificant effects because any changes would be unlikely to result in the PBR being exceeded and would not be likely to result in jeopardy of extinction or adverse modification or destruction of designated critical habitat.

Improved management of fur seals may result from the Council's formation of the Fur Seal Committee, and the continued development of information regarding groundfish fishery interactions and fur seals. The timing and nature of potential future protection measures for fur seals are unknown, but any action is likely to reduce the adverse effects of the groundfish fisheries on fur seals.

The ongoing research efforts described in the Consideration of Future Actions section of Chapter 3 is likely to improve our understanding of the interactions between the harvest of pollock and salmon and the impacts on marine mammals in the Bering Sea. NMFS is conducting or participating in several research projects summarized in Chapter 3 which include understanding the ecosystems, fisheries interactions, and gear modifications to reduce salmon bycatch. These projects will allow NMFS to better understand the potential impacts of commercial fisheries, the potential for reducing salmon bycatch, and the Bering Sea ecosystem. The results of the research will be useful in managing the fisheries with ecosystem considerations and is likely to result in reducing potential effects on marine mammals.

The implementation of the Arctic fishery management plan will provide protection to those marine mammals that use Arctic and Bering Sea waters, such as ice seals. The plan initially prohibits commercial fishing in the Arctic Management Area until information is available to sustainably manage the fishery. Once implementing regulations are effective in 2010, no commercial fishing in either the Chukchi or Beaufort Seas would prevent the potential for incidental takes, disturbance or competition for prey species between fishing vessels and marine mammals.

8.1.7.2 Traditional management tools

The cumulative impact of the annual harvest specifications in combination with future harvest specifications may have lasting effects on marine mammals. However, as long as future incidental takes remain at or below the PBR, the stocks will still be able to reach or maintain their optimal sustainable population. Additionally, since future TACs will be set with existing or enhanced protection measures, it is reasonable to assume that the effects of the fishery on the harvest of prey species and disturbance will likely decrease in future years. Improved monitoring and enforcement through the use of technology would improve the effectiveness of existing and future marine mammal protection measures by ensuring the fleet complies with the protection measures, and thus, reducing the adverse impacts of the alternatives.

8.1.7.3 Actions by other Federal, State, and International Agencies

Expansion of State pollock or Pacific cod fisheries may increase the potential for effects on marine mammals. However, due to ESA requirements, any expansion of State groundfish fisheries may result in reductions in Federal groundfish fisheries to ensure that the total removals of these species do not jeopardize any ESA-listed species or adversely modify designated critical habitat, including Steller sea lion critical habitat.

State management of the salmon fisheries of Alaska will continue into the future. The State's first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Subsistence use is the highest priority use under both State and Federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses, such as commercial and sport harvests. The State carefully monitors the status of salmon stocks returning to Alaska streams and controls fishing pressure on these stocks. Even though prey availability is not accounted for in the setting of salmon harvest levels, the management of salmon stocks effectively maintains healthy populations of salmon where possible and may provide sufficient prey availability to marine mammals.

Incidental takes of Steller sea lions and other marine mammals occur in the State managed set and drift gillnet, troll, and purse seine salmon fisheries (72 FR 66048, November 27, 2007). Marine mammal species taken in the State-managed fisheries and also the pollock fishery are in Table 8-8.

Table 8-8 Marine Mammals Taken in State-Managed and Federal Pollock Fisheries

Marine Mammal Stocks Taken in State Managed and Federal Pollock Fishery#	State Fisheries mean annual mortality*
Dall's porpoise	28
Harbor seal, Bering Sea	0
Steller sea lions, western	14.5
Humpback whale western and central stocks	2.0
Spotted seal	0

*Angliss and Outlaw 2008
#LOF 72 FR 66048, November 27, 2007

The mortalities listed in Table 8-8 are included in the total mean annual human caused mortalities in Table 8-4. The combination of the incidental takes in the pollock fishery with takes in the State-managed fisheries for these species is either well below the PBR or a small portion of the total mean annual human caused mortality for species which PBR is not determined. It is not likely that any of the alternatives or options would change the pollock fishery in a manner that would greatly increase the overall incidental takes of these marine mammals to where either the PBR would be exceeded or the proportion of fishery mortality in the total mean annual human caused mortality would greatly change.

8.1.7.4 Private actions

Subsistence harvest is the primary source of direct mortality for many species of marine mammals. Current levels of subsistence harvests, reflected in column 3 of Table 8-4, are controlled only for fur seals. Subsistence harvest information is collected for other marine mammals and considered in the stock assessment reports. It is unknown how rates of subsistence harvests of marine mammals may change in the future.

Other factors that may impact marine mammals include continued commercial fishing; non-fishing commercial, recreational, and military vessel traffic in Alaskan waters; oil and gas exploration; seismic surveying; and tourism and population growth that may impact the coastal zone. Little is known about the impacts of these activities on marine mammals in the BSAI. However, Alaska's coasts are currently relatively lightly developed, compared to coastal regions elsewhere. Despite the likelihood of localized impacts, the overall impact of these activities on marine mammal populations is expected to be modest.

8.1.7.5 Conclusions

The continuing fishing activity and continued subsistence harvest are potentially the most important sources of additional annual adverse impacts on marine mammals. Both of these activities are monitored and are not expected to increase beyond the PBRs for most marine mammals. The extent of the fishery impacts would depend on the size of the fisheries, the protection measures in place, and the level of interactions between the fisheries and marine mammals. However, a number of factors will tend to reduce the impacts of fishing activity on marine mammals in the future, most importantly ecosystem management. Ecosystem-sensitive management and institutionalization of ecosystem considerations into fisheries governance are likely to increase our understanding of marine mammal populations and interactions with fisheries. The effects of actions of other Federal, State, and international agencies are likely to be less important when compared to the direct interaction of the commercial fisheries, subsistence harvests, and marine mammals.

8.2 Seabirds

8.2.1 Seabird Resources in the Bering Sea

Thirty-eight species of seabirds breed in Alaska. There are approximately 1,800 seabird colonies in Alaska, ranging in size from a few pairs to 3.5 million birds. The U.S. Fish and Wildlife Service (USFWS) is the lead federal agency for managing and conserving seabirds and is responsible for monitoring the distribution and abundance of populations. Twelve sites along the coastline of Alaska are scheduled for annual monitoring, and additional sites are monitored every three years. Breeding populations are estimated to contain 36 million individual birds in the Bering Sea, and total population size (including subadults and nonbreeders) is estimated to be approximately 30% higher. Five additional species that breed elsewhere but occur in Alaskan waters during the summer months contribute another 30 million birds. The USFWS Beringian Seabird Colony Catalog (2004) represents the location, population size, and species composition for each colony based on the most recent information available (Fig. 8-5). These population estimates are based on opportunistic surveys of colonies, and may rely on historical information at some locations (Stephensen, pers. com.). Colonies in the Bering Sea include large numbers of cormorants, murres, puffins, auklets, black-legged kittiwakes, and gulls.

Table 8-9 Seabird species in the BSAI (NMFS 2004)

Albatrosses - Black-footed, Short-tailed, Laysan
Northern fulmar
Shearwaters - Short-tailed, Sooty
Storm petrels - Leach’s, Fork-tailed
Cormorants - Pelagic, Red-faced, Double-crested
Gulls - Glaucous-winged, Glaucous, Herring. Mew, Bonaparte’s Sabine, Ivory
Murres - Common, Thick-billed
Jaegers - Long-tailed, Parasitic, Pomarine
Guillemots - Black, Pigeon
Eiders - Common, King, Spectacled, Steller’s
Murrelets - Marbled, Kittlitz’s, Ancient
Kittiwakes - Black-legged, Red-legged
Auklets - Cassin’s, Parakeet, Least, Whiskered, Crested
Terns - Arctic, Aleutian
Puffins - Rhinoceros, Horned, Tufted

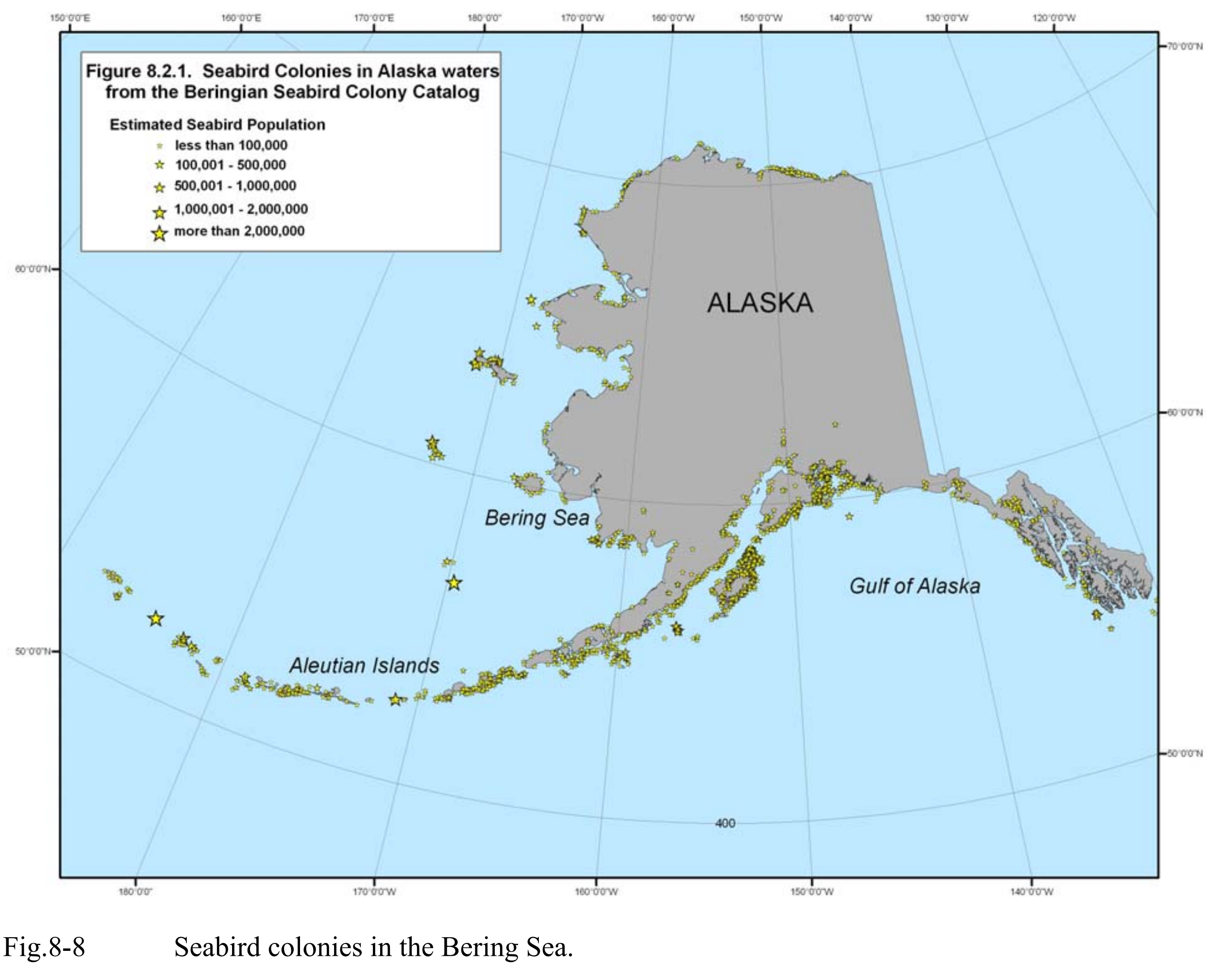

Fig.8-8 Seabird colonies in the Bering Sea.

As noted in the PSEIS, seabird life history includes low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity. These traits make seabird populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort. The problem with attributing population changes to specific impacts is that, because seabirds are long-lived animals, it may take years or decades before relatively small changes in survival rates result in observable impacts on the breeding population. Moloney et al (1994) estimated a 5- to 10-year lag time in detecting a breeding population decline from modeled hook-and-line incidental take of juvenile wandering albatross, and a 30- to 50-year population stabilization period after conservation measures were put in place.

More information on seabirds in Alaska's EEZ may be found in several NMFS, Council, and USFWS documents:

- The URL for the USFWS Migratory Bird Management program is at: http://alaska.fws.gov/mbsp/mbm/index.htm
- Section 3.7 of the PSEIS (NMFS 2004a) provides background on seabirds in the action area and their interactions with the fisheries. This may be accessed at http://www.fakr.noaa.gov/sustainablefisheries/seis/final062004/Chaps/chpt_3/chpt_3_7.pdf
- The annual Ecosystems Considerations chapter of the SAFE reports has a chapter on seabirds. Back issues of the Ecosystem SAFE reports may be accessed at http://www.afsc.noaa.gov/REFM/REEM/Assess/Default.htm.
- The Seabird Fishery Interaction Research webpage of the Alaska Fisheries Science Center: http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm
- The NMFS Alaska Region's Seabird Incidental Take Reduction webpage: http://www.fakr.noaa.gov/protectedresources/seabirds.html
- The BSAI and GOA Groundfish FMPs each contain an "Appendix I" dealing with marine mammal and seabird populations that interact with the fisheries. The FMPs may be accessed from the Council's home page at http://www.fakr.noaa.gov/npfmc/default.htm
- Washington Sea Grant has several publications on seabird takes, and technologies and practices for reducing them: http://www.wsg.washington.edu/publications/online/index.html
- The seabird component of the environment affected by the groundfish FMPs is described in detail in Section 3.7 of the PSEIS (NMFS 2004a).
- Seabirds and fishery impacts are also described in Chapter 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a).

8.2.2 ESA-Listed Seabirds in the Bering Sea

Three species of seabirds that range into the Bering Sea are listed under the ESA: the endangered short-tailed albatross (STAL) (*Phoebastria albatrus*), the threatened spectacled eider (*Somateria fischeri*) and the threatened Steller's eider (*Polysticta stelleri*). Two additional species, Kittitz's murrelet and black-footed albatrosses, are currently candidates species for listing.

STAL populations were decimated by hunters and volcanic activity at nesting sites in the early 1900s, and the species was reported to be extinct in 1949. By 1954 there were 25 total birds seen on Torishima Island. Prohibition of hunting and habitat enhancement work has allowed the population to recover at a 7%–8% rate based on egg counts from 1990-1998. The current world total population is estimated at around 2000 individuals (USFWS 2006). 80%–85% of nesting occurs at a colony subject to erosion and mudslides on Torishima Island, an active volcano in Japan, and smaller numbers nest in the Senkaku Islands where political uncertainty and the potential for oil development exist (USFWS 2005). Recently, STAL chicks were relocated to a new breeding colony without the volcanic threat. No critical habitat has been designated for the short-tailed albatross in the US, since the population growth rate doesn't appear to be limited by marine habitat loss (NMFS 2004a).

STAL feeding grounds are continental shelf breaks and areas of upwelling and high productivity. Although recent reliable diet information is not available, short-tailed albatross likely feed on squid and forage fish. Although surface foragers, their diet could include mid-water species that are positively buoyant after mortality (e.g. post-spawning for some squid species) or fragments of larger prey floating to the surface after being caught by subsurface predators (R. Suryan, pers.com.).

Most designated critical habitat for Spectacled and Steller's eiders is well outside the normal distribution of the pollock trawl fleet (Fig. 8-9 and Fig. 8-10). There is no recorded take of these species in Alaska trawl fisheries, and no take estimates produced by the AFSC (2006). Spectacled eider observations are reported in the NPPSD in Bristol Bay and Norton Sound, still outside the normal distribution of the pollock trawl fleet. Therefore, potential impacts to these species are not analyzed further in this document.

