## 3.7 Seabirds

The purpose of this chapter is to describe the baseline condition of seabirds as they relate to the federally managed groundfish fishery in Alaska. This baseline condition includes a description of the pertinent natural history for each species and an assessment of the various natural and anthropogenic factors that have shaped the status of each species in Alaskan waters. These accounts summarize the human and natural impacts on each species, to the extent that they are known, and thus provide the historical and scientific basis for analyzing the potential impacts of the alternative FMPs in Chapter 4.

The geographical and temporal scope of material presented in this chapter is not consistent between different species because of the wide variety in their distributions and the incompleteness of historical information. For some species, like the short-tailed albatross, the defining events that pertain to their present status in Alaska may be well known but took place many years ago in distant waters. For other species, like many of the auklets, there are few historical records of impacts and basic biological parameters such as population trends and winter distribution are still not known. The intent is to provide as much relevant information as possible for each species. In order to minimize redundancy in the individual species accounts, general information on seabird biology and the types of effects that may impact seabird populations are described below. Information pertinent to only one species or species group will be presented in the individual species accounts.

The USFWS is the lead federal agency for managing and conserving seabirds. Its Ecological Services Program addresses fish and wildlife conservation, endangered species, and contaminants issues through the review of federally permitted, licensed or constructed projects. USFWS biologists evaluate effects of land and water resource development projects and recommend mitigation measures to the developer or responsible federal agency. The USFWS Office of Migratory Bird Management is responsible for monitoring migratory seabird populations, and their distribution and abundance. Its goals are 1) to conserve migratory bird populations and their habitats in sufficient quantities to prevent them from being considered as threatened or endangered and 2) to ensure continued opportunities to enjoy both consumptive and non-consumptive uses of migratory birds and their habitats. Data are collected annually for selected species of marine birds at geographically dispersed breeding sites along the entire coastline of Alaska. Twelve sites, located roughly 300 to 500 km apart, are scheduled for annual monitoring, and a number of other sites are monitored every three years (Figure 3.7-1). Systematic monitoring provides long-term, time series data from which biologically-significant changes may be detected, and has alerted NOAA Fisheries to negative trends in individual seabird populations (USFWS 1999a).

Seabirds spend the majority of their life at sea rather than on land. Species from two Orders account for the vast majority of seabirds discussed in this document. The albatrosses, shearwaters, fulmars, and storm-petrels belong to the Order *Procellariiformes* and are commonly called “tubenoses.” The Order *Charadriiformes* has two families of birds that make up another large part of Alaskan seabirds, the gulls (family *Laridae*), and the alcids (family *Alcidae*), which include the puffins, murres, auklets, and murrelets. Other bird groups contain pelagic members, including the loons, grebes, sea ducks, and phalaropes, but only those species that regularly interact with the federally managed groundfish fisheries will be discussed.

Thirty-eight species of seabirds breed in Alaska. More than 1,600 colonies have been documented, ranging in size from a few pairs to 3.5 million birds (Figure 3.7-2). The USFWS has compiled population estimates of seabirds from many researchers at many colonies throughout Alaska (USFWS 1998a). This database is now called the Beringian Seabird Colony Catalog and is updated on the Internet as new information becomes available. Although it is the best source of information that we have on Alaska seabird numbers, many of the estimates are rated as "poor" or "fair" in quality and the resultant population totals cannot be considered reliable for anything but the most generalized discussions. They are certainly not sufficient for documenting anything but the most extreme changes in population-levels. Breeding populations are estimated to contain 36 million individual birds in the BSAI and 12 million in the GOA (Table 3.5-62). Total population size (including subadults and non-breeders) is estimated to be approximately 30 percent higher. Five additional species that do not breed in Alaskan waters but occur in Alaska during the summer months contribute another 30 million birds (Table 3.5-63).

**Assessment of Population-Level Effects**

In order to monitor population trends, the USFWS has established sample plots for different species in various locations, as described above. Population monitoring has been reasonably good for 5 to 20 years for most seabird species that nest on cliffs, and for some that nest on flat ground or in burrows. Information with which to estimate population trends is lacking for some open- and burrow-nesters and for almost all crevice-nesters. Groups whose populations are not monitored adequately enough to estimate population trends anywhere in Alaska include jaegers, all gulls except for glaucous-winged, terns, auklets, horned puffins, and rhinoceros auklets. Groups for which population trends are known only in a few small areas include storm-petrels, cormorants, and pigeon guillemots. The inability to estimate seabird population trends prevents analysis of past effects of fisheries management or environmental change on the seabird species. Population trends for those species that can be monitored are presented in an annual report entitled, "Breeding Status, Population Trends, and Diets of Seabirds in Alaska," published by the USFWS (Dragoo *et al.* 2001). Trends vary for different species and in different areas of the state and are summarized in the individual species accounts.

There are actually many other sources of seabird abundance and distribution information from various at-sea transect surveys over the years, including many from the Outer Continental Shelf Environmental Assessment Program (OSCEAP) in the 1970s and early 1980s. These data have been essentially unavailable to researchers because of the many different formats and parameters used to record data. A major interagency effort to standardize and compile this data in a searchable database was recently initiated and spearheaded by the USFWS and the U.S. Geological Survey (USGS)/Biological Resource Division. The North Pacific Pelagic Seabird Database is presently under development and will be made available to the public upon completion.

Seabirds are characterized by low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity—traits that make populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort (Ricklefs 1990, Russell *et al.* 1999, Saether and Bakke 2000, Ricklefs 2000). For this reason, Russell *et al.* (1999) caution against relying on productivity studies to reach conclusions about population dynamics. However, it is much more difficult to obtain long-term demographic data on seabirds to measure survival rates than it is to measure their reproductive success. As a practical matter, reproductive data are often collected in conjunction with population trend data and it is thus tempting to use reproductive data to "explain" population trends. 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. One study, which modeled impacts of the loss of juvenile wandering albatross from longline incidental take, estimated it would take 5 to 10 years to detect the decline in breeding populations and 30 to 50 years for the population to stabilize after conservation measures were taken (Moloney *et al.* 1994).

### 3.7.1 Past and Present Effects on Seabirds

**Direct Mortality from Intentional Take**

Some seabird species have been hunted by Alaska Natives for thousands of years and continue to be an important source of both meat and eggs in certain communities (Denlinger and Wohl 2001). Seabirds have also been used for clothing and decoration and are important in many cultural contexts. The impacts of subsistence hunts are concentrated during the breeding season and on the colonies most accessible to Native communities.

Commercial harvests of seabirds for meat, eggs, and feathers have not been widespread in Alaska, but there are historical accounts of specific colonies and species that have suffered major impacts (Veniaminov 1840). The commercial harvest of the once abundant short-tailed albatross on its breeding colonies in Japan during the early 1900s nearly wiped out the species, a situation from which it is still recovering (USFWS 1999b). In some cases, seabird nesting sites and breeding adults have been intentionally destroyed in an attempt to displace the birds from military facilities and airport runways, such as the Laysan albatross on Midway Island (NMFS 2001e).

**Direct Mortality from Incidental Take in Fisheries**

Seabirds are caught incidentally in all types of fishing operations. The risk of seabirds getting caught in fishing gear varies with the density and behavior of the bird species around the fishing vessel, the type of fishing gear used, and the techniques and devices used, if any, to deter or avoid the birds. Many factors contribute to the abundance and distribution of birds at sea, including the availability of natural prey, but many species are attracted to fishing vessels in order to forage on bait, offal, discards, and natural prey disturbed by the fishing operation. The sight and sound of swarming birds can attract other birds from many miles around. For some fishermen, watching the birds is an enjoyable part of their work at sea but mostly fishermen are too preoccupied with fishing to pay them much attention. Even among those who are interested in birds, only some can distinguish one species from another, especially immature birds and very rare species like the short-tailed albatross. Relying on self-reported seabird interactions would therefore underestimate the numbers of birds taken and lead to erroneous conclusions regarding the extent of biological impacts. The first step in getting reliable data is to have trained, dedicated personnel on-board fishing vessels to actually note which species are present and how many are caught. This is not an easy task on a busy commercial fishing vessel.

The definition of "take" in the Migratory Bird Treaty Act of 1918 is "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR 10.12). In a fishery context, "take" refers to birds killed or injured during commercial fishing operations, whether in fishing gear or by striking some part of a vessel. Under the Migratory Bird Treaty Act of 1918, take of migratory birds is illegal, even if it is accidental or inadvertent, unless permitted through regulations (such as hunting regulations or permit exemptions). Thus far, only certain forms of intentional take have been legalized in these ways. There are currently no regulations to allow unintentional take. The USFWS and Department of Justice are vested with enforcement discretion, which has been used in lieu of a permitting program. Enforcement has focused on those who take birds with disregard for the law and the impact of their actions on the resource, particularly where effective conservation measures are available but have not been applied ("Fact sheet" on Migratory Bird Treaty Act of 1918, K. Laing, USFWS). Executive Order 13186 (66 FR 3853-3856), "Responsibilities of Federal Agencies to Protect Migratory Birds", which was signed by the President on January 10, 2001, directs federal agencies to develop and implement a "Memorandum of Understanding" with the USFWS to promote the conservation of migratory birds affected by their actions, including mitigation of activities that cause unintentional take. NOAA Fisheries and USFWS are currently developing this framework document which will incorporate seabird protection measures designed for specific fisheries (K. Rivera, NOAA Fisheries National Seabird Coordinator, personal communication).

In addition to the Migratory Bird Treaty Act, the Bald Eagle Protection Act (16 U.S.C. 668(a)) specifically prohibits the taking of bald eagles. In February 2001, the USFWS surveyed the pollock shoreside fish processing facilities in Unalaska regarding interactions with bald eagles. Anecdotal information indicated that eagles were attracted to the pollock vessels delivering shoreside, with birds entering the ship holds and becoming caught in the hoppers as fish were being delivered. Occasionally an injured bird would be sent to the Bird Treatment and Learning Center in Anchorage, Alaska for rehabilitation. The Bird Treatment and Learning Center maintains a database recording information about the nature and cause of each bird's injury, but many birds received from Unalaska are not accompanied by information on the cause of the injury. The current database contains no birds reported as injured by groundfish fishing activities (Bird Treatment and Learning Center, personal communication).