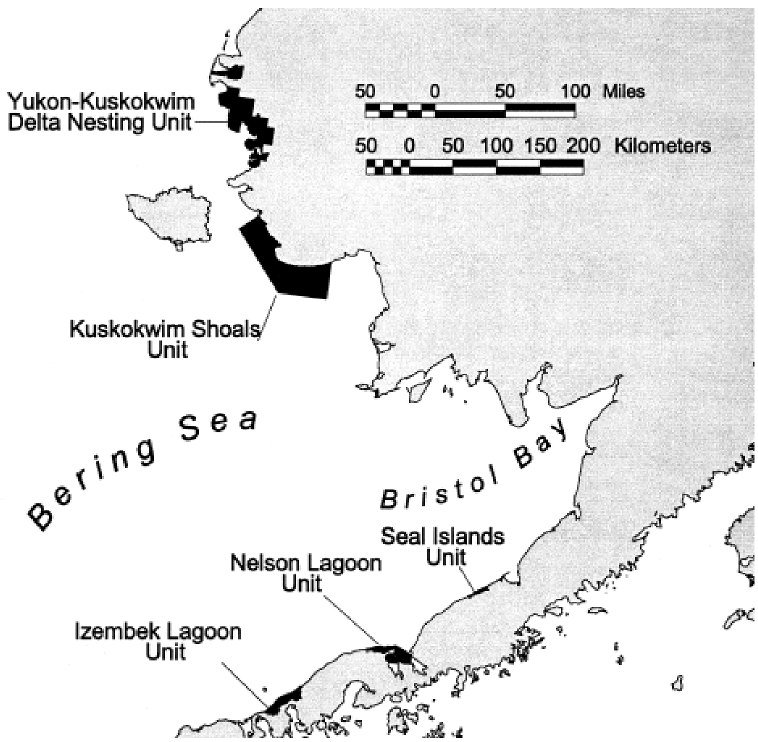

Fig. 8-9 Steller's Eider Critical Habitat (USFWS 2001b)

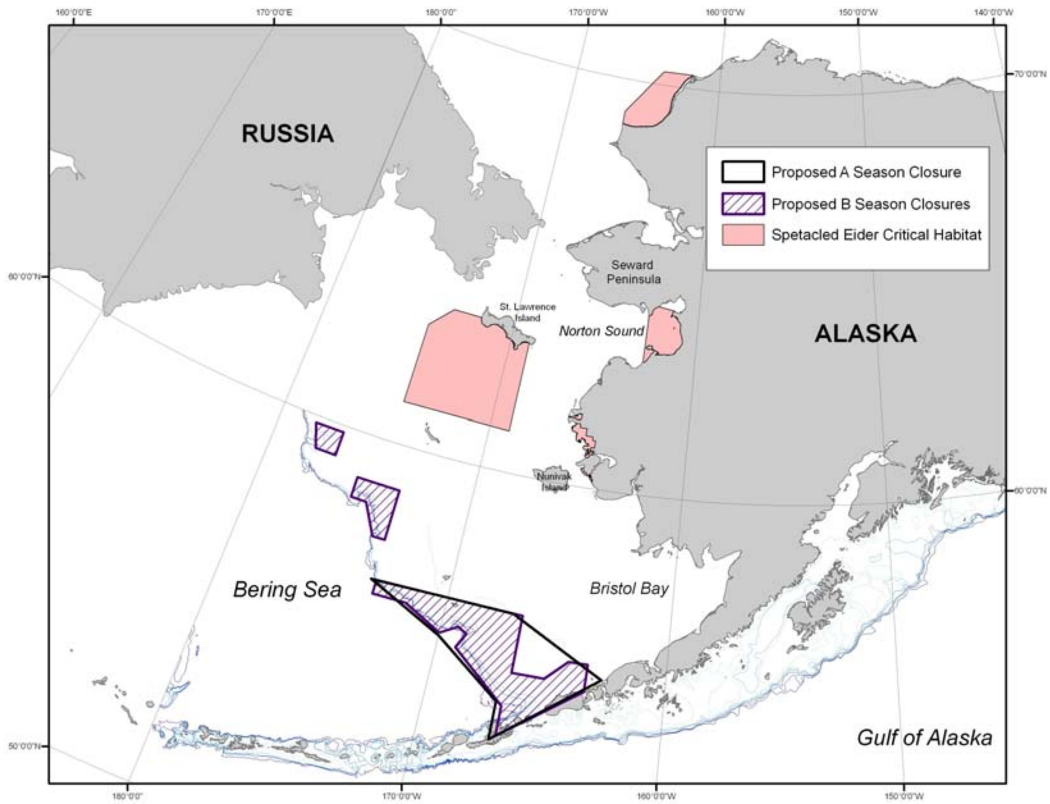

Fig. 8-10 Spectacled Eider Critical Habitat (USFWS 2001a) with the Alternative 3 proposed closures.

8.2.3 Status of ESA Consultations on Groundfish and Halibut Fisheries

The USFWS listed the short-tailed albatross as an endangered species under the ESA throughout its United States range (65 FR 46643, July 31, 2000). The current population status, life history, population biology, and foraging ecology of these species, as well as a history of ESA section 7 consultations and NMFS actions carried out as a result of those consultations are described in detail in section 3.7 of the PSEIS (NMFS 2004a). Although critical habitat has not been established for the short-tailed albatross, the FWS did designate critical habitat for the spectacled eider (66 FR 9146; February 6, 2001) and the Steller's eider (66 FR 8850; February 2, 2001).

In 1997, NMFS initiated a section 7 consultation with USFWS on the effects of the Pacific halibut fishery off Alaska on the short-tailed albatross. USFWS issued a Biological Opinion in 1998 that concluded that the Pacific halibut fishery off Alaska was not likely to jeopardize the continued existence of the short-tailed albatross (USFWS 1998b). USFWS issued an Incidental Take Statement of two short-tailed albatross in a two year period (1998/1999, 2000/2001, 2002/2003, etc), reflecting what the agency anticipated the incidental take could be from the fishery action. Under the authority of ESA, USFWS identified non-discretionary reasonable and prudent measures that NMFS must implement to minimize the impacts of any incidental take.

Two updated USFWS Biological Opinions (BO) were published in 2003:

- Section 7 Consultation - Biological Opinion on the Effects of the Total Allowable Catch (TAC)-Setting Process for the Gulf of Alaska and Bering Sea/Aleutian Islands Groundfish Fisheries to the Endangered Short-tailed Albatross (*Phoebastria albatrus*) and Threatened Steller's Eider (*Polysticta stelleri*), September 2003 (USFWS 2003b).

- Section 7 Consultation - Programmatic Biological Opinion on the effects of the Fishery Management Plans for the Gulf of Alaska and Bering Sea/Aleutian Islands groundfish fisheries on the endangered short-tailed albatross (*Phoebastria albatrus*) and threatened Steller's eider (*Polysticta stelleri*), September 2003 (USFWS 2003a).

Although USFWS has determined that the short-tailed albatross is adversely affected by hook-and-line Pacific halibut and groundfish fisheries off Alaska, both USFWS opinions concluded that the GOA and BSAI fishery actions are not likely to jeopardize the continued existence of the short-tailed albatross or Steller's eider or result in adverse modification of Steller's eider critical habitat. The USFWS also concluded that these fisheries are not likely to adversely affect the threatened spectacled eider. The Biological Opinion on the TAC-setting process updated incidental take limits of:

- four short-tailed albatross taken every two years in the hook-and-line groundfish fishery off Alaska, and
- two short-tailed albatross taken in the groundfish trawl fishery off Alaska while the BO is in effect (approximately 5 years).

These incidental take limits are in addition to previous take limit set in 1998 for the Pacific halibut hook-and-line fishery off Alaska of two STAL in a two year period.

The 2003 Biological Opinion on the TAC-setting process also included mandatory terms and conditions that NOAA must follow in order to be in compliance with the ESA. One is the implementation of seabird deterrent measures (NMFS 2002). Additionally, NOAA Fisheries must continue outreach and training of fishing crews as to proper deterrence techniques, continued training of observers in seabird identification, retention of all seabird carcasses until observers can identify and record takes, continued analysis and publication of estimated incidental take in the fisheries, collection of information regarding the efficacy of seabird protection measures, cooperation in reporting sightings of short-tailed albatross, and continued research and reporting on the incidental take of short-tailed albatross in trawl gear.

The USFWS released a short-tailed albatross draft recovery plan for public review (70 FR 61988, October 27, 2005). This recovery plan meets the ESA requirements of describing site-specific actions necessary to achieve conservation and survival of the species, downlisting and delisting criteria, and estimates of time and cost required to implement the recovery plan. Because the primary threat to the species recovery is the possibility of an eruption of Torishima Island, the most important recovery actions include monitoring the population and managing habitat on Torishima Island, establishing two or more breeding colonies on non-volcanic islands, monitoring the Senkaku population, and conducting telemetry and other research and outreach. Recovery criteria are currently under review. USFWS estimates that the STAL may be delisted in the year 2030, if new colony establishment is successful.

8.2.4 Other Seabird Species of Conservation Concern in the Bering Sea

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the USFWS to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." Birds of Conservation Concern (BCC) 2002 (USFWS 2002) identifies the migratory and non-migratory bird species (beyond those already designated as Federally threatened or endangered) with their highest conservation priorities and draws attention to species in need of conservation action." NMFS Evaluating Bycatch report (NMFS 2004b) says the purpose of the BCC list is to highlight potential conservation issues and concerns before species get listed. The Birds of Conservation Concern report, USFWS (2002) lists 28 species of birds in Region 7 (Alaska Region). Many of these species do not interact with Alaska fisheries, and thus are not addressed in this analysis. The birds that interact with Alaska fisheries and are addressed in this analysis are black-footed albatrosses (BFAL, *Phoebastria nigripes*), red-legged kittiwake, and Kittlitz's murrelet (*Brachyramphus brevirostris*).

Black-footed albatrosses occur in Alaska waters mainly in the northern Gulf of Alaska, but a few have been reported near Nunivak Island in the Bering Sea (USFWS 2006). A few BFAL are reported in the NPPSD in Bristol Bay (Fig.8-14). Although not an ESA-listed species, the black-footed albatross is of concern because some of the major colony population counts may be decreasing or of unknown status. World population estimates range from 275,000 to 327,753 individuals (Brooke 2004), with a total breeding population of 58,000 pairs (USFWS 2006). Most of the population (95%) breeds in the Hawaiian Islands. Conservation concerns in the last century have included albatross mortalities by feather hunters, the degradation of nesting habitat due to introduced species such as rabbits, and population reduction programs operated by the military. Tuna and swordfish pelagic longline fisheries in the North Pacific, including the Hawaiian longline fishery, and to a lesser extent the Alaska groundfish demersal longline fishery take black-footed albatrosses incidentally.

On October 1, 2004, the USFWS received a petition to list the BFAL as a threatened or endangered species, and to designate critical habitat at the time of listing. The Service's response to the 90-day finding was deferred until October 9, 2007, due to insufficient resources. At that time, the Service found that the petition warranted further review. Following the publication of the black-footed albatross population status review, the Service began developing its 12-month finding indicating whether it believes a proposal to list this species as threatened or endangered is warranted. That 12-month finding is not yet available.

Melvin et al (2006) cites the fact that the World Conservation Union (IUCN) changed the BFAL conservation status under the international classification criteria from vulnerable to endangered in 2003. The USFWS issued a conservation plan for black-footed and Laysan Albatrosses in October 2007. Additionally, the USFWS just published a status assessment of Laysan and Black-footed Albatrosses, in response to growing concerns regarding the current status and population trends of these two north Pacific albatrosses, particularly the black-footed (Arata et al, 2009).

The red-legged kittiwake is a small gull that breeds at only a few locations in the world, all of which are in the Bering Sea (USFWS 2006). Eighty percent of its worldwide population nests at St. George Island, with the remainder nesting at St. Paul, the Otter Islands, Bogoslof and Buldir Islands. The total population is estimated at around 209,000 birds (USFWS 2006). They are listed as a USFWS bird of conservation concern because recent severe population declines remain unexplained (NMFS 2004b), but could be due to irregular food supplies in the Pribilof Islands. Red-legged kittiwakes are present in the eastern Bering Sea, but do not interact regularly with the Bering Sea fisheries.

Kittlitz's murrelet is a small diving seabird that forages in shallow waters for capelin, Pacific sandlance, zooplankton and other invertebrates. It feeds near glaciers, icebergs, and outflows of glacial streams, sometimes nesting up to 45 miles inland on rugged mountains near glaciers. They nest on the ground, and not in colonies, thus less is known about their breeding behaviors. The entire North American population, and most of the world's population, inhabits Alaskan coastal waters discontinuously from Point Lay south to northern portions of Southeast Alaska. Kittlitz's murrelet is a relatively rare seabird. Most recent population estimates indicate that it has the smallest population of any seabird considered a regular breeder in Alaska (9,000 to 25,000 birds). This species appears to have undergone significant population declines in several of its core population centers—Prince William Sound (up to 84%), Malaspina Forelands (up to 75%), Kenai Fjords (up to 83%) and in Glacier Bay. Causes for the declines are not well known, but likely include: habitat loss or degradation, increased adult and juvenile mortality, and low recruitment. FWS believes that glacial retreat and oceanic regime shifts are the factors that are most likely causing population-level declines in this species. On May 4, 2004, the FWS (2004) gave the Kittlitz's murrelet a low ESA listing priority because it has no imminent, high magnitude threats (50 CFR Part 17 Volume 69, Number 86). The listing priority elevated from 5 to 2 in 2007 in recognition that climate change will have a more immediate effect on this species than previously believed and because of more evidence of declining population trends.

The USFWS has conducted surveys for Kittlitz's murrelet in the Alaska Maritime National Wildlife Refuge over the past few years (USFWS 2006). These surveys have revealed populations at Attu, Atka, Unalaska, and Adak. Intensive surveys in 2006 found an additional 10 nests in the mountains of Agattu. Bird biologists will now be able to study the species' breeding biology for the first time.

No Kittlitz's murrelets were specifically reported taken in the observed groundfish fisheries between 1993 and 2001 (NMFS 2004a), and no estimates are presented by AFSC (2006). While Kittlitz's murrelets have been observed in the Bering Sea (Fig.8-16), their foraging techniques, diet composition, and the fact that they do not follow fishing vessels or congregate around them reduces the likelihood of incidental take in groundfish fisheries (K. Rivera, NMFS, pers. comm.) (USFWS 2006).

8.2.5 Seabird Distribution in the Bering Sea

A number of data sources are available that describe the spatial distributions of seabirds species in the Bering Sea. The data sources used in this analysis are described below and represented in figures to follow. NMFS is highly appreciative of USFWS, Washington Seagrant, Oregon State University, International Pacific Halibut Commission, and the Alaska Fishery Science Center in their efforts to supply data and guidance in putting together this and other seabird-related analyses.

8.2.5.1 Washington Sea Grant Point Count Study

Melvin et al (2006) provide data on seabird distribution patterns in Alaska's EEZ, based on an inter-agency collaborative program that collected seabird distribution data during stock assessment surveys on hook-and-line vessels in the summers of 2002, 2003, and 2004. These surveys primarily report on species that are attracted to fishing vessels. Seabird data were collected from four summer hook-and-line stock assessment surveys: IPHC halibut surveys, NMFS sablefish surveys, ADF&G Southeast Inside sablefish surveys, and ADF&G Prince William Sound sablefish surveys. See Melvin et al (2006) for survey protocol and description.

Researchers observed a total of 230,452 birds over three years at an average of 1,456 stations surveyed each year. Eighty-five percent of all birds sighted were procellariformes, and of these, most were northern fulmars (71% of all birds sighted) or albatrosses (13% of all birds sighted). Albatrosses occurred throughout the fishing grounds in outside waters. Sightings of the endangered short-tailed albatrosses (Fig.8-17) were extremely rare (0.03% of all sightings) and had a similar distribution to Laysan albatrosses: rare or absent east and south of the western GOA and most abundant in the Aleutian Islands. Black-footed albatrosses were observed in all outside waters.

Note that this effort gives information about STAL use of Bering Sea habitat that corroborates other studies which reference STAL preference for continental shelf break and slope areas (Suryan et al. 2006, Piatt et al. 2006).

8.2.5.2 North Pacific Pelagic Seabird Database and Observers

The North Pacific Pelagic Seabird Database (NPPSD) represents a consolidation of pelagic seabird data collected from the Central and North Pacific Ocean, the Bering Sea, the Chukchi Sea, and the Beaufort Sea. The NPPSD was created to synthesize numerous disparate datasets including at-sea boat based surveys, stations, land based observations, fixed-wing and helicopter aerial surveys, collected since 1972 (Drew and Piatt 2004). Bird observations are shown in Fig.8-16. Species of conservation concern and those more likely to interact with fishing vessels are highlighted in the figure, but other species observed in this area include murres, loons, auklets, puffins, terns, black-legged kittiwakes, short-tailed and sooty shearwaters and other species in smaller numbers.

Seabird observers have conducted surveys onboard ships of opportunity from 2006-2008 in the Bering, Chukchi, and Beaufort seas. While surveyors did observe short-tailed, black-footed, and Laysan albatrosses in the Bering Sea, the bird distributions were mostly limited to the Bering Sea shelf break.

8.2.5.3 Seabird observations from IPHC surveys

The IPHC stock assessment surveys document interactions with seabirds at all survey stations, primarily reporting on observation of seabird species that are attracted to fishing vessels. Table 8-10 lists the numbers of seabirds observed in each IPHC management area during the 2006 survey. Fig. 7-1, in Chapter 7, shows the locations of the different areas. Many seabirds were observed in the Bering Sea in areas frequently fished by the pollock trawl fleet.

Table 8-10 Numbers of Seabirds Observed in IPHC 2006 Survey in Alaska

IPHC Area	Numbers of Observed Seabirds	Numbers of Counts
2C	**1,140**	**122**
3A	**13,468**	**372**
3B	**20,946**	**229**
4A	**8,596**	**117**
4B	**7,038**	**89**
4C	**1,799**	**25**
4D	**9,253**	**92**
4E	**227**	**22**
Closed Area	**631**	**17**

Data from IPHC.

8.2.5.4 Short-tailed albatross hotspots

Piatt et al (2006) discuss oceanic areas of seabird concentrations; they explain that STAL hotspots are characterized by vertical mixing and upwelling caused by currents and bathymetric relief and which persist over time. The continual upwelling brings food to the surface and, thus, draws predators back for repeated foraging, especially Albatross species which forage at the surface due to their limited diving ability (Hyrenbach et al. 2002). Sightings data were compiled from the following sources: from 1988-2004 records from seabird observers on the USFWS's research vessel M/V Tiglax; from incidental sightings by biologists, fishermen, seamen, fisheries observers and birdwatchers provided to the USFWS; from the IPHC; from the Alaska Natural Heritage Program; historical sightings documented in published literature; and from the North Pacific Pelagic Seabird Database. Researchers analyzed over 1400 sightings, the majority of which were located on the continental shelf edge of Alaska, abundance being greatly diminished along the east Gulf of Alaska coast and south to Southeast Alaska. Researchers concluded that the short-tailed albatross is most recently consistently associated with upwelling in Aleutian passes and along continental shelf margins in Alaska. The opportunistic sightings data suggest that the albatrosses appear persistently and predictably in some marine "hotspots." They were closely associated with shelf-edge habitats throughout the northern Gulf of Alaska and Bering Sea. In addition to Ingenstrem Rocks and Seguam Pass, important hotspots for short-tailed albatross in the Aleutians included Near Strait, Samalga Pass and the shelf-edge south of Umnak/Unalaska islands. In the Bering Sea, hotspots were located along margins of Zhemchug, St. Matthews and Pervenets Canyons (Piatt et al 2006). Similar findings in Byrd et al (2005) confirm the frequent presence of surface-feeding piscivores near the medium and large passes that create the bathymetric conditions for vertical mixing and upwelling. Researchers surmise that prior to decimation of the short-tailed albatross population by feather hunters around the turn of the century, the albatrosses may have been reasonably common nearshore (thus the term "coastal" albatross) but only where upwelling "hotspots" occurred near the coast. As short-tailed albatross numbers increase, it is likely that their distribution will shift into areas less utilized currently, including the coastal areas.

In the context of this analysis, the pertinent STAL hotspots in the Bering Sea are located along the Zhemchug, St Matthew, Pervenets, and Pribilof canyons along the continental shelf (Fig.8-18). Piatt et al report large groups (10-136 birds) of STAL concentrated along the Bering Sea canyons and call attention to a 2004 STAL flock sighting where approximately 10% of the world's population gathered at one hotspot near Pervenets canyon (green asterisk in Fig.8-18).

8.2.5.5 STAL takes in Alaska fisheries

Table 8-11 details the short-tailed albatrosses reported taken in Alaska fisheries since 1983. Except for the 2nd take in 1998, leg bands were recovered from all of the albatrosses allowing scientists to verify identification and age. Since 1977, Dr. Hiroshi Hasegawa has banded all short-tailed albatross chicks at their breeding colony on Torishima Island, Japan. See Fig.8-17 for a map of the take locations and note that no takes are reported from groundfish trawl fisheries (Table 8-11).

Table 8-11 Reported takes of STAL in Alaska fisheries (USFWS 2003)

Date of Take	Location	Fishery	Age when taken
July 1983	BS	brown crab	juvenile (4 mos)
1 Oct 87	GOA	halibut	juvenile (6 mos)
28 Aug 95	EAI	hook-and-line	sub-adult (16 mos)
8 Oct 95	BS	hook-and-line	sub-adult
27 Sept 96	BS	hook-and-line	sub-adult (5yrs)
21 Sept 98	BS	Pacific cod hook-and-line	adult (8yrs)
28 Sept 98	BS	Pacific cod hook-and-line	sub-adult

8.2.5.6 Opportunistic sightings of STAL in the Bering Sea

Balogh et al (2006) report opportunistic sightings of short-tailed albatrosses. Similar to other sources, more opportunistic sightings occurred over shelf-break areas than on the shelf. Although this pattern partially reflects where fishing effort occurred to observe STAL, and does not equally represent sightings in areas where fishing effort is less common. Large numbers of STAL were observed near the Pervenets, St. Matthew and Zhemchug canyons (Fig.8-18).

8.2.5.7 Satellite tracking of STAL (Suryan 2006a and 2006b)

The USFWS and Oregon State University have placed 52 satellite tags on Laysan, black-footed, and short-tailed albatrosses in the central Aleutian Islands over the past 4 years (USFWS 2006) to study movement patterns of the birds in relation to commercial fishing activity and other environmental variables. Details are summarized in NMFS (2008). Within Alaska, albatrosses spent varying amounts of time among NMFS reporting zones, with six of the zones (521, 524, 541, 542, 543, 610) being the most frequently used (Suryan et al 2006a). Albatrosses arriving from Japan spent the greatest amount of time in the western and central Aleutian Islands (541-543), whereas albatrosses tagged in Alaska were more widely distributed among fishing zones in the Aleutian Islands, Bering Sea, and the Alaska Peninsula. In the Aleutian Islands, area-restricted search patterns occurred within straits, particularly along the central and western part of the archipelago (Suryan et al 2006b). In the Bering Sea, area-restricted search patterns occurred along the northern continental shelf break, the Kamchatka Current region, and east of the Commander Islands. Non-breeding short-tailed albatross concentrate foraging in oceanic areas characterized by gradients in topography and water column productivity. The primary hot spots for short-tailed albatrosses in the Northwest Pacific Ocean and Bering Sea occur where a variety of underlying physical processes enhance biological productivity or prey aggregations.

8.2.6 Seabird Interactions with Alaska Groundfish Trawl Fisheries

Alaska groundfish fisheries' impacts on seabirds were analyzed in the Alaska Harvest Specifications EIS (NMFS 2007). That document evaluates the impacts of the alternative harvest strategies on seabird takes, prey availability, and seabird ability to exploit benthic habitat. The focus of this analysis is similar, as any changes to the pollock fishery in the Bering Sea could change the potential for direct take of seabirds. Potential changes in prey availability (seabird prey species caught in the pollock trawl fishery) and disruption of bottom habitat via the intermittent contact with non-pelagic trawl gear under different levels of harvest are discussed in NMFS (2007). These changes would be closely associated with changes in take levels because of the nature of the alternatives using caps and spatial restrictions. Therefore, all impacts are addressed by focusing on potential changes in seabird takes.

USFWS has determined that trawl gear may pose a threat to seabirds, primarily albatrosses and fulmars that strike cables extending from the vessel to the trawl net. Large winged birds such as albatrosses are most susceptible to mortalities from trawl-cable strikes (CCAMLR 2006a). Third wire cables have been prohibited in some southern hemisphere fisheries since the early 1990's due to substantial albatross mortality from cable strikes. No short-tailed albatrosses have been observed taken on trawl gear in Alaska fisheries, but mortalities to Laysan albatrosses have been observed. Much of the description of impacts in this section comes from Dietrich and Melvin (2007).

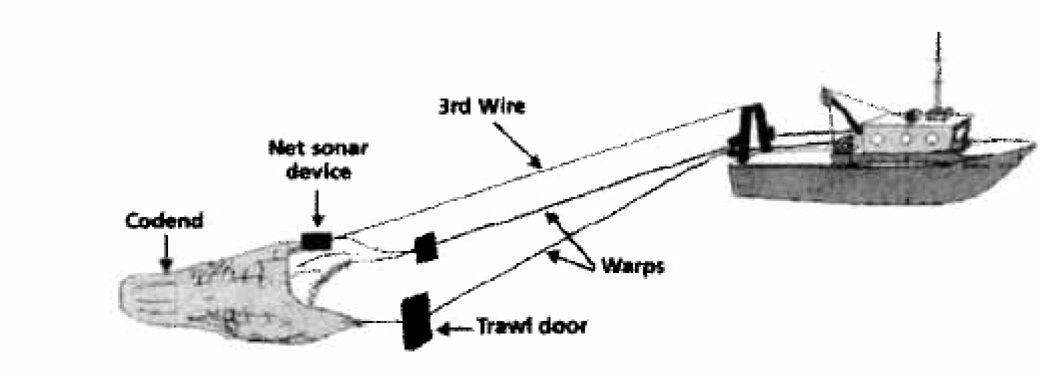

Fig.8-11 Trawl vessel diagram. (Reproduced from Dietrich and Melvin 2007, courtesy of K Williams)

Birds can collide or become entangled with either warp cables that connect the trawl net to the vessel, or by third wire, netsonde, or paravane cables that connect to net monitoring devices (Fig.8-11). In some trawl fisheries, equipment is mounted on the trawl net that sends signals to the vessel so net performance can be monitored. This is most important in midwater fisheries such as pollock trawl, but is employed in some bottom-trawl fishing applications as well. Seabirds attracted to offal and discards from the ship may either strike the hard-to-see cable while in flight, or get caught and tangled in the cable while they sit on the water due to the forward motion of the vessel. Onboard observations of birds (including Laysan albatross) colliding with either of these cables have been made by both researchers and observers. Some birds that strike vessels or fishing gear fly away without injury, while others are injured or killed. When the cable or third wire encounters a bird sitting on the water, the bird can be forced underwater and drown. The main distinction between the two systems is the different location of the transducer cables and third wires. The transducer wires are deployed from the side of the ship and can be very close to where offal is discharged. There, they are not so likely to be hit by flying birds, but very likely to encounter swimming birds. Alternatively, transducer cables can be suspended from relatively long outriggers. This gets them out of the offal discharge area, but puts them more into the birds' flying zone. In contrast, trawl sonar cables (third wires) are deployed from the center of the stern, above the main deck, and can be above the water for longer distances. Thus, they are more likely to intersect the birds' flying zone than the concentration of swimming birds feeding on offal. These differences in location are likely to affect the probability and mechanism of bird strikes.

Up to the present, information on seabird interactions with transducer or third wire cables in Alaska has not been collected systematically. NMFS (2002) reports that the 3000+ observation records by NMFS-certified observers from 1993 to 2001 include 25 definitive reports of birds specifically striking or being drowned by the 'third wire' on trawl gear, and one report of birds striking the main trawl cables. Many of the observer notes were not about the third wires, and all observations may not have been recorded, so encounter rates cannot be calculated from this information. The third wire incidents that were noted involved 92 birds, including about 30 northern fulmars and 19 Laysan albatross (NMFS 2002; USFWS Observer Notes Database). Researchers have made similar reports.

There are presently no standardized observer data on seabird mortality from trawler third wire collisions in Alaskan waters. Direct collection of seabird-third wire interaction data is problematic, for several reasons. Any birds killed by third wire collisions would most likely not be recorded in the observers' sampling of the trawl haul, as it is unlikely that such birds would make their way into the trawl net. Some trawlers are configured such that an observer's safety might be compromised were he or she to monitor the third wire during the tow, because direct observations would place the observer immediately below the net cables or expose them to heavy seas. Also, observer effort on trawlers is already fully allocated, and to monitor trawl third wire cables while gear is being towed may require abandoning some existing observer duties, or adding an additional observer to the trawl vessel. To date, striking of trawl vessels or gear by the short-tailed albatross has not been reported by observers. The probability of short-tailed albatross collisions with third wires or other trawl vessel gear in Alaskan waters cannot be assessed; however, given the available observer information and the observed at-sea locations of short-tailed albatrosses relative to trawling effort, the possibility of such collisions cannot be completely discounted. USFWS' biological opinion included an ITS of two short-tailed albatross for the trawl groundfish fisheries off Alaska (USFWS 2003).

Although the vast majority of warp and third wire effort during 2003-2005 occurred in three fisheries—pollock, cod and flatfish—overlap with albatross sighted during the NMFS surveys was minimal (June through August), except at the BS shelf break in 2004, when it was moderate to high. (Dietrich and Melvin 2007). Dietrich and Melvin suggest further studies to determine overlap of albatross distribution and the use of trawl gear focus on rockfish fisheries in the GOA, Atka mackerel fisheries in the BSAI from May to October, and Pacific cod fisheries in the AI in winter.

The impacts analysis primarily focuses on birds of conservation concern and those more likely to interact with fishing vessels. Impacts to other seabird species may occur at very low levels in relation to population size and are not expected to have significant long-term effects to those populations.