The application of the ESA to the case of the endangered short-tailed albatross has had a major impact on the longline sector of the BSAI and GOA groundfish fisheries. The history of these ESA deliberations and management actions is detailed in the species account for short-tailed albatross (Section 3.7.4). On a global level, the Food and Agriculture Organization of the United Nations Committee on Fisheries called for increased research and mitigation of seabird take, among other species taken incidentally in worldwide fisheries, in its *Code of Conduct for Responsible Fisheries* (FAO 1995). NOAA Fisheries developed a national Bycatch Plan that addressed these issues in a document entitled, *Managing the Nation's Bycatch: Programs, Activities, and Recommendations for the National Marine Fisheries Service* (NMFS 1998b). The management actions taken to protect short-tailed albatross in the groundfish fishery have instituted the recommendations in these documents, including monitoring and mitigation, and provide substantial protection for other species as well.

**Observer Program and Estimation of Incidental Take**

NOAA Fisheries began to collect data on seabird/groundfish fishery interactions in 1992 and expanded those efforts through the existing North Pacific Groundfish Observer Program in 1993, 1999, and 2000 (BSAI FMP Amendments 13, 27, 37 and GOA FMP Amendments 18 and 30). The Observer Program also collects data for a wide variety of fishery management and research purposes (see Section 2.5). A major change in 1993 was to train observers in seabird identification and provide group or species identifications of incidentally caught seabirds. NOAA Fisheries coordinated with the USFWS to update the seabird section of the NOAA Fisheries observer manual and to incorporate a standardized format for reporting sightings of sensitive species. Observers began providing information on seabird avoidance measures being used by hook-and-line vessels in 1997. The information collection was expanded in early 1999 to incorporate more detailed information about the frequency of measures used during a fishing trip and specific characteristics of different avoidance measures. In 2000, observers began to record the type of seabird avoidance measures used by longliners on a haul-by-haul basis. Recently, NOAA Fisheries and USFWS have developed and distributed an improved species identification guide for seabirds that focuses on feet and bills, often the only identifiable body parts remaining when a bird is retrieved onboard.

The seabird incidental take estimation methods and procedures, developed by USFWS in consultation with NOAA Fisheries, are described in a report using 1993-1997 data from the longline fishery (Stehn *et al.* 2000). Standard statistical procedures ("separate ratio estimators" of stratified random sampling; Cochran 1977) for estimating a population total from a sample were used. USFWS and NOAA Fisheries calculated rates and estimates for all seabird species or species groups in each stratum of all fishing gears, statistical fishing areas, regions (BSAI or GOA), vessel types (processors, motherships, and catcher-only vessels), and time periods (annual or each of 13 four-week periods in a year) (Stehn *et al.* 2000). As requested by USFWS, the following eleven groups of seabirds were chosen for analysis: short-tailed albatross, black-footed albatross, Laysan albatross, unidentified albatross, fulmars, gulls, shearwaters, unidentified tubenoses, alcids, other bird species, and unidentified seabirds (those not identified to one of the other ten groups). The Observer Program data actually includes some records of birds that are identified to species but which are included in a species group for statistical and analytical purposes.

Incidental catch estimates were based on the number of seabirds by species in samples from observed hauls and the total commercial fish catch as estimated by the NOAA Fisheries blend program. The NOAA Fisheries method utilized two measures of fishing effort: total tons of groundfish catch per haul or set for the trawl fishery (NOAA Fisheries blend program), and the number of hooks or pots per set for both the longline and pot fisheries (estimated for the unobserved fishery in the NOAA Fisheries blend program using the average number of hooks or pots, respectively, in the observed fishery). The NOAA Fisheries Observer Program data is incorporated into the NORPAC database which records the number and weight of the fishery catch by species in the species composition samples and the estimated weight of the entire catch (all species combined) in the whole haul or set. NORPAC also records the number of hooks or pots in the sample and the estimated number of total hooks or pots in the whole set. The number of observed birds in a species composition sample per effort (tons or hooks or pots) of that sample was used to extrapolate the number of seabirds to the whole haul or set, and similarly upwards to the whole fishery, including the unobserved effort. Both the catch rate of birds (number of birds per weight of fish, or birds per 1,000 hooks) and the catch rate of fish (total weight of all fish species per hook/pot/net) were assumed to be equal for observed and unobserved hauls of the same gear, area, and time period. These assumptions may not hold, not necessarily because the presence of the observer may change the fishing practices of the skipper or crew, but rather because, for some other operational reason, the smaller (unobserved) vessels may have different catch rates than the large or mid-sized vessels. The constant catch rates for birds and/or fish among vessel size categories are untested and critical assumptions. If different catch rates do exist for different vessel size categories, then the average area catch rates and the estimates of the total seabird incidental catch number may be overestimated or underestimated.

In some fisheries around the world, observer data have not accounted for birds that are hooked on longlines as they were deployed but fell off before they were retrieved on board. One study from Australia (Gales *et* *al.* 1998) indicated that 30 percent to 95 percent of the birds coming out of the water fell off or were shaken off the gangions before being hauled aboard and were thus missed by observers. However, that study was based on an observer program that did not actively watch the groundline as it was retrieved. In the North Pacific Groundfish Observer Program, observers actually watch the groundline as it is retrieved and do tally birds that fall off before being retrieved on board. This accounts for some of the "unidentified seabird" data (S. Fitzgerald, NOAA Fisheries, North Pacific Groundfish Observer Program, personal communication).

**Direct Mortality from Incidental Take on Longlines**

At a global level, concerns about the incidental catch of seabirds on longlines led to the development of the *International Plan of Action for Reducing the Incidental Catch of Seabirds in the Longline Fisheries*, a voluntary plan endorsed by the Food and Agriculture Organization of the United Nations Committee on Fisheries (FAO 1999). The plan applies to countries in whose waters longline fishing is being conducted by domestic or foreign vessels, and countries which conduct longline fishing on the high seas and in the EEZ of other countries. The international plan calls for individual countries to develop distinct national plans of action. Consequently, in addition to the local action taken by NPFMC and the NOAA Fisheries Alaska Regional Office, NOAA Fisheries and the USFWS have developed a *National Plan of Action for Reducing the Incidental Catch of Seabirds in the Longline Fisheries* (NMFS 2001d). The purpose of the plan is to reduce seabird incidental take in those U.S. longline fisheries where incidental take is determined to be a problem by a regional fishery management council. While not prescribing specific mitigation measures, the plan provides a framework of actions that the agencies can use within their area of authority. It is intended to give NPFMCs additional flexibility to incorporate local, fishery-specific measures. The national plan calls for the regional councils to assess the extent of incidental take in their fisheries on a regular basis, mitigate problems quickly, and cooperate with national and international agencies to address more widespread issues. NOAA Fisheries Alaska Region provides an annual assessment of seabird incidental take in all three groundfish gear sectors in the "Ecosystem Considerations" section of the annual Stock Assessment and Fishery Evaluation report (NPFMC 2002c, SAFE, available from the website: http://www.fakr.noaa.gov/npfmc/safes/safe.htm.

Seabirds are hooked on longline gear as they attempt to capture the bait or scavenge fishery wastes, mostly while the line is being deployed but sometimes as it is hauled aboard. With the closure of the international high-seas driftnet fisheries in 1992, longline fishing has grown tremendously and is now considered the most serious global threat faced by albatrosses and other tubenoses (Brothers *et al.* 1999a). The impacts of longline mortality on particular species are discussed in the separate species accounts.

Estimates of the annual seabird incidental take in the groundfish longline fisheries, based on 1993 to 2001 data, indicate that approximately 14,400 seabirds were taken annually in the BSAI at an average rate of 0.09 birds per 1,000 hooks (Table 3.7-1). The species composition of these birds is: 60 percent fulmars, 19 percent gull species, 12 percent unidentified seabirds, 4 percent albatross species, 3 percent shearwater species, and 2 percent all other species (Table 3.7-2, Figure 3.7-3). In the GOA, about 1,030 birds were estimated to be taken annually between 1993-2001 at an average rate of 0.03 birds per 1,000 hooks. The species composition of these birds is: 46 percent fulmars, 35 percent albatrosses, 11 percent gull species, 4 percent unidentified seabirds, 3 percent shearwater species, and less than one percent all other species (Table 3.7-3, Figure 3.7-3).

In the following species accounts, data on the incidental take in the groundfish fisheries are reported for each species or species group. In an effort to evaluate the effectiveness of the seabird protection measures that have been enacted (see below), the average take from 1993-1996 is compared to the average take from 1997-2001. However, these comparisons should be viewed with caution for several reasons. First, many longline fishermen began using a variety of seabird deterrence techniques of their own design before the techniques were required in regulations. In fact, many of the techniques that are included in the regulations came from the longline fleet's initiative in developing effective measures. There are no data on which techniques were used or how many vessels used them, but the data from 1993-1997 are clearly not a "no deterrence" baseline. Second, many variables influence the effectiveness of a given deterrence technique, including the quality of the deployment. One factor not under the control of the fishermen is the behavior of the birds. Many fishermen and observers have reported instances where flocks of birds swarmed the vessel and appeared to be unusually aggressive and persistent in going after bait, ignoring all attempts to deter them. These birds were assumed to be under great nutritional stress due to an area-wide shortage of natural food and the fishing vessel provided the only source of food available. Certain years, like 1997 and 1998, have anomalously high incidental take rates for many species groups which indicates that these years may have had widespread food shortages, at least for certain periods during the longline seasons. Since the data set compares a group of four years (1993-1996) with a group of five years (1997-2001), one or two high years can dominate an average take level. Again, these comparisons should be viewed with these caveats in mind.

It is difficult at this time to make valid comparisons of bird incidental catch rates between regions. It is difficult to discern whether the differences between the BSAI and GOA estimated incidental catch rates are due to vastly different levels of fishing effort in each region, different vessel types used in each region (small catcher vessels in the GOA and large catcher processors in the BSAI), different distribution and abundance of birds, or some other factor. It may be possible to use the Observer Program database to make a statistical comparison of incidental catch rates from different areas but this work would require some new budgetary resources.

As a result of ESA Section 7 consultations with the USFWS and their resulting BiOp on the protection of short-tailed albatross, NOAA Fisheries required the BSAI and GOA groundfish longline fleet to employ specified seabird avoidance measures to reduce incidental take in 1997 (62 FR 23176). Prior to 1997, avoidance measures were not required but observer information indicates that some vessel operators used mitigation measures voluntarily. In order to protect short-tailed albatross in other North Pacific fisheries, NOAA Fisheries required seabird avoidance measures to be used by vessels fishing for Pacific halibut and sablefish in U.S. EEZ waters off Alaska in 1998 (63 FR 11161) and for the Hawaii pelagic longline fleet in 2002 (67 FR 34408). The Alaska longline seabird avoidance regulations have been changed several times to reflect improvements in techniques and the need to evaluate the effectiveness of those techniques in reducing incidental take. The U.S. Coast Guard is responsible for at-sea enforcement of these and other regulations and regularly checks for compliance during at-sea boardings. Reports of these compliance checks are made in the Coast Guard's report to NPFMC at each meeting. NOAA Fisheries Enforcement currently is investigating several cases involving alleged violations of seabird avoidance regulations and other seabird-related issues (T. DuBois, NOAA Fisheries Enforcement, personal communication).

As of the 2002 season, all vessel operators using hook-and-line gear to fish for groundfish and Pacific halibut must conduct fishing operations as follows:

- Use baited hooks that sink as soon as they are put in the water.
- Discharge offal in a manner that distracts seabirds from baited hooks (if discharged at all during the setting or hauling of gear).
- Make every reasonable effort to ensure that birds brought on board alive are released alive.

In addition, all applicable hook-and-line vessels at or more than 26-ft length overall, must employ one or more of the following four measures:

- Set gear at night (during hours specified in regulation);
- Tow a streamer line or lines during deployment of gear to prevent birds from taking hooks.
- Tow a buoy, board, stick, or other device during deployment of gear at a distance appropriate to prevent birds from taking hooks;
- Deploy hooks underwater through a lining tube at a depth sufficient to prevent birds from settling on hooks during the deployment of gear.

Fishermen currently are provided some flexibility to choose the most appropriate and practicable methods for their vessel size, fishery, and fishing operations and conditions.

In September of 1998, two short-tailed albatross were taken by longline vessels that were using required avoidance measures in the BSAI cod fishery. However, at least one of these takes was the result of a poorly deployed avoidance technique. Concerned that the incidental take threshold for short-tailed albatross could be exceeded, the longline fleet petitioned NPFMC to improve the seabird avoidance measures and to specify performance standards for their deployment. In 1999, NPFMC recommended revising the existing regulations to make the most effective avoidance techniques mandatory. They also recommended that NOAA Fisheries undertake for the first time a comprehensive scientific study to experimentally determine the effectiveness of seabird deterrent measures. This research, conducted by the Washington Sea Grant Program in 1999 and 2000 in the IFQ halibut and sablefish fishery and in the BSAI Pacific cod freezer-longliner fishery, was a cooperative effort funded by NOAA Fisheries, USFWS, and the Washington Sea Grant Program, with major support by the North Pacific Groundfish Observer Program and the longline industry. It was the largest study of its kind in the world with over 1.2 million hooks set in the sablefish fishery and over 6.3 million hooks set in the cod fishery.

The results of the study were presented to NPFMC in October 2001 in its final report, "Solutions to Seabird Bycatch in Alaska's Demersal Longline Fisheries" (Melvin *et al.* 2001). The study found that paired streamer lines of specified performance and material standards successfully reduced seabird incidental take in both years, regions, and fleets by 88 to 100 percent relative to controls with no deterrent. Single streamer lines of specified performance and material standards were slightly less effective than paired streamer lines, reducing seabird incidental take by 96 percent and 71 percent relative to controls with no deterrent in the sablefish and cod fisheries, respectively. While the study participants took special precautions when short-tailed albatross were sighted and none of these birds were caught during the study, the dramatic reduction of incidental take of similar-feeding species with the use of paired streamer lines indicates that the risk of incidental take to the endangered species would be greatly reduced if this avoidance measure was widely adopted. However, despite their effectiveness in reducing overall take, single streamer lines were five times more likely to take Laysan albatross compared to paired streamers. The Washington Sea Grant study did not recommend use of single streamers to reduce the potential for taking short-tailed albatross.

Based on the results of their research (Melvin *et al.* 2001), the Washington Sea Grant Program, USFWS, and NOAA Fisheries jointly developed recommended changes to the existing seabird avoidance regulations required in the groundfish and halibut hook-and-line fisheries off Alaska. At its October and December 2001 meetings, NPFMC reviewed these recommendations, made some changes, and requested NOAA Fisheries to implement the necessary regulations. NPFMC's recommendations include the following:

- Vessels over 55 ft (16.8 m) LOA using hook-and-line gear in the EEZ would be required to use paired streamer lines of specified performance and materials standards.

- Vessels over 26 ft (7.9 m) LOA to 55 ft (16.8 m) LOA using hook-and-line gear would be required to use less stringent measures such as a buoy bag line or single streamer line—each with its own specified performance and materials standards. The requirement would depend upon fishing location ['Inside' or EEZ, where 'Inside' is PWS (NOAA Fisheries Area 649), southeast inside district (NOAA Fisheries Area 659), and state waters of Cook Inlet], vessel type (if masts, poles, or rigging are on vessel), and gear type (if snap gear is used).

- The performance and material standards for measures required on smaller vessels would be guidelines for an interim one-year period, at which time they would become required.

- Directed discharge (through chutes, pipes, or other similar devices suited for purpose of offal discharge) of residual bait or offal from the stern of the vessel while setting gear would be prohibited.

- Prior to offal discharge, embedded hooks would be removed from offal.

- A Seabird Avoidance Plan would be required onboard the vessel.

- Vessels less than or equal to 32 ft (9.8 m) LOA fishing for halibut in IPHC Area 4E within 0 to 3 miles of shore would be exempt from seabird avoidance measures.

- Vessels less than or equal to 26 ft (7.9 m) LOA would continue to be exempt from seabird avoidance measures.

The proposed seabird avoidance measures would apply to the operators of vessels using hook-and-line gear for:

- Pacific halibut in the IFQ and CDQ management programs (0 to 200 nm).

- IFQ sablefish in EEZ waters (3 to 200 nm) and waters of the State of Alaska (0 to 3 nm), except waters of PWS and areas in which sablefish fishing is managed under a State of Alaska limited entry program (Clarence Strait, Chatham Strait).

- Groundfish (except IFQ sablefish) with hook-and-line gear in the U.S. EEZ waters off Alaska (3-200 nm).

The longline fleet has been proactive in adopting these techniques and most vessels may already be in compliance in advance of the forthcoming regulations. At its March 2002 meeting, the Alaska Board of Fisheries approved a proposal that will change state groundfish regulations to parallel federal regulations governing seabird avoidance measure requirements for operators in hook-and-line fisheries.

NOAA Fisheries published the proposed regulations in February 2003 (68 FR 6386) and final regulations on January 13, 2004 (69 FR 1930). These regulations are in effect as of February 2004 and vary by length of vessel, area fished, type of gear, and other factors. They are available at NOAA Fisheries website http://www.fakr.noaa.gov/protectedresources/seabirds.html.

NOAA Fisheries attempted to incorporate the most current information as possible into this Final Programmatic SEIS document. Seabird avoidance measures are discussed throughout the following species accounts in Chapter 3 and in the analysis of alternatives in Chapter 4. Due to the timing of the publication of the Final Programmatic SEIS document and the newest regulations published in January 2004, only the Preferred Alternative analysis specifically references the new seabirds BiOps. However, the analyses of seabird impacts under Alternatives 1 through 4 in the Final Programmatic SEIS were written anticipating the adoption of these new regulations and therefore, no changes to significance ratings were necessary. The interested reader is directed to NOAA Fisheries website for the most recent fishing regulations that concern seabirds.

**Direct Mortality from Incidental Take in Trawls**

On trawl vessels only, observers may use any one of three different sample sizes of groundfish catch to monitor incidental take of birds in a haul. Observers are currently advised to use the largest of the three sample sizes whenever possible. However, observers do not record the sample size choice for monitored hauls which have no observable seabird take. Thus, it has been necessary to calculate two alternative sets of estimates for incidental take in trawls based on the smallest and largest sizes of sampling effort recorded. In each of these two alternative calculation methods, a "separate ratio estimator" was used to bind the results of the catch ratios and variances of data from the three different sample sizes into arbitrary equal samples which were then extrapolated to the total catch effort of the NOAA Fisheries blend program. Although, it is not known with certainty which of the two sets of estimates is more accurate, the level of seabird bycatch on trawl vessels during the 1990s probably lies somewhere between the two sets of estimates. Observer Program data on the numbers and species composition of incidental take in the combined BSAI and GOA trawl fisheries is currently available for 1997 through 2001 (Table 3.7-4). During this time period, an estimated average of between 961 to 9,687 seabirds were taken in trawls each year. Based on the means of the high and low estimates for each species group, the species composition of these birds is approximately: 58 percent fulmars, 15 percent shearwaters, 8 percent unidentified seabirds, 5 percent gulls, 5 percent alcids, 5 percent other species, 2 percent unidentified tubenoses, and 2 percent Laysan albatross.

Diving species, including some alcids, are taken more frequently in trawls than they are on longlines. However, trawls actually take many more individuals of the surface-feeding and shallow-diving species than they do of deep-diving species. Many of these birds are probably caught in trawls as they attempt to scavenge processing wastes or capture escaping fish as the net is being retrieved, rather than while it is actively fishing at depth. NOAA Fisheries analysis of 1997 to 2001 observer data indicates that trawl gear accounted for 6 to 35 percent of the total average annual incidental take of seabirds in the BSAI and GOA groundfish fisheries, depending on the trawl sampling methodology used (Figure 3.7-4).

**Direct Mortality from Incidental Take in Pot Gear**

Pot gear is the cleanest type of fishing as far as seabird incidental take is concerned. It accounts for only a small fraction of the total numbers of seabirds taken in the BSAI and GOA groundfish fisheries (Figure 3.7-4). Observer Program data on the numbers and species composition of incidental take in the combined BSAI and GOA pot fisheries are currently available for 1993 through 2001 (Table 3.7-5). During this time period, an estimated 48 birds were taken in pot gear per year, about 70 percent of which were northern fulmars. Many of these birds may have been killed by collisions with pot gear as it sat on deck, rather than as it was fishing.