8.2.6.1 Alternative 1 Status Quo

The effects of the status quo fisheries on the incidental takes of seabirds are detailed in the 2007 harvest specifications EIS (NMFS 2007). Fig.8-12 shows the seabird species taken as bycatch in the Bering Sea trawl fisheries and reported by fisheries observers from 2002-2006. This includes trawl fisheries for pollock, Pacific cod, Atka mackerel, rockfish, and flatfish. The high number of unidentified seabirds was influenced by one haul in the Pacific cod fishery in 2006 that occurred in NMFS Area 517. AFSC 2006 estimates of seabird bycatch in the pollock fishery are listed in Table 8-12. In 2006, the pollock fishery accounted for only 12.8% of the total trawl seabird bycatch. It accounted for 61.7% in 2005. These take estimates are small in comparison to seabird population estimates, and under the status quo alternative, it is reasonable to conclude that the impacts would continue to be similar. However, observers are not able to monitor all seabird mortality associated with trawl vessels. Several research project are currently underway to provide more information on these interactions.

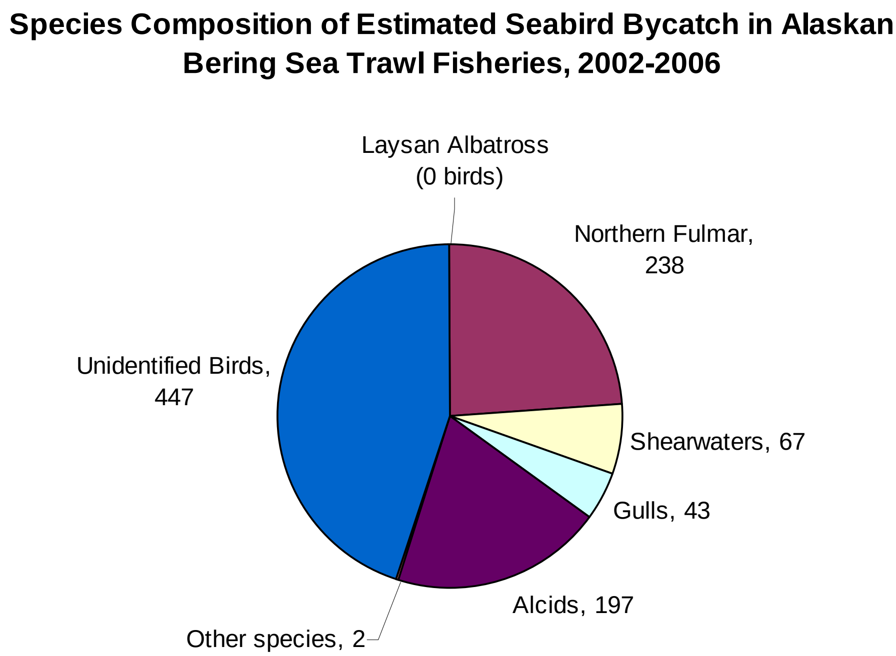

Fig.8-12 Bycatch composition of seabirds in the Bering Sea trawl fisheries, 2002-2006 (Fig. from AFSC)

Table 8-12 Estimates of seabird bycatch in the pollock fishery, 2006

Species	Point Estimate	95% Confidence Interval
Laysan Albatross	2	1-34
Northern Fulmar	335	286-393
Shearwater species	20	12-35
Unidentified Procellarids	2	1-5
Alcid species	3	1-12
Unidentified species	6	2-16

Data from AFSC. All other species are estimated at zero takes.

Dietrich and Melvin (2007) report observed warp hours from June - August pollock trawl fisheries in 2004 (Fig. 8-13 and Fig.8-14) with summer albatross sightings. A warp hour is a measure of effort used to indicate potential for bird interaction. The warp line is part of the trawl gear that interacts with seabirds (see Fig.8-11). While the vessel is trawling and has its warp lines out, each hour that passes would be one warp hour. In 2004, overlap was high along the shelf break for Laysan albatross and northwest of Zhemchug Canyon for short-tailed albatross. In 2005 overlap was minimal with only two black-footed and one short-tailed albatross. The authors are careful to point out that overlap does not necessarily imply interaction, only the potential for interaction.

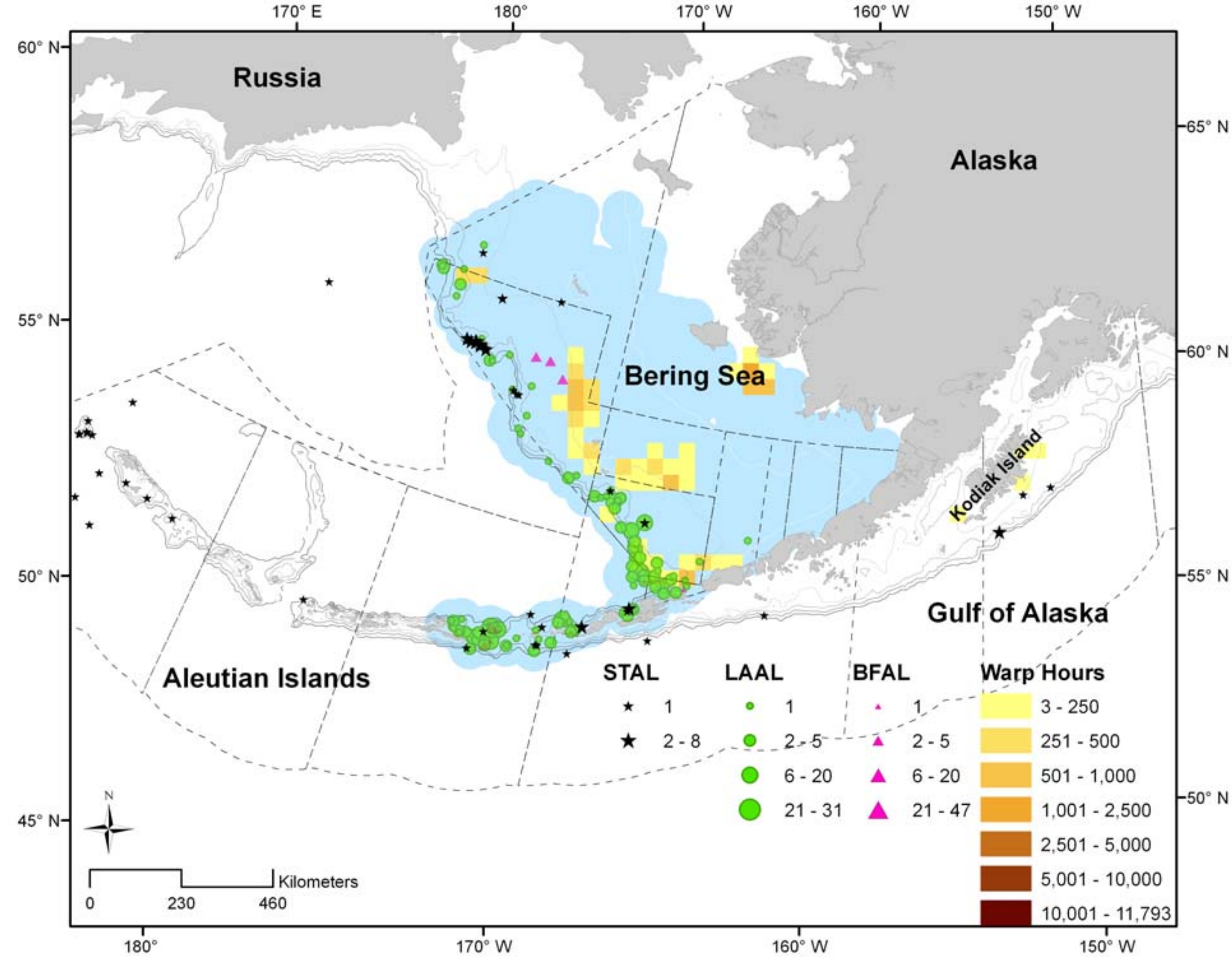

Fig. 8-13 Spatial distribution of warp hours in the pollock trawl fishery and albatross sightings, 2004. Fig. used with permission (Dietrich and Melvin 2007)

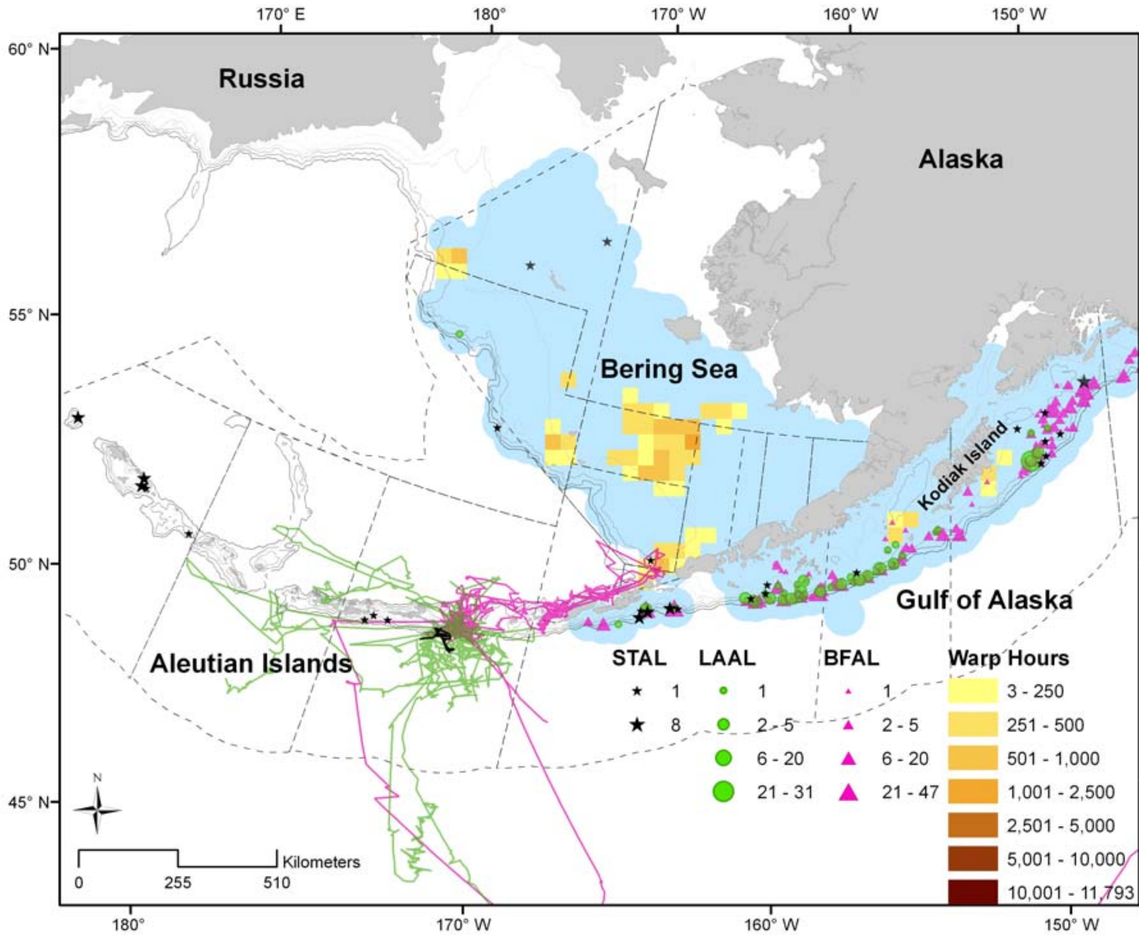

Fig.8-14 Spatial distribution of warp hours in the pollock trawl fishery and albatross sightings, 2005. Fig. used with permission (Dietrich and Melvin 2007)

Fig. 8-5 shows the current spatial restrictions on the pollock trawl fishery in the Bering Sea and Aleutian Islands. Steller sea lion haulouts near the Pribilof, St. Lawrence, St. Matthew, Walrus, and Round Islands are protected out to various distances by closing those waters to pollock fishing (and other fisheries). Additionally, Bristol Bay, Bogoslof, and the CVOA further spatially restrict the pollock fishery. These closures decrease the potential for interaction with birds in these areas. Fig.8-8 shows that there are seabird colonies at most of these islands and nearshore in the Bogoslof area. Fig.8-16 shows the distribution of seabird species in these areas, and Fig. 8-10 shows the wintering critical habitat area for spectacled eider near St. Lawrence Island. These restrictions are not anticipated to change, so this protection would continue to be provided under any of the alternatives in this analysis.

8.2.6.2 Alternative 2 Hard Cap

The range of hard caps under Alternative 2 offers a range of potential for incidental take of seabirds. The lower hard caps may preclude pollock fishing in the Bering Sea at some point in the fishing season, which would reduce the potential for incidental takes in fishing areas that overlap with seabird distributions after the cap is reached. The higher hard caps would allow for more pollock fishing and more potential interaction and incidental takes of seabird species than the smaller caps.

The options to seasonally distribute the hard cap would seasonally limit the amount of fishing. Seasonal information on estimated takes of seabirds should be examined to better understand the potential impacts of seasonal hard caps. We only have distribution information for tagged STAL in the summer and fall months (Fig.8-15). Fig.8-17 shows the spatial distribution of these tagged birds in Alaska waters. We do not have definitive information about STAL use of the Bering Sea in winter and spring months, so it's harder to anticipate the impacts of seasonal hard caps on STAL.

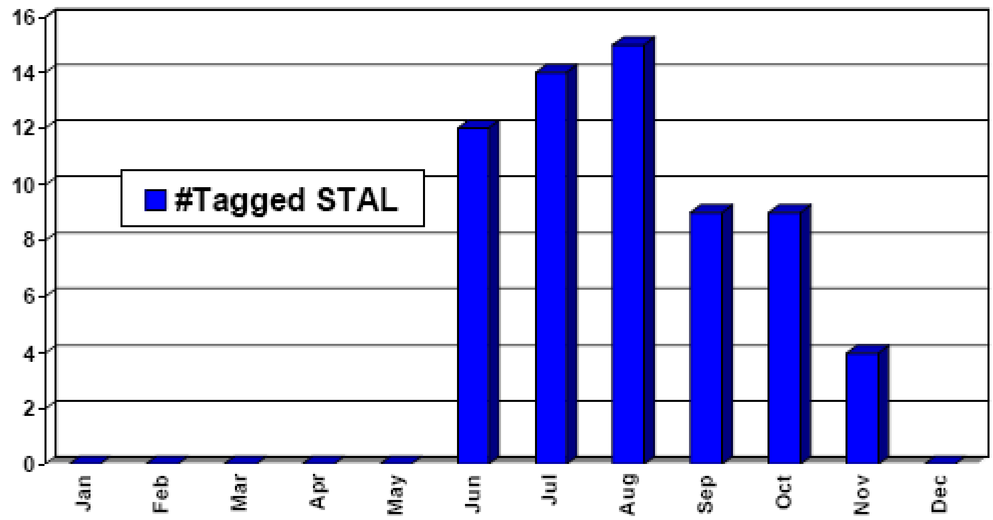

Fig.8-15 Numbers of STAL tagged in 2002-2006 by month

The options for indexed caps, sector allocations and transfers, and cooperative provisions affect the management and distribution of the cap across the sectors and consider certain salmon stocks. These options are not likely to have an effect on pollock fishing in a manner that would change the potential for incidental take of seabirds.

8.2.6.3 Alternative 3 Triggered Closures

Closing an area where interactions between pollock trawl vessels and seabirds are more likely to occur would reduce the potential for incidental takes. Fig.8-16 shows a large overlap between the distributions of red-legged kittiwakes, northern fulmars, short-tailed shearwaters, and laysan albatross with the proposed A season closure. Prohibiting pollock fishing in this area could decrease the potential for interaction with these species in this area, but could also shift pollock trawl effort immediately north where there are similar large concentrations of seabirds. The lower of the three polygons comprising the B season proposed closures is similar in size and shape to the proposed A season closure, so the effects of closing that area are similar.