**Direct Mortality from Vessel Strikes**

Seabirds sometimes strike vessels and fishing gear in flight. Some birds fly away without injury but others are injured or killed. The Observer Program records of bird-strikes from 1993-2000 have been entered into the Observer Notes Database (USFWS, Anchorage). Statistical analysis of the bird-strike data has not been completed but some preliminary summaries can be made (NPFMC 2002c). There are 120 definitive records of birds striking the vessel (n = 101) or the rigging (n = 19). The main species involved in vessel strikes were northern fulmars (564 birds in 38 incidents), Laysan albatross (21 birds in 15 incidents), storm-petrels (631 birds in 19 incidents), crested auklets (1,305 birds in seven incidents), and sooty shearwater (526 birds in six incidents), with almost half of the birds being killed or injured. As the last two records indicate, collisions of large numbers of birds occasionally occur. In one historical account, approximately 6,000 crested auklets were attracted to lights and collided with a fishing vessel near Kodiak Island during the winter of 1977 (Dick and Donaldson 1978). Bird strikes are probably most numerous during the night and during storms or foggy conditions when bright deck lights are on, which can cause the birds to become disoriented. From the limited number of observer records that included weather observations (n = 53), most of the bird-vessel interactions occurred when it was snowing (83 percent), with some occurring during rain (10 percent) or fog (seven percent). The proximity of the vessels to seabird colonies during the breeding season is also a factor (V. Byrd, USFWS, personal communication).

Many trawl vessels deploy a cable ("third wire") from the vessel to the trawl net monitoring device (sonar transducers). There are 16 records of birds striking the "third wire" in the Observer Notes Database. These incidents involved 79 birds, mainly fulmars and Laysan albatross, with approximately 90 percent mortality. However, these cables are not typically monitored by groundfish observers and any birds killed by such collisions would not be likely to make their way into the trawl net and would therefore not be recorded in observers' haul samples. The distribution and extent of seabird mortalities or injuries by species are therefore unknown. NOAA Fisheries' AFSC is currently pursuing the possibility of using video technology to evaluate this issue. NOAA Fisheries and USFWS are presently trying to determine if this impact poses a threat to short-tailed albatross (USFWS 2000c). Solutions may be as simple as hanging streamers from the third wire (G. Balogh, USFWS, Anchorage – personal communication).

**Indirect Mortality or Reduced Fitness**

The following effects are classified as indirect because the impacts are removed in time and/or space from the initial incident. In some cases, individual birds may be killed outright by the effect. In other cases, individuals are affected in ways that may decrease their chances of surviving natural phenomenon or reproducing successfully. These sub-lethal impacts may thus decrease their overall "fitness" as individuals and may have population-level implications if enough birds are impacted.

**Indirect Effects Through Changes in Prey Availability**

Seabird species differ greatly from one another in their prey requirements and feeding behaviors, leading to substantial differences in their responses to changes in the environment. Diets consist largely of fish or squid less than 15 cm long and large zooplankton. Although they may take a wide variety of prey species during the year, most seabirds in a given area and time depend on one or a few prey species (Springer 1991b). Diets and foraging ranges are most restricted during the breeding season, when high-energy food must be delivered efficiently to nestlings, and are somewhat more flexible at other times of the year. Winter foraging ecology is not known for most species (Hunt *et al.* 1999b). Seabird diets have been summarized in Tables 3.5-62 and 3.5-63 and specific research results are cited in the following species accounts.

A major constraint on seabird breeding is the distance between the breeding grounds on land and the feeding zones at sea (Weimerskirch and Cherel 1998). Breeding success in most species varies among years, but in stable populations, poor success is compensated for by occasional good years (Boersma 1998, Russell *et al.* 1999). Adult non-breeding seabird survival is unlikely to be affected by the common interannual variability of prey stock because adults can shift to alternative prey or migrate to seek prey in other regions. In contrast, breeding birds are tied to their colonies and local fluctuations in fish availability can have a dramatic effect on seabird reproduction. If food supplies are reduced below the amount needed to generate and incubate eggs, or if the specific species and size of prey needed to feed chicks are unavailable, local reproduction by seabirds will fail (Hunt *et al.* 1996a). The natural factor most often associated with lower breeding success is food scarcity (Kuletz 1983, Murphy *et al.* 1984, Murphy *et al.* 1987, Springer 1991b, Furness and Monaghan 1987, Croxall and Rothery 1991, Cairns 1992). Reproductive success, therefore, is usually limited by food availability (Furness 1982, Croxall and Rothery 1991).

Some authors believe that food is more limited in winter than summer for many species (Croxall 1987). Outside the breeding season, diets, feeding habitats, energy requirements, and distribution have been studied only minimally for most seabird species. Limited information suggests that in winter months many seabirds consume a greater variety of fish as well as higher proportions of zooplankton and invertebrates (DeGange and Sanger 1986, Sanger 1987).

The availability of prey to seabirds depends on a large number of factors and differs among species and seasons. All seabird species depend on one or more oceanographic processes that concentrate their prey at the necessary time and place; these include upwellings, stratification, ice edges, fronts, gyres, and tidal currents (Schneider *et al.* 1987, Coyle *et al.* 1992, Elphick and Hunt 1993, Hunt and Harrison 1990, Hunt

1997, Hunt *et al.* 1999b, Springer *et al.* 1999). Oceanographic phenomena that influence seabird foraging habitat primarily are on the scale of hundreds of meters to hundreds of kilometers (Hunt and Schneider 1987). Favorable foraging conditions are likely to last for a relatively short time (hours to weeks) at one spot and for many seabirds foraging in shelf waters, small-scale physical processes that concentrate prey are very important for successful foraging (Hunt *et al.* 1999b). Prey availability may also depend on the ecology of food species, including productivity, other predators, food-web relationships of the prey, and prey behavior, such as migration of fish and zooplankton. Many factors that influence prey availability are completely unknown. Most critical is the lack of information on how events beyond a seabird's foraging range may influence the prey availability. Such factors may include environmental changes, fluctuations in regionwide stocks of forage and non-forage species, and commercial harvests.

Reductions in the availability of forage fish to seabirds have been attributed to both climatic cycles and commercial fisheries but a NRC study (1996) concluded that both factors probably are significant. Regime shifts are major changes in atmospheric conditions and ocean climate that take place on multi-decade time scales and trigger community-level reorganizations of the marine biota (Anderson and Piatt 1999). Two cycles of warm and cold regimes have been documented in the GOA in the past 100 years, with the latest shift being from a cold regime to a warm regime in 1977. The consequences of this shift on fish and crustacean populations have been documented, including major improvements in groundfish recruitment and the collapse of some high-value forage species such as capelin and Pacific sand lance (Anderson and Piatt 1999). Unfortunately, that is around the time that data on most Alaskan seabird populations began to be collected so the effects of regime shifts on seabird populations can only be surmised on general principles. Declines in the breeding success and populations of piscivorous (fish-eating) species in several areas of Alaska have been attributed to the general decline in certain forage fish species (Springer 1992, NRC 1996, Piatt and Anderson 1996, Kuletz *et al.* 1997, Francis *et al.* 1998, McGowan *et al.* 1998, Anderson and Piatt 1999, Agler *et al.* 1999). However, directed fisheries on forage fish can deepen and prolong their natural low population cycles (Duffy 1983, Steele 1991). In nations with directed forage fish fisheries, some stocks have been decimated due to a combination of climatic and fishery pressures, which led to local population declines in seabirds (Duffy 1983, Anker-Nilssen and Barrett 1991, Crawford and Shelton 1978).

Competition and predation may also influence seabird prey availability. Links between seabirds and other species could be direct or they could be extremely diffuse and indirect. Possible links include competition between seabird species (Mehlum *et al.* 1998, Hunt *et al.* 1999b); competition of piscivorous seabirds with other large marine predators such as marine mammals and fish (Harrison 1979, Hunt 1990, Obst and Hunt 1990); cannibalism by large pollock on the smaller pollock preyed on by some seabirds; competition for food among forage species, such as small pollock, capelin, Pacific sand lance, herring, myctophids, and squid; competition between planktivorous seabirds with whales or planktivorous fish (including forage fish of other seabird species); and even ecosystem links with groups such as jellyfish. Little information is available on the magnitude or direction of these potential links.

The fraction of total exploitable stocks in the EBS that are consumed by seabirds has been estimated at 3 percent for pollock and less than one percent for herring (Livingston 1993), which is similar to an estimate of 4 percent for Pacific sand lance in the North Sea (Furness and Tasker 1997). Seabirds, therefore, may account for a very minor proportion of forage fish mortality, even for the young age classes that they consume (Livingston 1993). Seabirds may have greater impacts on fish stocks within foraging range of seabird colonies, however, because the birds are concentrated there during summer (Springer *et al.* 1986, Roseneau *et al.* 1998, Birt *et al.* 1987). About 15 to 80 percent of the biomass of juvenile forage fish may be removed by birds near breeding colonies each year (Wiens and Scott 1975, Furness 1978, Springer *et al.* 1986, Logerwell and Hargreaves 1997). This suggests that food availability to birds may be limited, at least in a given season, by the size of the local component of fish stocks. Seabirds may, therefore, be vulnerable to factors that reduce forage fish stocks in the vicinity of colonies (Monaghan *et al.* 1994).

In April 1997, NPFMC adopted Amendment 36 to the BSAI FMP and Amendment 39 to the GOA FMP to prevent the development of commercial fisheries for forage fish. NOAA Fisheries published the final rule implementing the regulations on March 17, 1998 (63 FR 13009). Amendments 36/39 defined a forage fish species category and prevented the development of a commercial directed fishery for forage fish. The amendment established a 2 percent maximum retainable bycatch (MRB) amount in other directed fisheries and prohibited the selling, bartering, trading, or receiving any remuneration for forage fish species. However, within the 2 percent limit, forage fish could be reduced to fish meal and sold. Forage fish identified under this action include: capelin, smelt, lanternfish, deep-sea smelts, sand lance, bristlemouths, pricklebacks, gunnels, Pacific sandfish, and euphausiids. These amendments are presumed to have had beneficial impacts on the availability of prey to seabirds but no quantitative benefits have been demonstrated to date.

**Indirect Effects Through Ingestion of Processing Wastes and Discards**

Scavenging of fishery wastes can influence population trends in either direction. About 30 percent of the total food consumed by seabirds in the North Sea is estimated to be offal and discards (Tasker and Furness 1996). These foods are, therefore, of direct importance in sustaining populations of some seabirds. Processing wastes may not be adequate foods for successfully rearing chicks (Murphy *et al.* 1984, Baird and Gould 1986, Irons *et al.* 1986, DeGange and Sanger 1986), but abundant scavenging during winter may increase populations because survival of immature birds is enhanced (Patten and Patten 1982). On the other hand, if populations of the larger gull species increase, local populations of other species may be reduced through increased competition for nest sites and predation pressure on their young (Spaans and Blokpoel 1991, Furness 1999). Sudden withdrawal of discards might cause the predatory species to increase pressure on other species long before the predator populations decline to previous levels (Furness 1999). In the North Sea, numerous instances are cited showing potential relationships between discards in diets and changes in breeding populations of different species, some of which were beneficial and some adverse (Garthe *et al.* 1999). No data are available on these effects in Alaska.

The seabird species whose normal foraging behavior includes scavenging on dead material, including the tubenoses and gulls (Patten and Patten 1982, Furness and Ainley 1984, Gould *et al.*1997), are strongly attracted to the food provided by fishing vessels. While this may benefit individual birds, it also places them in danger from entanglement and incidental take in fishing gear. As discussed above, incidental take may have population-level impacts on some seabird species and is a continuing fishery management concern. The timing and method of disposing of fishery wastes is an important element in efforts to reduce incidental take. The net impact of fishery wastes on particular seabird species, whether beneficial or adverse, has not been demonstrated in Alaska.

**Indirect Effects Through Disturbance by Fishing Vessels**

Fishing vessels can affect seabird populations whether or not the vessels are engaged in fishing or processing activities. Many surface-feeding birds are attracted to vessels (Furness 1999), but others, such as marbled murrelets, may be displaced from forage areas by vessel activity (Kuletz 1996). The magnitude of the impact on such species depends on the location, timing, and frequency of vessel traffic and on how closely those factors coincide with important seabird foraging areas. While avoidance behavior has been observed in many areas, measurable impacts of vessel traffic on seabird survival or reproduction have not been demonstrated in Alaska.

There is some concern that fishing activity, especially trawling, may have detrimental impacts on seabirds by disrupting the schooling behavior of their prey and therefore decreasing their foraging success. Although the intensity and longevity of trawling impacts on the structure and distribution of forage fish schools are not known, improvements in hydroacoustic methods may allow such research to be conducted in the future. However, given the large number of variables that influence foraging success for different species and the ability of birds to search for prey over large distances, it is unlikely that any localized disruptions of the prey field could be demonstrated to have specific adverse effects on seabirds. On the other hand, there is evidence that some forms of trawling may make fish vulnerable to diving birds by disturbing or injuring the fish. Black guillemots (Ewins 1987) and great cormorants (*Phalacrocorax carbo sinensis*) in the North Atlantic Ocean (Camphuysen 1999) are two species that may have learned to take advantage of such disruptions.

**Indirect Effects Through Contamination by Oil Spills**

The threat of oil spills to seabirds is well-known. All types of oil and fuel are dangerous, and only a few drops of oil are enough, under some situations, to kill a seabird. Oil kills birds because it damages the feathers, which are necessary to insulate the bird from cold water, and also because the bird ingests toxic oil as it tries to clean its plumage and suffers damage to various internal organs and its immune system (Burger and Fry 1993). Oiled feathers also affect the bird's buoyancy and ability to dive and fly. Since the insulation value of the feather is reduced, energy demands increase, requiring the birds to feed more when they are least able to do so (Wiens 1995). Reproductive success can also be decreased through effects to the endocrine system, transferring oil to eggs which affects hatching success, and through the loss of mates (Fry *et al.* 1987). In addition to the direct pathways of exposure listed above, birds may be indirectly affected by oil through habitat loss (e.g., vegetation mortality), habitat degradation, and diminished food populations (Huguenin *et al.* 1996).

A dramatic accident like the *Exxon Valdez* oil spill may kill hundreds of thousands of seabirds and reduce local populations of vulnerable species for several years (Piatt *et al.* 1990, Piatt and Ford 1996). The types of oil spills most commonly associated with fishing vessels are the chronic small spills of refined oil products (less than 100 gallons) caused by accidents during routine activities such as fuel transfer operations and bilge cleaning. For instance, in Dutch Harbor between November 1997 and June 1998, 13 oil or fuel spills were reported. The largest spill was 47,000 gallons from the *M/V Kuroshima*; the remainder of the spills were 1 to 15 gallons each. In the winter of 1996, the freighter *M/V Citrus* collided with a crab processing vessel off St. Paul Island, spilling an unknown quantity of bunker oil, which killed over 1,700 birds (Flint *et al.* 1998). The overall risk of these threats also depends on the number and condition of all vessels in the area, many of which are not associated with the fishing industry. Due to the great number of variables, including spill type and volume, wind and ocean currents, and season, the overall risk of oil contamination has not been quantified for particular species or in specific ocean areas. A report of data from 1995-2001 from the Alaska Department of Environmental Conservation (ADEC) indicates that the number of spills and volume from all sources in the BSAI and GOA is greatest during the summer months (ADEC 2001).

Many field and laboratory studies have demonstrated the differences in the effects of oil on various groups of birds. The three most important factors affecting sensitivity are behavior, distribution, and reproductive rate (Huguenin *et al.* 1996). The species at most risk are diving seabirds, which spend more time resting on the water than do surface-feeders (King and Sanger 1979). More specifically, of all bird groups alcids are considered to be the most vulnerable to oil, followed by diving ducks. Surface feeding and plunge feeding pelagic seabirds (albatrosses, petrels, fulmars, shearwaters, skuas, and jaegers) are moderately sensitive to oil effects given their extreme reliance on open-water marine habitats for feeding and roosting, making them susceptible to incidents in these settings. Gulls and terns are usually oiled in low proportion to the exposed populations because they are readily able to avoid oil (Huguenin *et al.* 1996).

**Indirect Effects by Introducing Mammalian Predators to Nesting Islands**

Seabird colonies on nesting islands are extremely sensitive to introductions of exotic predators. Seabirds nest on inaccessible islands and steep cliffs because these habitats provide protection against predators such as arctic fox (*Vulpes fulva*), red fox (*Alopex lagopus*), and rats (*Rattus norvegicus*). These mammals attack eggs, chicks, and even adult birds. When Vitus Bering first discovered Alaska in 1741, most islands in the Aleutian chain, along the south coast of the Alaska Peninsula, and in the GOA were not inhabited by foxes (Bailey and Kaiser 1993). In contrast, arctic foxes and, on a few nearshore islands, red foxes were indigenous to the islands in the Bering Sea. Apparently, foxes did not occur on any of the central or western Aleutians. Starting in 1750 and continuing into the 1930s, it was the policy of the Russian and, later, U.S. governments to facilitate the introduction of foxes for commercial fur farming purposes. The intent was for the foxes to feed on the seabirds, which they did most efficiently. In some cases, rats and voles were introduced to serve as alternative prey for foxes, but they preyed on seabirds and their eggs. Burrow and cliff-nesting species as well as Aleutian Canada geese were especially hard hit. Concern for the seabirds (and crash of the fox market) finally put an end to the practice. The USFWS has actively exterminated foxes on many islands since then, except where they occur naturally (Bailey 1993), and the foxes have died out on many other islands after eliminating the birds. Auklets and other species have begun to recolonize some of those islands after the removal of the foxes but populations are probably still depressed from pre-fox levels (Bailey and Kaiser 1993).

Rats are not native to Alaska, but they have become established on 22 Alaskan islands, including Kodiak and some of the Aleutian Islands. Fishing vessels and other ships inadvertently transport rats to previously uninvaded islands when the rats jump ship at docks or after wrecks (Brechbill 1977, Jones and Byrd 1979, Bailey 1993). At present, rats pose the greatest introduced predator threat to seabirds breeding in Alaska. Rats are voracious predators and can burrow, enter crevices, and climb cliffs with great agility (Jones and Byrd 1979). They can also kill small adult birds (Bailey 1993). Rats are a major management concern and the USFWS in Alaska has an extensive program to reduce the threat of new rat invasions. Efforts include maintaining networks of poison-bait boxes at ports on rat-free islands; training local communities to monitor and counteract rats aboard ships and on land; conducting public outreach programs to encourage operation of rat-free vessels in Alaskan waters; and training emergency-response teams to attack rats when they are found at remote shipwrecks. These efforts are in early stages, however, and the threat of rat invasions from vessels remains very serious. It is not known what proportion of fishing vessels carry rats. The effects of rat invasions on local seabird populations are not known in Alaska, because no islands have been monitored before and after their arrival. However, for most islands in other parts of the world where rats have invaded, seabird populations have declined or gone extinct (Jones and Byrd 1979, Moors *et al.* 1992, Burger and Gochfeld 1994).

**Indirect Effects Through Plastics Ingestion**

The presence of plastic pollution in marine birds was first recorded in 1962, coinciding with the increase in production of plastic resin (Robards *et al.* 1997). Ingestion of plastic pollutants has been recorded in 80 species of marine birds from around the world (Sievert and Sileo 1993). Species feeding primarily by surface-seizing or pursuit-diving have the highest frequencies of plastic ingestion, including the tubenoses and the parakeet auklet, whereas gulls and most alcids ingest little or no plastic. Species feeding primarily on crustaceans or cephalopods have the highest frequencies of plastic ingestion, probably because certain sizes and colors of plastic resemble their natural prey. Subadult seabirds, because they are less experienced in discriminating food items, ingest more pieces of plastic than do adult seabirds (Day *et al.* 1985). Adult seabirds may pass plastics on to chicks by regurgitation (Robards *et al.* 1997).