The northern two polygons of the proposed B season closure warrant additional discussion. The northern-most polygon is just to the east of Pervenets Canyon, where the single largest accumulation of STAL has ever been documented (NMFS 2008), shown in Fig.8-17. If the closure of this polygon shifted pollock trawl effort west or north, potential interactions with STAL and other seabird species could increase in those areas. Fig.8-17 shows several different STAL data sources depicting STAL distribution in this area. Opportunistic sightings, surveys, and satellite tag locations all show heavy STAL use of this area and Piatt et al. (2006) discusses STAL use of Bering Sea canyons and areas of upwelling as STAL hot spots.

The polygon just east of Zhemchug Canyon also includes areas where STAL have been observed and reported taken in hook-and-line fisheries (Fig.8-17). Shifting effort just outside the closure may cause additional interactions outside the closure, while protecting birds inside the closure.

Due to the small number of incidental takes and changing seabird distributions, it is not possible to quantify how spatially shifting the pollock fishery with the trigger closures may impact the potential for incidental takes of seabirds in the Bering Sea.

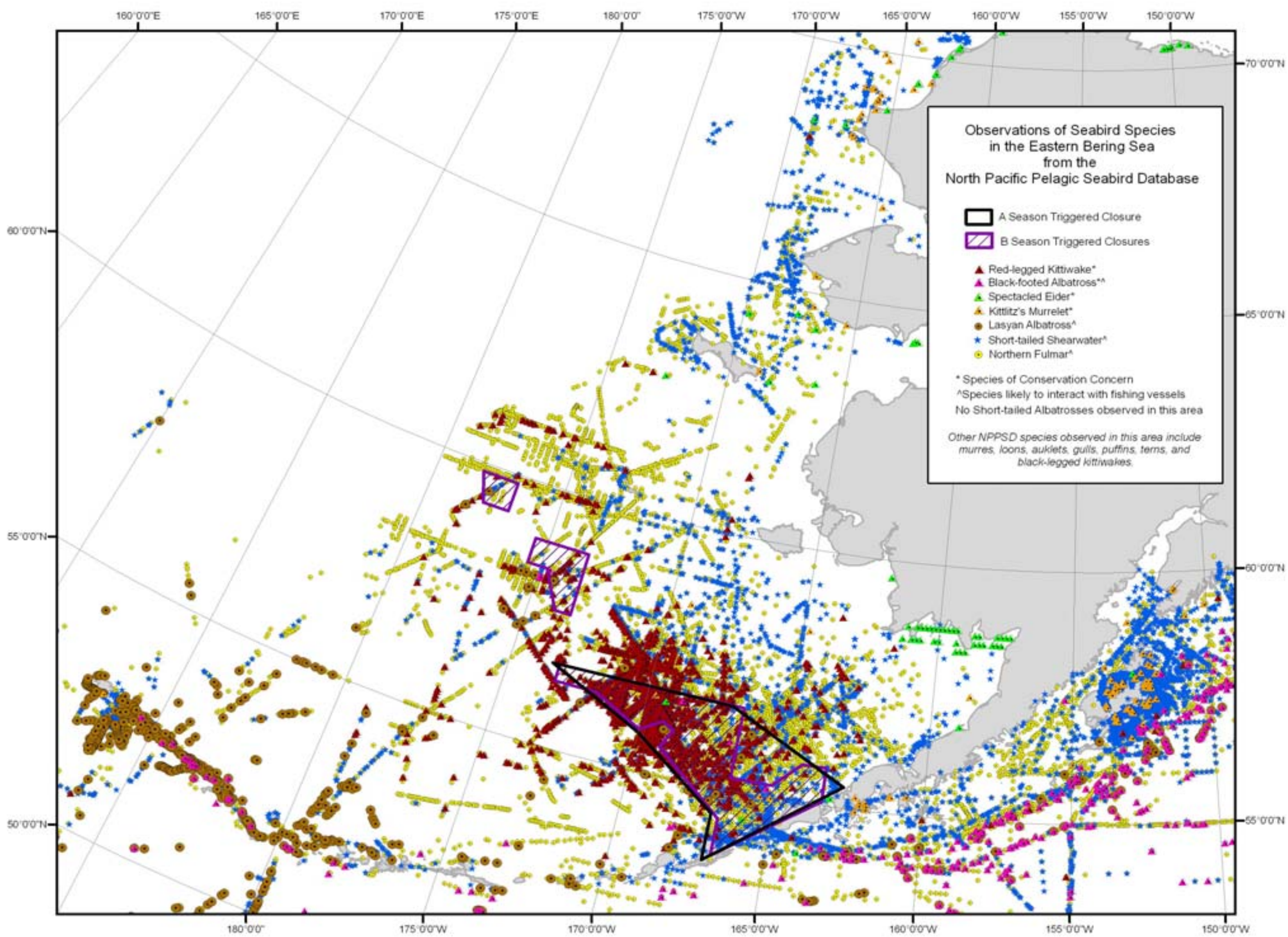

Fig.8-16 Observations of seabird species in the Bering Sea with boundaries of triggered closure areas

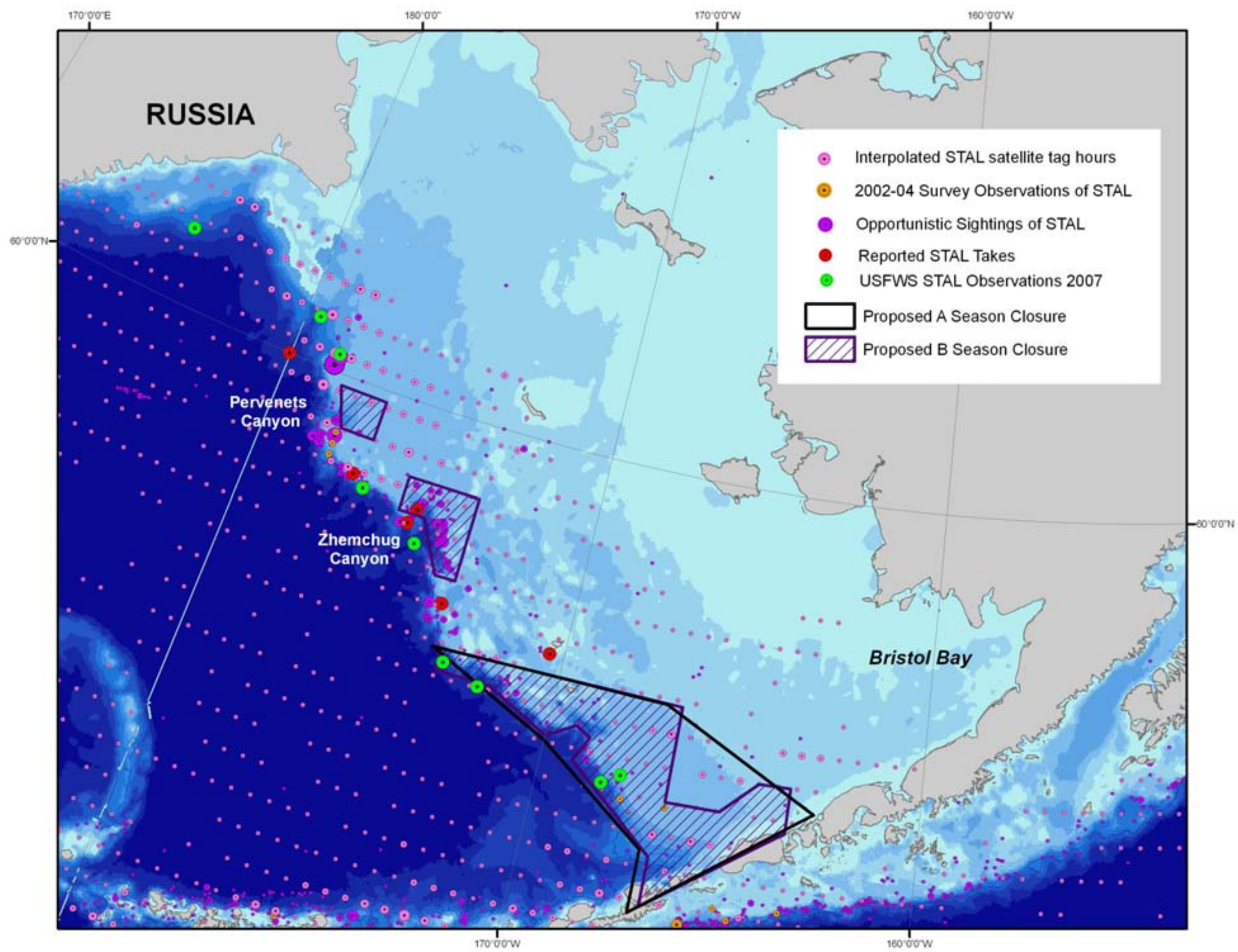

Fig.8-17 Short-tailed albatross takes (NPPSD 2004), satellite tag observations (Suryan 2006a,b), survey data (Melvin et al 2006) and (Kuletz and Labunski unpublished) and Opportunistic Sightings of Short-tailed Albatrosses (Balogh et al 2006) in relation to area closure boundaries. Bigger dots in the same color indicate greater numbers of STAL observed. Comparisons are not valid between colors. Each take (red dot) is reported as a single observation. STAL satellite tags (pink dots) were interpolated and summed over half-degree grid (NMFS 2008).

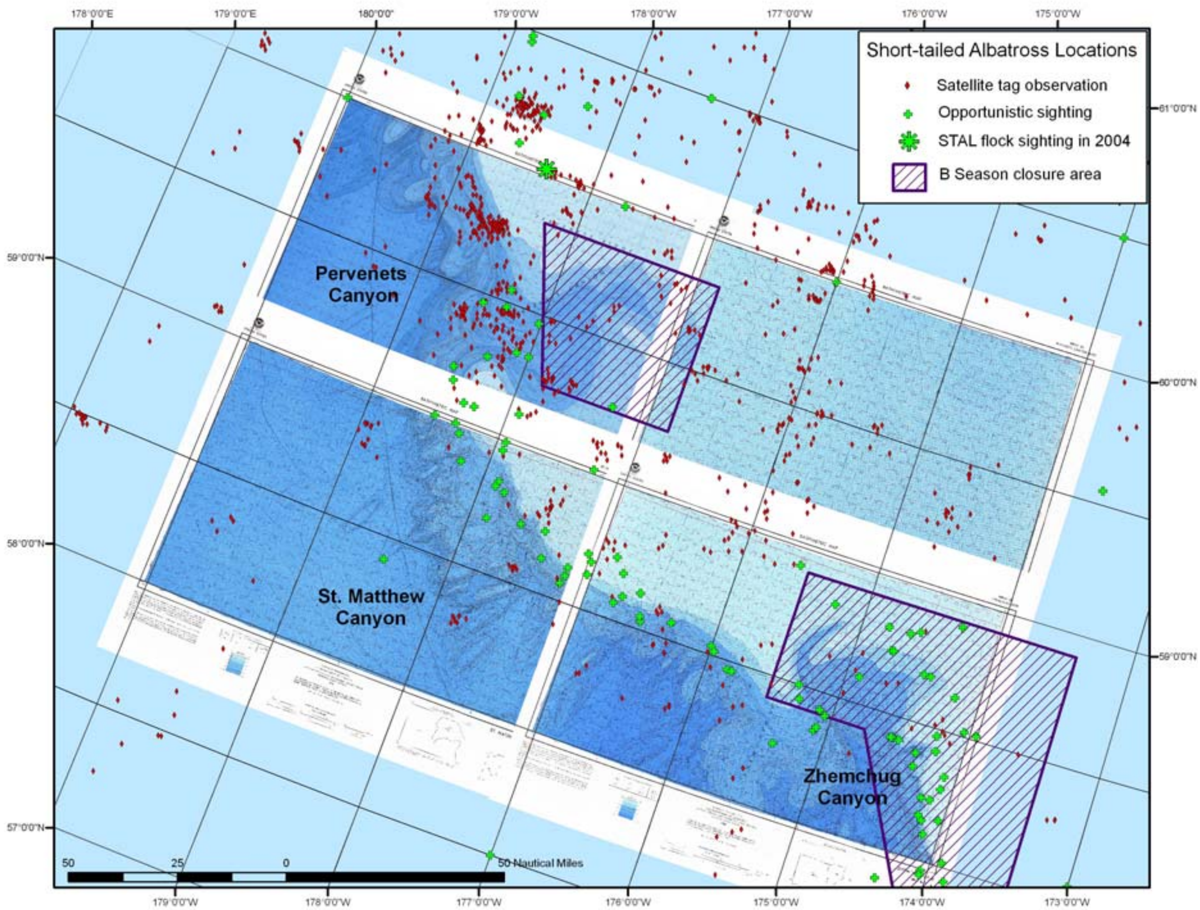

Fig.8-18 STAL locations near Bering Sea Canyons and proposed B season closure areas.

8.2.6.4 Alternatives 4 and 5

The effects of Alternatives 4 and 5 on the incidental take of seabirds are very similar to those of Alternative 2 because it is just a variation on the hard caps and seasonal and sector splits. The 47,591 Chinook salmon cap may result in less pollock fishing which may result in less potential interaction between fishing vessels and seabirds and fewer incidental takes than the 68,392 or 60,000 Chinook salmon. However, because seabirds make substantial use of fish resources discarded from fishing vessels in the form of offal, the net effects of less fishing is unclear.

As noted in Table 8-13, pollock and salmon are not major diet components of seabirds species in the Bering Sea. However, seabird species that do not depend on pollock or salmon may be impacted indirectly by effects that the pelagic trawl gear has on the benthic habitat where they are dependent on benthic prey, such as clams, bottom fish, and crab. The EFH EIS provides a description of the effects of pollock fishing on bottom habitat in the Appendix (NMFS 2005), including the effects of the pollock fishery on the Bering Sea slope and shelf. Pollock trawl gear is known to contact the bottom and may impact benthic habitat. The fisheries effects analysis in the EFH EIS determined that the long term effects indices for pollock fishing on sand/mud and slope biostructure in the Bering Sea were much larger than the effects from other fisheries conducted in the Bering Sea, especially on the slope (Table 8.2-10 in NMFS 2005)

Table 8-13 Bering Sea Seabird Prey (USFWS 2006 and Dragoo 2006)

Species	Foraging Habitats	Prey
Red-legged Kittiwake	**Surface fish feeder**	**Myctophids, squid, amphipods, euphausids, minor amounts of pollock and sand lance**
Black-footed albatross	**Surface fish**	**Fish eggs, fish, squid, crustaceans**
Spectacled Eider	**Diving**	**Mollusks and crustaceans**
Kittlitz's Murrelet	**Surface dives**	**Fish, invertebrates, macroplankton**
Short-tailed shearwater	**Surface dives**	**Crustaceans, fish, squid**
Northern Fulmar	**Surface fish feeder**	**Fish, squid, crustraceans**
Murres (thick-billed and common)	**Diving fish-feeders offshore**	**Fish, crustaceans, invertebrates**
Cormorants (pelagic and red-faced)	**Diving fish-feeders nearshore**	**Bottom fish, crab, shrimp**
Glaucos winged gull	**Surface fish feeder**	**Fish, marine invertebrates, birds**

Fig. 8-19 shows the location of 2006-2008 observed targeted pollock harvest in relation to the bathymetry of the Bering Sea. Note that most targeted Pollock trawls occur between 100 and 200 meters depth in the Bering Sea. It is not known how much seabird species use benthic habitat directly in this area, although research funded by the NPRB has been conducted on foraging behavior of seabirds in the Bering Sea in recent years. Thick-billed murres easily dive to 100 meters, and have been documented diving to 200 meters, while Common murres dive to 100m+ also. Since cephalopods and benthic fish comprise some of their diet, it's not unreasonable to think they could be foraging on or near the bottom (pers. com. Kuletz, October 2008).