Two classes of plastic are commonly found in seabirds; pellets and fragments. Pellets are the raw product of the plastic industry and most probably enter the marine ecosystem during transportation or via drainage systems. Plastic fragments or "user" plastics are small, weathered pieces of larger manufactured items that are discarded or lost at sea, particularly from fishing boats and marine shipping vessels (Robards *et al.* 1997). Ocean currents, winds, and the location of disposal influence the abundance and distribution of plastic in the North Pacific Ocean (Auman *et al.* 1997). The highest incidence of ingested particles in the subarctic North Pacific was in the Aleutian coastal waters. Densities of small plastic particles in the subarctic North Pacific and Bering Sea are 26 to 400 times lower, respectively, than in subtropical waters. Of small oceanic plastic particles found in the central North Pacific, 3.7 percent were pellets and 96.3 percent were user fragments (Robards *et al.* 1997). In contrast, seabirds in the subarctic North Pacific ingested mostly pellets (76 percent pellets, 22 percent user plastic, 2 percent unrecognizable plastic particles) (Robards *et al.* 1997). Some of the recognizable plastic objects are consistent with debris originating from dumping as opposed to fishing activities.

Available evidence suggests that plastics are damaging to seabirds when they are consumed in sufficient quantity to obstruct the passage of food or cause stomach ulcers. Other effects may include bioaccumulation of polychlorinated biphenyls, toxic effects of hydrocarbons, diminished feeding stimulus, reduced fat deposition, lowered steroid hormone levels, and delayed reproduction. However, at present, acute effects of plastic ingestion are rarely observed, and chronic effects on body condition are generally equivocal (Robards *et al.* 1997). It may not be possible to demonstrate direct cause-and-effect relationships between plastic ingestion and body condition in wild seabirds because of natural variability in the environment and the fact that affected birds may quickly disappear from sampled populations (Robards *et al.* 1997).

The Marine Plastic Pollution Research and Control Act of 1987 (33 USC §§ 1901 *et seq.*) implements the provisions relating to garbage and plastics of the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). These regulations apply to all vessels, regardless of flag, on the navigable waters of the U.S. and in the Exclusive Economic Zone of the U.S. It applies to U.S. flag vessels wherever they are located. The discharge of plastics into the water is prohibited, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics. In 1995, as part of their BiOp on the status of short-tailed albatross (USFWS 1995a), the USFWS recommended that NOAA Fisheries begin an education program to help fishers be aware of and comply with the laws against discarding plastic at sea, an effort that continues to the present time.

### 3.7.2 Black-Footed Albatross (*Phoebastria nigripes)*

**Life History and Distribution**

The black-footed albatross is a large, dark-plumaged seabird with a wingspan of up to 80 inches. Nearly the entire world population nests on the Hawaiian Islands National Wildlife Refuge, principally Laysan and Midway Islands. Breeding begins in early November. One egg is laid and both parents share incubation which lasts about 65 days. Chicks begin to hatch in mid-January and are fed by regurgitation from both adults. This high calorie, nutrient-rich regurgitate consists primarily of squid and stomach oil and can sustain a chick for a number of days while the parents forage for food at sea. Fledging occurs in June and July. Sub-adults return to their natal colony when they are three years of age but do not mate and nest until they are between 5 and 8 years old. USFWS banding studies on Midway Island indicate that individuals may live 40 years or more in the wild.

The historic range of the species is from the coasts of China, Japan, and Russia east to continental North America; and from the Sea of Okhotsk and the Bering Sea south to about 18°N in the central Pacific (Shuntov 1972). Although the central Pacific is considered to be the preferred wintering area for non-breeding adults, low numbers of black-footed albatross are found in the eastern temperate North Pacific Ocean throughout the entire winter, as far north as 55°N (McDermond and Morgan 1993). Black-footed albatross are more abundant over the outer continental shelf, especially at the shelf break, than elsewhere. Areas with strong, persistent upwelling and the boundaries of different water masses are also favored. Their concentration over the continental slope may in part be a result of the distribution of fishing vessels in these areas, to which they are strongly attracted by fish wastes and bait (McDermond and Morgan 1993). Black-footed albatross spend the summer (approximately May through September) in Alaskan waters, although some non-breeding birds may be encountered at any time. In Alaska, black-footed albatross are most abundant in the GOA.

The USFWS conducts census counts annually at the Hawaiian breeding colonies. The census data suggest that during the last decade the estimated numbers of breeding pairs of black-footed albatross in nesting colonies in the Northwest Hawaiian Islands have fluctuated between approximately 53,000 and 41,000, with the high estimate in 1993 and the low in 2000. The estimate increased in 2001 to approximately 45,000 pairs. However, the overall breeding population of black-footed albatross appears to be decreasing by as much as 1.3 percent annually (NMFS 2001e). Individual nesting colonies such as French Frigate Shoals and Midway Atoll have shown dramatic inter-annual fluctuations (NMFS 2001e). The reasons for these fluctuations are not clear. Breeding adults do not typically nest every year and may skip a year for various reasons, including for molting or possibly if they are nutritionally stressed. Mortality of adults and subadults at sea is also a factor in determining how many birds return to nest.

The most recent estimate for the number of black-footed albatross breeding pairs is 54,548 (NMFS 2001e). Since the number of sub-adult (i.e., non-breeding) albatross may be five to six times the number of breeding pairs (Pradel 1996), the total world population of black-footed albatross is approximately 300,000 (Cousins and Cooper 2000).

**Trophic Interactions**

Cephalopods play a major role in the diet of black-footed albatross (Cherel and Klages 1998). Squid from the families Ommastrephidae and Onychoteuthidae are the most important food items although the species eaten by black-footed albatross are poorly known. Few observations have been published of black-footed albatross feeding in the wild, other than by scavenging near fishing vessels. They take food in the upper 1 m of the ocean's surface by seizing and dipping while sitting on the water (Gould *et al.* 1998). In addition to squid, other food items include myctophids (lanternfish), other invertebrates, and fish. In one study prior to the cessation of the high-seas driftnet fisheries in 1992, squids were more important than fishes in the diets of non-breeding black-footed albatross (review in Gould *et al.* 1998). A study in Hawaii found that fish eggs were the main component of the diet of black-footed chicks (Harrison *et al.* 1983). Black-footed albatross, with their short, stocky bills, are better adapted to scavenging naturally occurring large carrion or refuse from ships than they are at retrieving small prey from surface waters (Gould *et al.* 1998). Because of this attraction to fish waste and bait, black-footed albatross are drawn to fishing vessels and are vulnerable to being caught by longlines. One recent study incorporated the use of immersion monitors to study the foraging behavior of Laysan and black-footed albatross (Fernandez and Anderson 2000). The data suggested that individuals split their time between nocturnal and diurnal foraging.

In 1998 and 1999, satellite telemetry studies indicated that black-footed albatross nesting in the northwestern Hawaiian Islands mixed short foraging trips near their nesting island with much longer trips that typically extended to the California, Oregon, and Washington State coasts but did not include the colder waters of the GOA (Hyrenbach *et al.* 2002).

**Management Overview**

Wildlife management responsibility for the black-footed albatross, established by the Migratory Bird Treaty Act (16 U.S.C. 703 *et.seq.*), falls under the jurisdiction of the USFWS. Most research on the species has taken place in their northwest Hawaiian breeding colonies (where 96 percent of the world population resides) which are predominately on National Wildlife Refuge lands. Black-footed albatross were recently assigned "vulnerable" status on the World Conservation Union's *Red List of Threatened Species* (IUCN 2000) because of reported declines in numbers on their breeding colonies. This criterion is used for species that are deemed to have a high risk of extinction in the wild in the medium-term future (60 years).

**Past and Present Effects and Management Actions**

<u>Direct Mortality: Harvest and Other Intentional Take</u>

Within historic time, black-footed albatross have experienced periods of heavy mortality at their breeding colonies from various human activities, including mass harvesting of adults for feathers at the beginning of the 20th century, warfare, intentional destruction of nest sites and breeding birds for airport runway construction, collisions with aircraft and communication towers, and contamination with lead paint and other toxic wastes left from 50 years of military use (NMFS 2001e). The impact of these mortality factors on the population has not been quantified.

Direct Mortality from Incidental Take in External Fisheries

Human impacts on albatross at sea are also substantial. High-seas driftnet fisheries for tuna, squid, and salmon have been identified as a major source of mortality for albatrosses in the past. The Japanese large-mesh driftnet fishery for tuna and swordfish dates back to 1905. This fishery peaked in 1982 with over 700 vessels but declined to only 70 vessels by 1991. There are no data on the incidental take of seabirds for most of this fishery except for the 1990-1991 season when over 3500 seabirds were estimated to be taken, including a large number of black-footed albatross (DeGange *et al.* 1993). Driftnet fisheries targeting *Ommastrephes* squid, one of the preferred prey of black-footed albatross, were started in the late 1970s by Japan, Korea, and Taiwan. At their peak in the late 1980s, these fisheries deployed millions of kilometers of driftnet. Rough estimates of the total number of seabirds killed by the squid driftnet fisheries were between 875,000 and 1,660,000 seabirds annually, including 2,000-5,000 black-footed albatross per year (DeGange *et al.* 1993). Due to the tremendous amount of waste and ecosystem damage associated with the high-seas driftnet fisheries, they were outlawed by international agreement through United Nations Resolution (46/215) in December of 1992 (Paul 1994). Because black-footed albatross are such a long-lived and slowly maturing species, high rates of mortality from the driftnet fisheries may have a lingering impact on the population growth rate at present.

Longline fishing is considered the most recent and potentially most serious global threat faced by albatrosses (Brothers *et al.* 1999a). Longlines catch surface-feeding seabirds when they attempt to capture the bait as the line is being set. Mortality of black-footed albatross occurs in Alaskan and Hawaiian longline fisheries as well as in North Pacific longline fisheries conducted by Japan, Taiwan, Korea, Russia, and China (Brothers *et al.* 1999). Estimates of incidental take in some of these fisheries may underestimate actual mortality because they are based on samples of birds brought on-board and do not account for birds that are hooked as the line is being deployed but fall from the hook before the lines are retrieved. When observers do not watch the groundline as it is retrieved, underestimates of incidental take may be as high as 30 to 95 percent (Gales 1998). However, observers in the North Pacific Groundfish Observer Program actually watch the groundline as it is retrieved and tally birds that fall off before being retrieved on board.

Based on 1994 through 1999 data, the estimated average annual total catch of black-footed albatross in the Hawaiian pelagic longline fishery is 1,743 birds (NMFS 2001e). Preliminary estimates of the number of both black-footed and Laysan albatross taken in non-U.S. fisheries in the north and central Pacific pelagic longline fisheries (swordfish and tuna) are about 34,700 birds per year (Cousins *et al.* 2001). It is not known what portion of these are black-footed albatross. An estimate of this mortality may be made if one assumes that the percentages of Laysan and black-footed albatross are about the same in foreign fishing waters as they are in the U.S. Black-footed albatross make up about 57 percent of the total albatross taken in the Hawaiian longline fishery (NMFS 2001e) and 60 percent in the GOA longline fishery (Table 3.7-3). Based on the assumption that the U.S. data are comparable to the foreign fisheries situation, where there are no data, the numbers of black-footed albatross taken in the foreign longline fisheries could be over 20,000 birds per year.

State-managed longline fisheries and IPHC halibut fisheries may contribute only relatively small amounts to the overall incidental take of albatross. The larger hooks used in the halibut fisheries presumably result in lower incidental catch rates although there is little data to support this. In 1998, incidental takes of 32 unidentified albatrosses were documented in the IPHC halibut fishery through interviews with fishermen (Trumble and Geernaert 1999). However, since the halibut and state-managed fisheries are not subject to the NOAA Fisheries Observer Program, there is no way to independently verify or quantify the numbers of particular species taken by these vessels. NOAA Fisheries and NPFMC are working with the IPHC to find new ways to provide oversight and monitoring of the bycatch from these fisheries, which set millions of hooks each year.

Direct Mortality from Incidental Take on Groundfish Longlines

Tables 3.7-2 and 3.7-3 list the estimated incidental take of various species of seabirds by longline fisheries in the BSAI and GOA for the period 1993-2001 (Observer Program data). In the BSAI, the estimated number of black-footed albatross killed by longlines varied between 4 and 66 birds per year with an average of 21 per year (95 percent confidence interval is 14-29 birds per year). There were also an average of 63 unidentified albatross caught each year in the BSAI. If we assume that the unidentified albatross occurred in the same proportion as the identified numbers of black-footed and Laysan albatross, the average number of unidentified albatross would translate into 2 more black-footed albatross caught in the BSAI every year. This gives an estimated average of 23 black-footed albatross taken in the BSAI groundfish longline fishery every year between 1993-2001. In the GOA, between 7 and 658 black-footed albatross were caught each year with an average of 190 per year (95 percent confidence interval is 144-236 birds). An average of 56 unidentified albatross were also taken each year. Black-footed albatross make up a higher proportion of the identified albatross caught in the GOA, so this translates into an additional 34 black-footed albatross caught. This gives an estimated average of 224 black-footed albatross incidentally taken in the GOA groundfish longline fishery every year between 1993-2001. In this time period, the estimated total take of black-footed albatross in the BSAI and GOA longline fishery was thus an average of 247 birds per year. No black-footed albatross were observed to be taken in the trawl or pot fisheries during this period (Tables 3.7-4 and 3.7-5).

Several factors are likely to affect the risk of seabird incidental catch, including: fishing effort (number of hooks per year), the distribution of effort by sub-area and season, the abundance and distribution of seabirds in the vicinity of fishing vessels, seabird nutritional condition (i.e., starvation), and the use of seabird deterrents in longline fisheries. The relative importance of these factors has not been fully studied. NOAA Fisheries analyzed the relationship between fishing effort and numbers of birds hooked in the BSAI and GOA and found that the relationship varies for different species groups (Figures 3.7-5 and 3.7-6, respectively). The data suggest that fishing effort (number of hooks set) does not play a strong role in determining how many albatross are caught.

NPFMC and NOAA Fisheries have addressed the issue of seabird bycatch in numerous ways over the years, including scientific research and regulations that require changes in fishing techniques. Although these efforts have been pursued largely to protect the endangered short-tailed albatross, the take reduction measures that have been enacted since 1997 should decrease take of all seabird species that are susceptible to capture by longlines, including black-footed albatross. (See Section 3.7.4 on short-tailed albatross for a discussion of research and regulatory measures taken to protect seabirds from longline take). Observer Program data (Tables 3.7-2 and 3.7-3) show an estimated average of 33 black-footed albatross taken every year in the BSAI from 1993-1996. From 1997-2001, this estimated yearly take decreased to 11 birds. In the GOA, estimated annual take of black-footed albatross averaged 233 birds between 1993-1996. From 1997-2001, that average dropped to an estimated 156 birds taken per year. In the recently completed Washington Sea Grant Project study, new avoidance techniques resulted in a reduction of 70-95 percent of all species caught and were especially effective for black-footed albatross and other species that do not dive deeply on baited lines (Melvin *et al.* 2001).

Assessment of Population-Level Effects

Recent evidence from population studies and modeling exercises suggests that the combination of domestic and foreign longline fisheries in the North and Central Pacific has had a negative impact on the black-footed albatross population (Cousins and Cooper 2000). One finding of the modeling exercises indicates that the sustained growth rate of an albatross population (without any fishing-related mortality) is in the range of zero to four percent. The model concluded that a total loss of 10,000 birds per year (natural and anthropogenic mortality sources combined) is about the maximum a population of 300,000 black-footed albatross could sustain and still remain stable (Cousins and Cooper 2000). The modeling also showed that the growth rate of the population may be reduced by an equivalent percentage of the total number of birds killed in the fisheries each year. Thus, if fisheries mortality is one percent of the total population (3,000 birds), then the population growth rate will be reduced by more than one percent (Cousins 2001). This estimated reduction in population growth is a robust estimate in that it is not sensitive to the ratio of juveniles to adults lost and thus includes the potentially greater impact of taking nesting adults.

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on black-footed albatross, but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects is outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** Abundance and distribution of squid and other prey are greatly influenced by climatic and oceanic fluctuations. High-seas squid drift fisheries by several Asian countries may have impacted prey availability but these fisheries were outlawed in 1992 (Paul 1994). Impacts of groundfish and other fisheries on availability of squid and small fish to albatross are unknown. Ability of albatross to forage over huge areas is presumed to lessen the potential impact of localized depletion of prey.

- **Indirect effects through consumption of fishery discards.** Albatross are attracted to fishing vessels and processors to eat discards and offal. Benefits of the food source are countered by increased risk of incidental take on longlines. The net benefit or adverse impact of this effect has not been studied.

- **Indirect effects through plastics ingestion.** There are many sources of plastic pollution on land and at sea. Albatross are particularly attracted to small consumer products that resemble floating prey. Adults may suffer from swallowing sharp objects and excessive amounts of non-digestible material (Sievert and Sileo 1993, McDermond and Morgan 1993). Chicks fed regurgitated plastics are subject to physiological stress as a result of satiation and mechanical blockages which may affect chick survival when the volume of plastic ingested is high (Sievert and Sileo 1993, Auman *et al.* 1997).

**Comparative Baseline**

There are an estimated 300,000 black-footed albatross in the world as of 2001, but their breeding numbers have declined over the past ten years (NMFS 2001e). They are not listed under the ESA, but are listed as "vulnerable" according to international conservation criteria. The great majority of nesting occurs in Hawaii and is protected under the National Wildlife Refuge System. The species faces serious threats from incidental take in longline fisheries throughout its range, especially by foreign tuna and swordfish pelagic longline fisheries in the Central and North Pacific. The numbers of black-footed albatross taken in the BSAI and GOA groundfish longline fisheries are relatively small compared to the estimated take in foreign fisheries. Seabird avoidance measures instituted for the BSAI and GOA longline fleet in 1997 have reduced the numbers of black-footed albatross taken. The past and present effects on black-footed albatross are summarized in Table 3.7-6.

**Status for Cumulative Effects Analysis**

Incidental take of black-footed albatross is expected to continue under all alternatives and warrants consideration in the cumulative effects analysis. Because of the similarity of their fishery interactions and responses to management measures, black-footed albatross will be discussed in conjunction with Laysan albatross in the analysis of FMP Alternatives.

### 3.7.3 Laysan Albatross (*Phoebastria immutabilis)*

**Life History and Distribution**

The Laysan albatross, also known as "gooney bird," is a large white and black seabird with a wingspan that reaches 85 inches. More than 99 percent of Laysan albatross nest in the northwest Hawaiian Islands. They are monogamous and if one of the mates should die it may be several years before the survivor can make a new pair bond. Only one egg is laid per year beginning around mid-November, and incubation lasts about 65 days. Both parents share in incubation duties although females usually leave for a few weeks after egg-laying. Chicks hatch during late January to mid-February. Both parents will feed the chick by regurgitation and will often leave them for several days while they obtain food out at sea. Fledging occurs 5 to 6 months after hatching (mid-June through late July). Parents will often leave before the chicks have reached their full juvenile plumage. Sub-adults return to their natal nesting colony after spending 3 to 5 years at sea. Mating and first nesting usually occurs by age 6 to 8.

Laysan albatross occur throughout the North Pacific from the southern Bering Sea to the Hawaiian Islands (Shuntov 1972). Laysan albatross spend the summer (approximately May through September) in Alaskan waters, although some non-breeding birds may be encountered at any time. In 1989 and 1999, satellite telemetry studies indicated that Laysan albatross nesting in the northwestern Hawaiian Islands mixed short foraging trips near their nesting island with much longer trips primarily to the north, frequently reaching the Aleutian Islands and GOA. Thus, based on satellite telemetry data, breeding Laysan albatross are known to forage in waters off Alaska (Anderson *et al.* 2000, Hyrenbach *et al.* 2002). Since the 1970s, the Laysan albatross has greatly expanded its presence in the southeastern Bering Sea. At present, Laysan albatross are most abundant in the western Aleutian Islands but are increasingly encountered in and north of the passes through the Aleutian Islands, over the shelf north of the Alaska Peninsula, and along the shelf break as far as the Pribilof Islands; hence, these birds are likely to attend even more vessels than may have previously been the case (G. L. Hunt, Jr., University of California, Irvine, personal communication).