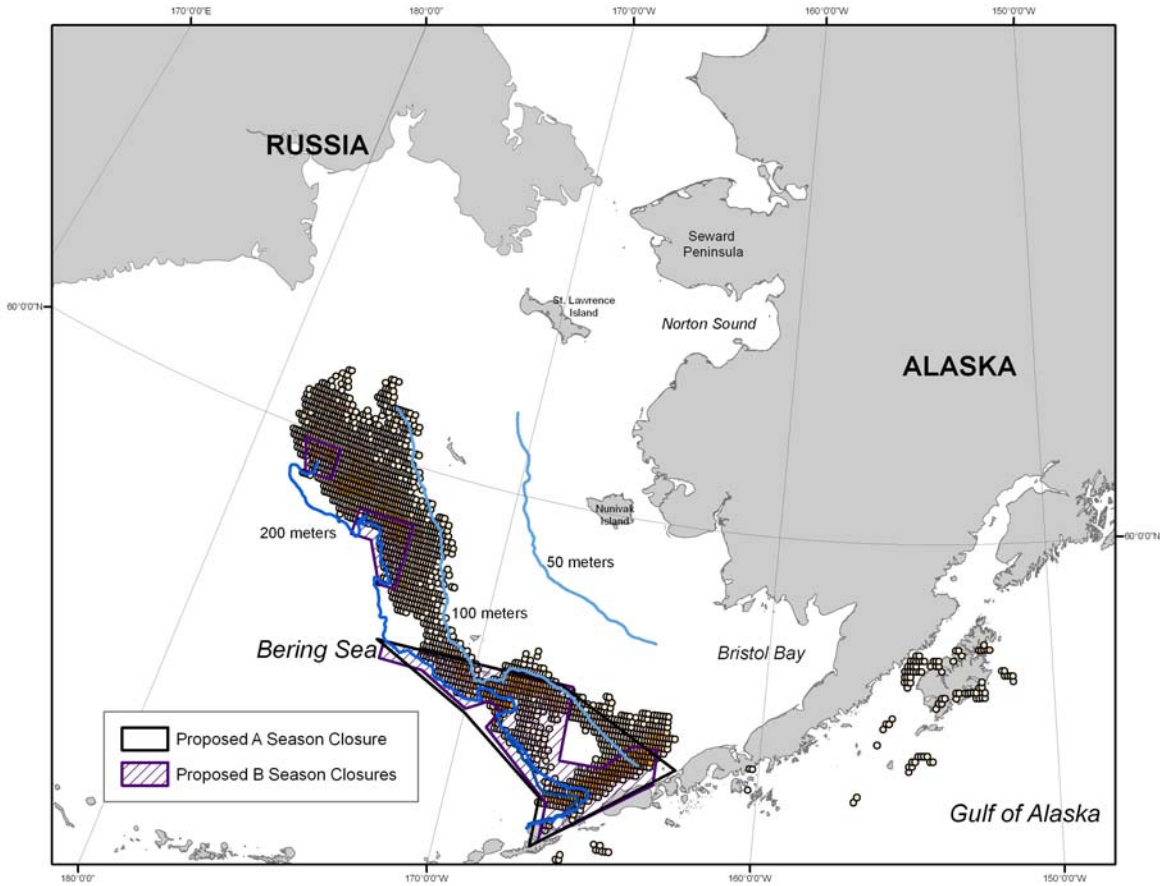

Fig. 8-19 2006-2008 Observed Pollock targeted harvest and Bathymetry of the Bering Sea (data from Steve Lewis, NMFS Alaska Region).

8.2.7 Consideration of Future Actions

8.2.7.1 Other threats to seabird species in Alaska waters

Current and future threats to seabirds other than those analyzed in this document include collisions with aircrafts, plastics ingestion, oil spills and ship bilge dumping, high seas driftnets and gillnet fisheries, and increased flightseeing near glaciers and tour boat traffic (specifically for Kittlitz's murrelets). Table 8-14 lists stressors on seabirds species of concern in Alaska waters.

Table 8-14 Stressors on seabird species of concern in Alaska

Human Activity Stressor	Species affected
Gillnet fisheries	Kittlitz's murrelet, Steller's eider
Oil spills and leaks	Kittlitz's murrelet, red-legged kittiwake, short-tailed albatross
Other hook and line fisheries outside Alaska	black-footed albatross
Tourism/vessel traffic	Kittlitz's murrelet
Feather Hunting	short-tailed albatross, black-footed albatross
Ingestion of Plastics	short-tailed albatross, black-footed albatross, laysan albatross
Collisions with fishing vessels	short-tailed albatross, Steller's eider, spectacled eider
Introduced species	black-footed albatross, red-legged kittiwake
Military eradication programs	black-footed albatross, laysan albatross

8.2.7.2 Recovery of the Short-tailed Albatross

Because the short-tailed albatross population is rapidly increasing at approximately 7% annually (Zador et al. *in review*), the potential for interaction with North Pacific fisheries is also increasing. However, recent modeling of the impact of trawl mortality on the endangered STAL population suggests that even if the current estimated take (two birds in a 5 year period) was increased ten-fold, it would have little impact on the time course of achieving the species' proposed recovery goals, barring significant changes in non-trawl bycatch and a large volcanic eruption at the breeding colony (Zador et al 2008).

8.2.7.3 Continuation of seabird protection measures in Alaska fisheries

As research continues on seabird and fisheries interactions in Alaska waters, gear modification solutions may arise that mitigate potential interactions between trawl cables and seabirds, particularly with short-tailed albatrosses, if the research suggests further mitigation is necessary. In the hook-and-line groundfish and halibut fisheries in Alaska, fishing vessels are required to use seabird avoidance gear in areas where interactions with seabirds are likely to occur. The use of this avoidance gear has likely contributed to a drastic decline in seabird bycatch in hook-and-line fisheries since 2001 (NMFS 2007). These protection measures help to minimize the total effect of Alaska fisheries on seabird populations in Alaska waters. Also, Dietrich et al. 2008 discuss the benefits of using integrated weight lines in further reducing seabird interactions.

8.2.7.4 Actions by other Federal, State, and International Agencies

Currently ADF&G mirrors federal regulations for the use of seabird avoidance measures in state waters. This affords seabird populations in these waters increased protection from interaction with hook-and-line and trawl vessels under state management.

8.2.8 Conclusions

Many seabird species utilize the marine habitat of the Bering Sea. Several species of conservation concern and many other species could potentially interact with trawl cables. The AFSC estimates of takes are small relative to seabird population total estimates, however, those estimates do not include cable-related trawl mortalities. Recent modeling suggests that even if there were to be a large increase in trawl cable incidental takes of short-tailed albatross (the only seabird listed as endangered under the ESA), it would have negligible effects on the recovery of the species. The impacts to seabirds from each of the action alternatives are summarized below in Table 8-15.

Table 8-15 Summary of impacts to seabirds from alternatives in this analysis

Alternative	Component	Impact on Seabird populations in Alaska waters
Alternative 1	Status quo	Seabird takes are at low levels and are mitigated (to some degree) by current spatial restrictions on the pollock trawl fishery in the Bering Sea.
Alternative 2	Hard Cap	Lower caps could decrease potential seabird/fisheries interactions. Higher caps could increase potential seabird/fisheries interactions.
	Seasonal distribution of hard caps	Not enough is known about seasonal seabird distributions and their spatial overlap with seasonal pollock trawl effort to make evaluate statements about seasonal hard caps. More research is needed.
	Other options and components	Other components of this alternative should not affect the amount of impacts to seabird populations.
Alternative 3	Triggered closures	Closing the proposed A and B season closures in the Bering Sea could provide additional protection to seabirds in some locations but could also push pollock trawl effort into areas of higher potential interactions for some species.
Alternative 4	Variable caps with the ICA	Caps would decrease potential for interactions from Alternative 1. Other components of this alternative should not alter the impacts to seabird populations.
Alternative 5	Variable caps with the IPA and performance standard	Caps would decrease potential for interactions from Alternative 1. Other components of this alternative should not alter the impacts to seabird populations.

8.3 Essential Fish Habitat

This section addresses the mandatory requirements for an essential fish habitat (EFH) assessment enumerated in the final rule (67 FR 2343, January 17, 2002) implementing the EFH provisions of the Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267). Importantly, an EFH assessment is required for any federal action that may adversely affect EFH. The mandatory requirements for an EFH assessment are:

- a description of the action;
- an analysis of the potential adverse effects of the action on EFH and the managed species;
- the Federal agency's conclusions regarding the effects of the action on EFH; and
- proposed mitigation, if applicable.

An EFH assessment may incorporate by reference other relevant environmental assessment documents, such as a Biological Assessment, a NEPA document, or another EFH assessment prepared for a similar action.

The Magnuson-Stevens Act defines EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition of EFH, the EFH regulations at 50 CFR 600.10 specify that "waters" include aquatic areas that are used by fish and their associated physical, chemical, and biological properties, and may include areas historically used by fish where appropriate; "substrate" includes sediments, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' entire life cycle.

The criterion for analyzing effects on habitat is derived from the requirement at 50 CFR 600.815(a)(2)(ii) that NMFS must determine whether fishing adversely affects EFH in a manner that is "more than minimal and not temporary in nature." This standard determines whether actions are required to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable.

The final rule for EFH (67 FR 2343; January 17, 2002) does not define minimal and temporary, although the preamble to the rule states, "Temporary impacts are those that are limited in duration and that allow the particular environment to recover without measurable impact. Minimal impacts are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions" (67 FR 2354).

In 2005, NMFS and the Council completed the EIS for EFH Identification and Conservation in Alaska (EFH EIS; NMFS 2005). The EFH EIS provided a thorough analysis of alternatives and environmental consequences for amending the Council's FMPs to include EFH information pursuant to Section 303(a)(7) of the Magnuson-Stevens Act and 50 CFR 600.815(a). Specifically, the EFH EIS examined three actions: (1) describing and identifying EFH for Council managed fisheries, (2) adopting an approach to identify HAPC within EFH, and (3) minimizing to the extent practicable the adverse effects of Council-managed fishing on EFH. The EFH EIS evaluates the long term effects of fishing on benthic habitat features, as well as the likely consequences of those habitat changes for each managed stock based on the best available scientific information.

In this analysis, the effects of fishing on EFH are analyzed for alternative salmon bycatch reduction measures, using the best available scientific information. Analysis included the review of the EFH Descriptions (EFH EIS Appendix D.3), the effects of fishing analysis (EFH EIS Appendix B.2), and associated Habitat Assessment Reports (EFH EIS Appendix F) to conclude whether or not an adverse effect on EFH will occur. A complete evaluation of effects would require detailed information on the distribution and abundance of habitat types, the life history of living habitat, habitat recovery rates, and natural disturbance regimes. Although more habitat data become available from various research projects each fishing year, much is still unknown about EFH in the EEZ off Alaska.

Chapter 4 discusses the effects of this action on pollock through a range of alternatives, including the preferred alternative. Chapter 5 discusses the effects of the action on Chinook salmon through a range of alternatives, including the preferred alternative. Chapter 6 discusses the effects of the alternatives on chum salmon. The following text, including references to Chapters 4, 5, and 6, discusses the potential effects to EFH and incorporates existing, recent, and precautionary measures that lessen the effects to EFH. Specific effects on EFH for alternatives, and the magnitude of the differences between them, are hard to predict with existing data.

8.3.1 Description of the Action

The actions considered in this EFH assessment are the EIS alternatives described in detail in Chapter 2. The important components of these alternatives for the EFH assessment are the gear used, the fishing effort, and the location of the fishery. This information for the pollock fishery is presented in the EFH EIS, and is incorporated here by reference. Appendix B of the EFH EIS contains an evaluation of the potential adverse effects of fishing activities on EFH, including the effects of pelagic trawl gear. Summaries and assessments of habitat information for all federally managed species in the BSAI are provided in Appendix F of the EFH EIS. The EFH EIS describes an overall fishery impact for each fishery based on the relative impacts of the gear used (which is related to physical and ecological effects), the type of habitat fished (which is related to recovery time), and the proportion of that bottom type utilized by the fishery. Under the alternative salmon bycatch reduction measures, pollock fishing effort may change and the location of the fisheries may change to avoid salmon bycatch or because specified areas may be closed to pollock fishing. However, the fishing seasons and the gear used in the fisheries are not likely to change under the alternatives. Changes to the prosecution of the pollock fishery are described in Chapter 4.

8.3.2 Impacts on EFH

Fishing operations change the abundance or availability of certain habitat features (e.g., prey availability or the presence of living or non-living habitat structure) used by managed fish species to spawn, breed, feed, and grow to maturity. These changes can reduce or alter the abundance, distribution, or productivity of that species, which in turn can affect the species' ability to support a sustainable fishery and the managed species' contribution to a healthy ecosystem (50 CFR 600.10). The outcome of this chain of effects depends on characteristics of the fishing activities, the habitat, fish use of the habitat, and fish population dynamics. The duration and degree of fishing's effects on habitat features depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of habitat features.

The Bering Sea pollock fishery harvests pollock with pelagic trawl gear in pelagic habitat. Pelagic habitat is identified as EFH for marine juvenile and maturing salmon. Amendments 7 and 8 defined salmon EFH in the FMP for the Salmon Fisheries in the EEZ off the Coast of Alaska. The EFH EIS, in Section 3.2.1.5 and Appendix F, provides habitat descriptions for the five salmon species managed under the FMP. Briefly, marine salmon stocks school in pelagic waters and utilize ocean conditions to grow and mature before returning to nearshore and freshwater adult spawning areas. Salmon are known to associate with ocean ledges and features, such as ridges and seamounts. Salmon utilize these features because the features attract and concentrate prey.

Appendix B to the EFH EIS describes how pelagic trawl gear impacts pelagic habitat (NMFS 2005). The EFH EIS concluded that pelagic effects from fisheries are minimal because no information was found indicating significant effects of fishing on features of pelagic waters serving a habitat function for managed species. The Bering Sea pollock fishery only interacts with salmon habitat in the ocean, and the concerns about these interactions center on effects on bycatch of prey and prey availability. Salmon prey (copepods, squid, herring, and other forage fish) are subject to only a few targeted fisheries outside of the EEZ, such as the State of Alaska herring fisheries and international squid fishery. However, the pollock fishery does catch salmon prey species, including squid, capelin, eulachon, and herring. Currently, the catch of these prey species is very small relative to overall population size of these species, thus fishing activities are considered to have minimal and temporary effects on prey availability for salmon. Chapter 7 provides more information on the impacts of the Bering Sea pollock fishery on these prey species.

Appendix B to the EFH EIS also describes how pelagic trawl gear impacts benthic species and habitat (NMFS 2005). The EFH EIS notes that "pelagic trawls may be fished in contact with the seafloor, and there are times and places where there may be strong incentives to do so, for example, the EBS shelf during the summer" (NMFS 2005). Trawl performance standards for the directed pollock fishery at 50 CFR 679.7(a)(14) reduce the likelihood of pelagic trawl gear use on the bottom. However, concern exists about the contact of pelagic trawl gear on the bottom and the current standards used to limit bottom contact (from June 2006 minutes of the SSC and AP, available at: http://www.fakr.noaa.gov/npfmc/minutes/minutes.htm). Flatfish and crab bycatch in the pollock fishery also shows that pelagic gear contacts the bottom. The description of impacts by pelagic trawl gear on habitat in this document is based on the best available science, but may be considered controversial with some believing the impact may be more than described.

The results of the EFH EIS analysis of the effects of fishing on benthic habitat features determined the long-term effect index (LEI) to represent the proportion of feature abundances (relative to an unfished state) that would be lost if recent fishing patterns were continued indefinitely. The LEI was 10.9% for the biological structure of sand/mud and slope habitats of the eastern Bering Sea where fishing effort is concentrated, and recovery rates are moderately low. The analysis also calculated the proportion of each LEI attributable to each fishery. The pollock pelagic trawl fishery was the largest single component (4.6%) of the total effects on living structure in the eastern Bering Sea sand/mud habitat. The combined effects of the bottom trawl fisheries made up all of the remaining 6.3%. Nearly all (7.2%) of the LEI for living structure on the eastern Bering Sea slope was due to the pollock pelagic fishery. Based on this analysis, the EFH EIS determined that the fishing effects are not limited in duration and therefore not temporary. However, the EFH EIS considered LEIs of less than 11% as small.

The EFH EIS also evaluated the effects on managed species to determine whether stock condition indicates that the fisheries affect EFH in a way that is more than minimal. To conduct this evaluation, the analysts first reviewed the LEI from the fishing effects model to assess overlap with the distribution of each stock. The analysts then focused on habitat impacts relative to the three life-history processes of spawning/breeding, feeding, and growth to maturity. Finally, the analysts assessed whether available information on the stock status and trends indicated any potential influence of habitat disturbance due to fishing. Based on the available information, the EFH EIS analysis found no indication that continued fishing at the current rate and intensity would affect the capacity of EFH to support life history processes of any species. In other words, the effects of fishing of EFH would not be more than minimal.

Due to the nature of this action, the Bering Sea pollock fishery as modified by the proposed action is not predicted to have additional impacts beyond those identified in the EFH EIS. Based on the analysis presented in the EFH EIS and summarized above, NMFS concludes that Alternative 1 would impact EFH for managed species, but that the available information does not identify effects of fishing that are more than minimal. In other words, effects may occur but they would not exceed the minimal and temporary limits established by 50 CFR 600.815(a)(2).

The Alternatives 2, 4, and 5 caps would, to the extent that they prevent the pollock fleet from harvesting the pollock TAC and therefore reduce pollock fishing effort, reduce the pollock fisheries impacts on EFH from status quo. The RIR provides a discussion of the ability of the pollock fleet to harvest the TAC under Alternative 2, 4 and 5. It is not possible to predict how much less fishing effort would occur in years when a given cap level was constraining because the fleet will have strong incentives to reduce bycatch through other means, such as gear modifications and avoiding areas with high salmon catch rates, to avoid reaching the hard cap and closing the fishery. Additionally, under Alternatives 4 and 5, a portion of the fleet would have the opportunity to operate under an ICA or IPA with incentives to avoid bycatch. And, depending on the extent vessels move to avoid salmon bycatch or as pollock catch rates decrease, pollock trawling effort may increase even if the fishery is eventually closed due to a hard cap.

The Alternative 3 trigger closures would close identified areas when a specific cap level is reached. The area closure would reduce the pollock fisheries impacts to EFH in the closed area, but it would increase the fishing effort and therefore the impacts in the adjoining areas. However, many areas identified as having vulnerable or sensitive habitat features, such as canyons, hard corals, and skate nursery areas would be contained in the closure area. Since the total amount of pollock harvested and the total effort would not change under Alternative 3, it is reasonable to conclude that the overall impacts on EFH would be similar to Alternative 1. As with Alternative 2, fishing effort may increase as vessels move to avoid salmon bycatch or as pollock catch rates decrease.

8.3.3 Mitigation

Currently, pelagic trawl gear is subject to a number of area closures to protect habitat and marine species: the Steller Sea lion closure areas, the Nearshore Bristol Bay closure, the Pribilof Islands Habitat Conservation Zone. If new information emerges to indicate that the Bering Sea pollock trawl fishery is having more than a minimal impact on EFH, the Council may consider additional habitat conservation measures.

8.3.4 Consideration of Future Actions

The following reasonably foreseeable future actions may have a continuing, additive and meaningful relationship to the effects of the alternatives on EFH. These actions are described in Chapter 3.

8.3.4.1 Ecosystem-sensitive management

Habitat is one component of the ecosystem in which the pollock fishery is prosecuted. If the implementation of an ecosystem approach to management results in reduced or modified fishing, the impacts of the proposed action will likely be reduced. Future fisheries management measures will be developed that consider the entire ecosystem, including habitat. Ongoing habitat research will increase our understanding of the spatial distribution of different habitats, the importance of different habitats to different life stages of fish species, the impact of different types of fishing gear on different types of living and nonliving habitat, and the recovery rates for different types of habitat. Ongoing research is summarized in the Ecosystems Considerations chapter of the SAFE report (Boldt 2007).

8.3.4.2 Traditional management tools

Since portions of habitat are impacted each year by fishing activities and since some of those habitats may require exceptionally long periods to recover from fishing impacts (i.e., slow growing, long lived corals; NMFS 2005, NMFS 2008), the current pollock fishery, in combination with future pollock fisheries, may have lasting effects on habitat. As the slow-growing, long-lived components of the habitat are impacted by cumulative years of fishing, there is likely to be cumulative mortality and damage to living habitat and changes to the benthic community structure. Species that are able to recover faster from fishing impacts may displace the longer-lived, slower-growing species, changing the structure and diversity of the benthic community. Improved monitoring and enforcement would improve the effectiveness of existing and future EFH conservation measures by ensuring the fleet complies with the protection measures, and thus, reduces the impacts of the future harvest specifications.

The EFH EIS noted that "…habitat loss due to fishing off Alaska is relatively small overall, with most of the available habitats unaffected by fishing…[b]ased on the best available scientific information, the EIS analysis concludes that despite persistent disturbance to certain habitats, the effects on EFH are minimal because the analysis finds no indication that continued fishing activities at the current rate and intensity would alter the capacity of EFH to support healthy populations of managed species over the long term" (NMFS 2005). Since past fishing activity has not resulted in impacts that are more than minimal, and future fishing activity is expected to be constrained by reasonably foreseeable future actions, the future effects of a continued fishery on EFH are predicted to continue to be minimal.

8.3.4.3 Other Federal, State, and international agency actions

The Minerals Management Service (MMS) consults with NMFS regarding leasing, exploration, and development activities and any effects on EFH. MMS prepares environmental assessments for upcoming sales in their Outer Continental Shelf Leasing Program. MMS assessed the cumulative effects of such activities on fisheries and finds only small incremental increases in effects of development are unlikely to significantly impact fisheries and EFH (Minerals Management Service 2003). Most recently, MMS has re-opened discussion to lease within the North Aleutian Basin (NAB, also known as Bristol Bay), as the moratorium to lease in this area was removed. Federally managed fisheries, including pollock, Pacific cod, crab, and scallop, are within this lease area. In fact, the overlap of the lease area is directly atop several of the nation's richest and robust commercial fisheries. Further, EFH has been described for over 40 species of federally managed fish with the NAB lease area. (NAB Energy-Fisheries Workshop at http://seagrant.uaf.edu/conferences/2008/energy-fisheries/info.html; MMS OCS 2007-066 Literature and Information Related to the Natural Resources of the NAB of Alaska.)

8.3.4.4 Private actions

Other factors that may impact marine benthic habitat include ongoing non-fishing commercial, recreational, and military vessel traffic in Alaskan waters and population growth. Appendix G of the EFH EIS identifies 24 categories of upland, riverine, estuarine, and coastal/marine activities that may have adverse effects on EFH (NMFS 2005). Little is known about the impacts of the listed activities on EFH in the Bering Sea. However, Alaska's coasts are currently relatively undeveloped, as compared to coastal regions elsewhere. Despite the likelihood of localized impacts, the overall impact of these activities on EFH during the period under consideration is expected to be insignificant.

8.3.5 Conclusions

All alternatives would have impacts on EFH similar to those found in the EFH EIS. NMFS concludes that all of the alternatives would affect EFH for managed species. However, best available information does not identify any effects of fishing as significantly adverse. In other words, effects may occur from fishing, however these effects do not exceed the minimal and temporary limits established by 50 CFR 600.815(a)(2). Alternatives 2, 4, and 5, to the extent that the cap level would close the pollock fishery before the TAC is harvested, could have less of an impact on EFH. Alternative 3 may have less of an impact because it would close, if a trigger cap was reached, areas that include important habitat. If information indicates that the Bering Sea pollock trawl fishery is having an increased impact on EFH as a result of salmon bycatch reduction measures, then the Council could consider habitat conservation measures for pelagic trawl gear.

The continuing fishing activity in the years 2008 to 2015 is potentially the most important source of additional annual adverse impacts on marine benthic habitat in the action area. The size of these impacts would depend on the size of the fisheries, the protection measures in place, and the recovery rates of the benthic habitat. However, a number of factors will tend to reduce the impacts of fishing activity on benthic habitat in the future. These include the trend towards ecosystems management. Ecosystem-sensitive management will increase understanding of habitat and the impacts of fisheries on them, protection of EFH and HAPC, and institutionalization of ecosystems considerations into fisheries governance. With diligent oversight, the effects of actions of other federal, state, and international agencies and private parties are likely to be less important when compared to the direct interaction of commercial fishing gear with the benthic habitat.

8.4 Ecosystem Relationships

The action area for Bering Sea salmon bycatch management is subject to periodic climatic and ecological "regime shifts." These shifts change the values of key parameters of ecosystem relationships, and can lead to changes in the relative success of different species.

Regime shifts are natural phenomena that have important implications for future human actions in the Bering Sea. The following discussion of these phenomena has been summarized from the Ecosystem Considerations chapters of the 2005 SAFE report and the 2007 SAFE report (NPFMC 2005 and 2007).

Predicting regime shifts will be difficult until the mechanisms that cause the shifts are better understood. It will require better understanding of the probability of certain climate states in the near-term and longer term, and the effects of this variability on individual species' production, distribution, and food webs. Future ecosystem assessments may integrate various climate scenarios into the multispecies and ecosystem forecasting models by using assumptions about the effects of climate on average recruitment of target species.

8.4.1 North Pacific

In the past three decades the North Pacific climate system experienced one major and two minor regime shifts. A major transformation, or regime shift, occurred in atmospheric and oceanic conditions around 1977, part of the Pacific Decadal Oscillation, which represents the leading mode of North Pacific sea surface temperature variability and is related to the strength of the Aleutian low. During the period 1989-1997, atmospheric pressure tended to be above normal in the high latitudes and below normal in the mid-latitudes, which translated to a relative cooling in the Bering Sea. Since 1998, the sea surface temperature in the eastern Bering Sea became anomalously warm, whereas colder-than-normal conditions were established along the U.S. West Coast. During the winter of 2003, temperatures were above the 1971-2000 average in the Bering Sea and near the average in the Gulf of Alaska and the U.S. West Coast. El Niños were present in both the winters of 2003-2004 and 2004-2005. The increase in sea surface temperature along the coast of South America which is associated with El Niños, was brief, and conditions returned to neutral in July.

It has been shown that the North Pacific atmosphere-ocean system included anomalies during the winter of 2004-05 that were unlike those associated with the primary modes of past variability. This result suggests a combination of two factors: (1) that the nature of North Pacific is actually richer in variability than appreciated previously, and (2) that there is the potential for significant evolution in the patterns of variability due to both random, stochastic effects and systematic trends such as global warming.

The Pacific Decadal Oscillation transitioned from moderately positive in early 2006 to moderately negative in the summer/early fall of 2006 and has slowly increased to weakly positive values during the summer of 2007. When the Pacific Decadal Oscillation is positive sea surface temperature anomalies tend to be positive along the North American coast, extending to the south-eastern Bering Sea. There were weak-moderate El Nino conditions near the end of 2006. Neutral conditions returned by early spring 2007. A cooling trend resumed in summer 2007 and it now appears a weak La Nina formed in the fall/winter of 2007-08.

8.4.2 Bering Sea

The major shift in the Bering Sea occurred after 1977, when conditions changed from a predominantly cold Arctic climate to a warmer subarctic maritime climate. The very warm winters of the late 1970s and 1980s were followed by cooler winters in the 1990s. Since 1998, the Bering Sea region has had milder winters. The anomalously warm winter of 2005 followed similarly warm winters of 2003 and 2004. This warming is comparable to major warm episodes in the late 1930s and late 1970s – early 1980s. The spring transition is occurring earlier, and the number of days with ice cover after March 15 has a significant downward trend. In 2005, the ice cover index reached the record low value. The lack of ice cover over the southeastern shelf during recent winters resulted in significantly higher heat content in the water column. Sea surface temperature in May 2005 was above its long-term average value, which means that the summer bottom temperatures also will likely be above average.

In 2007, the Bering Sea experienced a relatively cold winter and spring with pronounced warming in late spring resulting in above normal upper ocean temperatures by mid-summer. This and the presence of a substantial cold pool resulted in strong thermal stratification on the Bering Sea shelf. The amount of ice and the extent of the cold pool can affect production and distribution of marine organisms. Unlike the northern Bering Sea and Arctic Ocean hot spots, the rate of warming in the southern Bering Sea is slowing down, suggesting a large natural variability component to recent extremes in addition to a background anthropogenic contribution toward warmer temperatures.

8.4.3 Bering Sea warming and loss of sea ice

Since 1921, there have been three multidecadal regimes in surface air temperatures in the North Pacific: 1921-1939 (warm), 1940-1976 (cold), and 1977-2005 (warm; Rodionov et al. 2005). Depth-integrated temperatures in the southeast Bering Sea indicate that there was a shift to even warmer conditions in the Bering Sea that began in the spring of 2000 (Rodionov et al. 2005). It is worth noting that the two previous regimes had a similar pattern, when surface air temperature anomalies were strongest at the end of the regime, right before the system switched to a new one. In the current warm regime, the magnitude of surface air temperature fluctuations has been steadily increasing since the mid-1980s, and the Bering Sea may become even warmer before it will switch to a new cold regime. If the regime concept is true, this switch may happen soon, especially given the uncertain state of the North Pacific climate, suggesting that it may be in a transition phase. During the last three decades there has been a marked decrease in ice extent, duration and concentration over the southeastern Bering Sea (Stabeno et al. 2006).

Stabeno et al. (2006) state that the decrease in sea ice directly impacts water column temperature and salinity. The average temperature in the southeast Bering Sea has increased by ~3°C over the last decade, with warmer temperatures in both winter and summer. Ocean temperatures have profound influences on the distribution of many species in the eastern Bering Sea, as well as the timing of the spring transition, which is occurring earlier (Rodionov et al. 2005). Stabeno et al. (2006) also state that the sea ice over the shelf also determines the timing and nature of the spring phytoplankton bloom. Recent observations also indicate a disappearance in the southeast Bering Sea of cold water invertebrate species which were previously common (e.g. *Calanus marshallae*; *Themisto libulella*, *Chionoecetes opilio*). Populations of smaller copepods, such as Pseudocalanus spp., are much more numerous and may be much more productive in the warmer years. The direction of climate change affects different components of the ecosystem in different ways and will affect the transfer of energy through the food web.

The distributions of adult and juvenile fish respond to water temperatures. For example, the distribution of species such as Arctic cod that prefer cold temperatures may be retreating to the northern portion of the Bering Sea. On the other hand, Walleye pollock (*Theragra chalcogramma*) tend to avoid water below 2°C (e.g. Wyllie-Echeverria 1995, Overland and Stabeno 2004), and the disappearance of the summer cold pool over the shelf may result in the distribution of pollock extending further north. Spencer (2005) has shown rock sole and flathead sole are distributed further north or northwest in warm years relative to cold years.

The Bering Sea Interagency Working Group (2006) states "Changes in the finfish and shellfish communities have occurred since the 1980s, but these have included both increases and decreases in overall abundance and changes in species composition. Walleye pollock and Pacific cod abundances have fluctuated but remain at high levels. Flatfish, as an assemblage, are at high levels, but individual species have changed their relative importance (e.g., Greenland turbot has decreased in importance and arrowtooth flounder has increased). Recruitment of sockeye salmon stocks has been strong with the exception of the Kvichak run; some runs of Chinook and chum salmon have shown reduced recruitment in the Yukon and Kuskokwim Rivers (Kruse 1998). …Snow crab, the dominant species, has been decreasing, and there is evidence that populations may be retreating to the north with the cold bottom water (Orensanz et al. 2004)."

"…there is much concern about ice-dependent seals (i.e., ring, spotted, bearded, and ribbon) that require ice for different parts of their life history (molting and pupping). There is also concern that the retreating ice is transporting some benthic-feeding, ice-dependent seals and walrus away from suitable feeding grounds (e.g., shallow, productive benthic habitats)."

In spring 2007, Bering Sea sea ice lasted for almost two months just to the north of the Pribilof Islands, contrasting with previous years since 2000. The presence of sea ice together with below normal ocean temperatures likely resulted in the first ice edge primary production bloom since 1999. Additionally, there was a record low total area of sea ice in the Arctic in the summer of 2007. The implications of this trend for the North Pacific are likely to include a tendency for a shorter season during which intense cold-air outbreaks of Arctic origin can occur.

In the Bering Sea, the year 2008 was the third sequential year with cold temperatures and extensive springtime sea ice cover, partially due to La Nina and a positive Arctic Oscillation. Bering Sea bottom and sea surface temperatures were cold in summer 2008. In the summers of 2006-2008, the extent of the cold pool increased from low values observed during 2000-2005. Cold pool size and location may affect the distribution and dynamics of Bering Sea fish species. The Bering Sea contrasted with much of the larger Arctic which had extreme summer minimum sea ice extents in 2007 and 2008 and positive autumn 2007 surface temperature anomalies north of Bering Strait of greater than 5°C. Despite continuing warming trends throughout the Arctic, Bering Sea climate will remain controlled by large multi-annual natural variability, relative to a small background trend due to an anthropogenic (global warming) contribution. Over the next five years the Bering Sea may shift back toward warmer temperatures and less sea ice.

8.4.4 Ocean Acidification

The increase in carbon and a decrease in pH in the surface waters of a large section of the northeast Pacific Ocean is direct evidence of ocean acidification (Kleypas et al. 2006). This increase in acidification is attributed to anthropogenic sources (i.e., burning of fossil fuels). Increased acidification affects the calcification process utilized by calcium-secreting organisms, such as corals and zooplankton (Kleypas et al. 2006). Skeletal growth rates of these types of organisms are reduced by the increase in acidification, increased dissolution of carbonate and decreased $CaCO_3$ saturation state; however, the combined effect of acidification, lights, nutrients, and temperature are unknown (Kleypas et al. 2006).

Acidification could have implications, as yet unknown, for the food web of the northeast Pacific Ocean. Kleypas et al. (2006) outline one hypothesized ecosystem response to increased acidification: as the CO_2/carbonate chemistry of seawater changes, then calcifying species may undergo shifts in their latitudinal distributions and vertical depth ranges. Kleypas et al. (2006) points out that the potential impacts of increased CO_2 on planktonic ecosystem structure and functions are unknown because we do not known (1) whether planktonic calcifiers require calcification to survive, (2) the capacity for planktonic organisms to adapt to lower saturation states (or reduced calcification rates), and (3) the long-term impacts of elevated CO_2 on reproduction, growth, and survivorship of planktonic calcifying organisms. However, marine plankton is a vital food source for many marine species and their decline could have serious consequences for the marine food web.

However, a more acidic ocean might not be harmful to all organisms that produce calcium carbonate. Recent research indicates that increased carbon dioxide in the Earth's atmosphere is causing microscopic ocean plants to produce greater amounts of calcium carbonate (chalk) and that calcification by phytoplankton could double by the end of this century (Iglesias-Rodriguez et al. 2008). This is important because the majority of ocean calcification is carried out by coccolithophores. The Bering Sea experienced coccolithophore blooms in 1997 and 1998. Coccolithophore blooms occur when light intensity is high and nutrient levels are low and are evidence that the normal nutrient pump is not working. Coccolitophore blooms are not thought to directly harm salmon, however, they may be indicators that the conditions that support healthy Chinook salmon runs are not present. More information on the relationship between coccolitophores and salmon is presented in Kruse 1998.

Research is ongoing to better understand ocean acidification and the potential effects on fisheries from the changing chemical properties of the ocean. NOAA laboratories contribute to several international; and national research program that study ocean acidification. More information about ocean acidification is available on NOAA's Ocean Acidification website at http://www.pmel.noaa.gov/co2/OA/. Additionally, Section 701 of the MSRA requires that the Secretary of Commerce request the National Research Council study of the acidification of the oceans and how this process affects the United States.

8.4.5 Recent ecosystem trends

The following is a summary of recent trends from the 2007 and 2008 SAFE report Ecosystem Considerations chapters that are relevant to the Bering Sea and this proposed action.

8.4.5.1 Fishing Effects on Ecosystems

- No significant adverse impacts of fishing on the ecosystem relating to predator/prey interactions, energy flow/removal, or diversity were noted, either in observed trends or ecosystem-level modeling results
- No BSAI groundfish stock or stock complex is overfished and no BSAI groundfish stock or stock complex is being subjected to overfishing. One crab stocks is overfished
- Recent exploitation rates on biological guilds are within one standard deviation of long-term mean levels. An exception was for the forage species of the Bering Sea (dominated by walleye pollock) which has relatively high exploitation rates 2005-2007 as the stock declined. The 2008 and 2009-recommended catch levels are again within one standard deviation of the historical mean. This is a more direct measure of catch with respect to food-web structure than are trophic level metrics.
- Chinook salmon bycatch increased in recent years and for all of Alaska was essentially unchanged in 2006 compared to 2005, but it increased by about 18% in the BSAI where, in 2006 for the first time ever, the Chinook SSA was closed to fishing during the pollock 'A' season. The closure resulted in a large economic impact on the pollock fishery during the winter roe season.
- The "other salmon" bycatch (primarily chum) has also increased dramatically in 2003-2005 and decreased by about 54% in 2006. The increases in 2003 and 2005 and the decrease in 2006 are in line with changes in salmon abundance.
- Non-target catch of Habitat Areas of Particular Concern biota and non-specified biota has decreased and non-target forage fish catch has increased in the BSAI.
- Analysis of the trends in the size of eastern Bering Sea fishes indicates there has not been a systematic decline in the amount of large fish from 1982 to 2006.

8.4.5.2 Ecosystem Trends

- In the Bering Sea, the year 2008 was the third sequential year with cold temperatures and extensive springtime sea ice cover, partially due to La Nina and a positive Arctic Oscillation.

- Bering Sea bottom and sea surface temperatures were cold in summer 2008. In the summers of 2006-2008, the extent of the cold pool increased from low values observed during 2000-2005. Cold pool size and location may affect the distribution and dynamics of Bering Sea fish species.

- The Bering Sea contrasted with much of the larger Arctic which had extreme summer minimum sea ice extents in 2007 and 2008 and positive autumn 2007 surface temperature anomalies north of Bering Strait of greater than 5°C.

- Despite continuing warming trends throughout the Arctic, Bering Sea climate will remain controlled by large multi-annual natural variability, relative to a small background trend due to an anthropogenic (global warming) contribution. Over the next five years we should look for the next shift back toward warmer temperatures and less sea ice.

- Demersal groundfish species in the BSAI had above-average recruitments from the mid- or late 1970s to the late 1980s, followed by below-average recruitments during most of the 1990s. There is an indication for above-average recruitment from 1994-2000 (with the exception of 1996). In the Gulf of Alaska, recruitment has been below average across stocks since 2001.
- Annual groundfish surplus production in the eastern Bering Sea decreased between 1978 and 2005. Declines in production may be a density-dependent response to observed increases in biomass and aging populations of groundfish.
- There was a larger than expected return of age-4 and age-5 Togiak herring in the 2006 fishery, suggesting a strong recruitment event in the future.
- Jellyfish catch-per-unit-effort in the Bering Sea survey continues to be low. Declines in biomass of most species of jellyfish were observed in the BASIS survey in 2006 and 2007 compared to 2004 and 2005.
- Eulachon catch per unit effort sampled in the NMFS bottom trawl survey was the highest of the last 4 years in the eastern Bering Sea.
- The overall trend for the western stock of Steller sea lions in Alaska through 2007 is either stable or declining slightly.
- Pribilof Islands northern fur seal pup production continued to decrease in 2006; whereas, Bogoslof Island pup production increased (1995-2007). Neither trend is due solely to migration between islands.
- Trends in harbor seal populations are mixed, but overall populations are lower than they were in the 1970s and 1980s. Harbor seal populations in the Bering Sea and Aleutian Islands have decreased from the late 1970s to the 1990s.
- Reliable estimates for the current minimum population size, abundance, and trend of the Alaska stocks of bearded, ribbon, ringed or spotted seals are unavailable.

8.4.5.3 Climate Effects on Ecosystems and Ecosystem Trends

- In a comparison between warm years (2002 to 2005) and cold years (2006 and 2007) in the Bering Sea BASIS survey, age-0 EBS pollock appear to be more broadly distributed and of higher relative abundance during warm years. They tended to be more cannibalistic in warm years and had lower energy density; whereas, in cool years they tended to switch to euphausiid-foraging and had higher energy densities. Juvenile sockeye salmon tended to consume age-0 pollock during warm years and also switched to sandlance and euphausiids in cool years. Overall there appears to be a negative relationship between relative abundance of age-0 pollock from the BASIS survey (high in recent warm years) and subsequent recruitment to age-1 pollock (low following warm years).

- Bering Sea zooplankton biomass appears to have returned towards average levels in 2006-2007 since a prolonged low period in 2001-2005.
- The relative CPUE of Arctic cod increased dramatically in the area of the cold pool in the summer Bering Sea bottom trawl survey.
- Togiak herring abundance in 2007 was below average but the stock is considered stable.
- EBS groundfish condition was low in 1999 and tended to be high in 2002-2003. Condition also tended to be higher on the outer shelf, but this may be due to the survey sampling timing.
- Spring wind-driven advection of rock sole larvae was onshore to favorable nursery areas in 2008 suggesting the potential for an above average strength 2008 year class.
- In the Bering Sea, there was an indication of a return to below average groundfish recruitment across multiple stocks in 2004.
- Overall annual surplus production in the EBS has been relatively stable. Annual surplus production of all non-pollock species in the EBS, however, decreased significantly from 1977 to 1995, increased and then has been very stable since 2000.

8.4.6 Impacts on Ecosystem Relationships

The impacts of the groundfish fisheries on ecosystem relationships were analyzed in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007). That EIS examines the impacts of the fisheries, as currently managed, on predator-prey relationships, energy flow and removal, and diversity. Predator-prey relationships were evaluated with respect to four indicators: (1) pelagic forage availability, (2) spatial and temporal concentration of fishery impact on forage, (3) removal of top level predators, and (4) introduction of non-native species (see Section 8.4.7). The EIS concluded that, overall, there appears to be little indication of fishing down the trophic level. The primary impact to pelagic forage availability is the predicted decline of pollock in the near-term which reduces their availability as forage sources. Biomass is likely to increase subsequently. There appear to be few other issues with forage species. The impacts on the movement of energy through the ecosystem were evaluated with respect to two indicators: (1) removal of energy from the system through fishing operations, and (2) the redirection of energy flow into new pathways by fishing operations. The EIS concluded that biomass removals are believed to be small with respect to total system biomass. Diversity was evaluated with respect to (1) species diversity, (2) functional diversity (or the diversity of components playing different roles in the ecosystem) and (3) genetic diversity. The EIS concluded that measures of species richness and diversity do not suggest a concern and that functional diversity is not considered a concern. However, impacts on genetic diversity are unknown to a considerable extent in the absence of a baseline genetic survey.

Due to the nature of this action, the Bering Sea pollock fishery as modified by the proposed action is not predicted to have additional impacts beyond those identified in the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a). Based on the analysis presented in the Harvest Specifications EIS and summarized above, NMFS concludes that the pollock fisheries, as prosecuted under Alternative 1, would have similar ecosystem impacts. The impacts of Alternatives 2, 3, 4, and 5, on each component of the ecosystem is detailed in the chapter addressing that component. Based on the analysis in those chapters, none of the alternatives would have a significant impact on any individual component, to the extent that the impacts are known. The Alternative 2 hard caps, to the extent that they prevent the pollock fleet from harvesting the pollock TAC and therefore reduce pollock fishing effort, would reduce the pollock fisheries impacts on ecosystem relationships from status quo. The Alternative 4 and 5 hard cap structures would have similar impacts as Alternative 2. The RIR provides a discussion of the ability of the pollock fleet to harvest the TAC under the hard cap options. It is not possible to predict how much less fishing effort would occur under Alternative 2 because the fleet will have strong incentives to reduce bycatch through other means, such as gear modifications and avoiding areas with high salmon catch rates, to avoid reaching the hard cap and closing the fishery. And, depending on the extent vessels move to avoid salmon bycatch or as pollock catch rates decrease, pollock trawling effort may increase even if the fishery is eventually closed due to a hard cap. The Alternative 3 trigger closures would close identified areas when a specific cap level is reached. Since the total amount of pollock harvested and the total effort would not change under Alternative 3, it is reasonable to conclude that the overall impacts on ecosystem relationships would be similar to Alternative 1. As with Alternative 2, fishing effort may increase as vessels move to avoid salmon bycatch or as pollock catch rates decrease.

8.4.7 Introduction of non-indigenous species

The Alaska Groundfish Harvest Specifications EIS (NMFS 2007) identifies the introduction of invasive species by fishing vessels as a concern. The introduction of non-native species through ballast water exchange and hull-fouling organism release from fishing vessels could potentially disrupt the Alaskan marine food web structure. Additionally, the potential for an introduction of Norway rats by fishing vessels onto islands with colonies of seabirds that may be vulnerable to rat predation is an important invasive species concern. Visits by fishing vessels to islands with ports, moorage near shore in protected waters, or shipwrecks, could lead to the introduction of rats. Burrowing or cliff dwelling seabirds may be particularly vulnerable to rat predation. Populations in vulnerable colonies could be reduced, or possibly destroyed. The harvest specifications EIS uses total groundfish catch levels as an indicator of potential changes in the risk of invasive species introductions by groundfish fishery vessels. Larger catch levels are associated with increased vessel activity, more exchanges of ballast water, and more visits to islands with vulnerable bird colonies. None of the alternatives under consideration are expected to increase catch levels of pollock. And, Alternatives 2, 4, and 5 may result in a decrease in pollock catch. Therefore the impacts of the alternatives on the introduction of non-indigenous species would be similar, or slightly less than those analyzed in the harvest specifications EIS.

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