Laysan albatrosses are the most numerous of the North Pacific albatrosses, but the species was probably even more abundant before feather hunters decimated breeding colonies in the early 1900s. No systematic population estimates were made until the USFWS began to make population estimates in 1992. The current world estimate of the number of breeding pairs of Laysan albatross is 488,852 (NMFS 2001e). Since the number of sub-adult (i.e., non-breeding) albatross may be five to six times the number of breeding pairs (Pradel 1996), the total world population of Laysan albatross is approximately 2.4 million birds (Cousins *et al.* 2000). Given the relative abundance of this species compared to other albatross species, its status is generally considered to be relatively secure. However, the number of breeding pairs at the largest nesting site, Midway Atoll, has decreased substantially in the past decade, from approximately 429,300 pairs in 1992 to 285,600 pairs in 2001 (NMFS 2001e). At the second largest nesting site, Laysan Island, the number of breeding pairs decreased from approximately 200,000 pairs in 1997 to about 55,000 pairs in 2000. This downward trend changed in 2001 when the number of breeding pairs increased on Laysan Island to approximately 118,000 pairs (NMFS 2001e). It is not clear why these fluctuations have been so dramatic. Albatross tend to return to their same nest sites over the years so it seems unlikely that breeding pairs are moving to different islands. Breeding adults do not typically nest every year and may skip a year for various reasons, including for molting or possibly if they are nutritionally stressed. Of course, adult and juvenile mortality at sea is also a factor in determining how many birds return to nest.

**Trophic Interactions**

Cephalopods play a major role in the diet of Laysan albatross (Cherel and Klages 1998). Squid from the families Ommastrephidae and Onychoteuthidae are the most important food items although which species are eaten by Laysan albatross is poorly known. Few observations have been published of Laysan albatross feeding in the wild, other than of those birds scavenging near fishing vessels. They take food in the upper 1 m of the ocean’s surface by seizing and dipping while sitting on the water (Gould *et al.* 1998). In addition to squid, other food items include myctophids (lanternfish), other invertebrates, and fish. In one study prior to the cessation of the high-seas driftnet fisheries in 1992, fishes were more numerous than squid in the diets of non-breeding Laysan albatross (review in Gould *et al.* 1998). A study in Hawaii found that squid was the main component of the diet fed to Laysan chicks (Harrison *et al.* 1983). Numerous studies have noted that Laysan albatrosses are more frequently observed seaward of the continental slope, over areas of strong, persistent upwelling, and at the boundaries between different water masses, presumably because of the natural concentration of their prey in those situations (review in McDermond and Morgan 1993). Laysan albatross have better night vision than black-footed albatross and may be more capable of rapid retrieval of small prey that are active in surface waters at night. (Gould *et al.* 1998). One recent study incorporated the use of immersion monitors to study the foraging behavior of Laysan and black-footed albatross (Fernandez and Anderson 2000). The data suggested that individuals split their time between nocturnal and diurnal foraging. Laysan albatross are also strongly attracted to fishing vessels where the birds may aggressively pursue bait and fish processing waste.

**Management Overview**

Wildlife management responsibility for Laysan albatross falls under the jurisdiction of the USFWS. The species is protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*). Most research on the species has taken place on their nesting grounds which are predominantly on National Wildlife Refuge lands.

**Past and Present Effects and Management Actions**

Direct Mortality: Harvest and Other Intentional Take

Early Aleut and Eskimo hunters apparently preferred albatross for their meals, because archeologists find hundreds of albatross bones in the remains of old houses and villages along the Bering Sea coast (Smithsonian's Arctic Studies Center 2002). Although these remains have not been identified to species, it may be an indication that albatross were once more abundant and widespread in the Bering Sea. No albatross were identified in recent Alaska Native subsistence hunts (Denlinger and Wohl 2001).

Within historic time, Laysan albatross have experienced periods of heavy mortality at their breeding colonies in the northwest Hawaiian Islands from various human activities, especially mass harvesting of adults for feathers at the beginning of the 20th century. At only one of the many breeding colonies that were subjected to massive hunts, Laysan Island, feather hunters killed at least 300,000 birds in 1909 alone (Dill and Bryan 1912). The species has also suffered from intentional destruction of nest sites and breeding birds for military airport runways, collisions with aircraft and communication towers, and contamination with lead paint and other toxic wastes left from 50 years of military use (NMFS 2001e). Since systematic population estimates were only begun in 1992 by USFWS, the impact of these past mortality factors on the population have not been quantified.

Direct Mortality from Incidental Take in External Fisheries

High-seas driftnet fisheries for tuna, squid, and salmon have been identified as a major source of mortality for albatross in the past. The Japanese large-mesh driftnet fishery for tuna and swordfish dates back to 1905. This fishery peaked in 1982 with over 700 vessels but declined to only 70 vessels by 1991. There are no data on the incidental take of seabirds for most of this fishery except for the 1990-1991 season when over 3500 seabirds were estimated to have been taken, including a "large number" of Laysan albatross (DeGange *et al.* 1993). The land-based Japanese salmon gillnet fishery was responsible for millions of seabird deaths between 1952-1987, including an estimated 921 Laysan albatross in 1977. By 1987, fishing effort had been reduced and an estimated 231 Laysan albatross were caught (DeGange and Day 1991). Between 1981-1984, the Japanese salmon driftnet mothership fleet killed an estimated average of 86 Laysan albatross each year (Jones and DeGange 1988). Driftnet fisheries targeting *Ommastrephes* squid, one of the preferred prey of Laysan albatross, were started in the late 1970s by Japan, Korea, and Taiwan. At their peak in the late 1980s, these fisheries deployed millions of kilometers of driftnet. Rough estimates suggest that the total number of seabirds killed by the squid driftnet fisheries ranged between 875,000 and 1,660,000 seabirds annually, including 50,000-108,000 Laysan albatross per year (DeGange *et al.* 1993). Due to the tremendous amount of associated waste and ecosystem damage, the high-seas driftnet fisheries were outlawed by international agreement through United Nations Resolution (46/215) in December of 1992 (Paul 1994). Because Laysan albatross are such a long-lived and slowly maturing species, high rates of mortality from the driftnet fisheries may have a lingering impact on the population growth rate at present.

Longline fishing is considered the most recent and potentially most serious global threat faced by albatrosses (Brothers *et al.* 1999a). Mortality of Laysan albatross occurs in both Alaskan and Hawaiian longline fisheries as well as in other North and Central Pacific longline fisheries conducted by Japan, Taiwan, Korea, Russia, and China (Brothers *et al.* 1999). Preliminary estimates suggest that the number of both black-footed and Laysan albatross taken in non-U.S. pelagic longline fisheries in the North and Central Pacific (swordfish and tuna) is about 34,700 birds per year (Cousins *et al* 2001). It is not known what portion of these are Laysan albatross. An estimate of this mortality may be made if one assumes that the percentages of Laysan and black-footed albatross are about the same in foreign fishing waters as they are in the U.S. Laysan albatross make up about 43 percent of the total albatross taken in the Hawaiian longline fishery (NMFS 2001e) and 39 percent in the GOA longline fishery (Table 3.7-3). Based on the assumption that the U.S. data are comparable to the foreign fisheries situation, where there are no data, the numbers of Laysan albatross taken in the foreign longline fisheries could be close to 15,000 birds per year.

Based on 1994 through 1999 data, the estimated average annual take of Laysan albatross in the Hawaiian pelagic longline fishery is 1,330 birds (NMFS 2001e). NOAA Fisheries established mandatory seabird protection measures for this Hawaiian fishery in 2002 (67 FR 34408).

State-managed longline fisheries, which are typically near-shore operations, and halibut fisheries may contribute only a small amount to the overall incidental take of albatrosses. The larger hooks used in the halibut fisheries presumably result in lower incidental catch rates but there is little data to support this claim. In 1998, incidental takes of 32 unidentified albatrosses were documented in the halibut fishery through interviews with fishermen (Trumble and Geernaert 1999). However, since the halibut and state-managed fisheries are not subject to the NOAA Fisheries Observer Program, there is no way to independently verify or quantify the numbers of particular species taken by these vessels. NOAA Fisheries and NPFMC are working with the IPHC to find new ways to provide oversight and monitoring of the bycatch from these fisheries which set millions of hooks each year.

<u>Direct Mortality from Incidental Take on Groundfish Longlines</u>

Tables 3.7-2 and 3.7-3 list the estimated incidental take of Laysan albatross in the BSAI and GOA longline fisheries between 1993-2001 (Observer Program data). In the BSAI, the estimated number of Laysan albatross killed by longlines varied between 234 and 1,431 birds per year with an average of 538 per year (95 percent confidence interval is 481-595 birds). There was also an average of 63 unidentified albatross caught each year in the BSAI. If we assume that the unidentified albatrosses occurred in the same proportion as the identified numbers of black-footed and Laysan albatross, the average number of unidentified albatross would translate into 61 more Laysan caught in the BSAI every year. This gives an estimated average of 599 Laysan albatross taken in the BSAI groundfish longline fishery every year between 1993-2001. In the GOA, between 40 and 217 Laysan albatross were caught each year with an average of 126 per year (95 percent confidence interval is 98-154 birds). An additional 45 unidentified albatross were also taken each year. Laysan albatross make up a smaller proportion of the identified albatross caught in the GOA so this translates into an additional 18 Laysan caught. This gives an estimated average take of 144 Laysan albatross in the

GOA groundfish longline fishery every year between 1993-2001. In this time period, the estimated total take of Laysan albatross in the BSAI and GOA longline fishery was thus an average of 773 birds per year.

In an effort to reduce the incidental take of seabirds on longlines, NOAA Fisheries instituted mandatory seabird avoidance measures for the groundfish fleet in 1997 (62 FR 23176). Prior to 1997, the average estimated number of Laysan albatross taken in the BSAI was 406 birds per year. Between 1997 and 2001, the estimated annual average take in the BSAI increased to 643 Laysan albatross per year. Most of this increased average take was due to an unusually high number of birds taken in 1998 (1,431 albatross). The reason this one year was so different than the others is not known but it may be related to nutritional stress. Starving birds appear to be much more aggressive in pursuit of food around fishing vessels and the numbers of fulmars, gulls, and shearwaters taken on longlines were also well above average in 1998, indicating a possible region-wide food shortage. In the GOA, the average take before and after the seabird avoidance measures were enacted remained essentially the same (129 albatross per year in 1993-1996 versus 124 birds per year in 1997-2001).

Direct Mortality from Incidental Take in Groundfish Trawls

According to 1993-2001 Observer Program data, the amount of estimated incidental take of Laysan albatross in BSAI and GOA groundfish trawls varied substantially between years (Table 3.7-4). From 1997-2001, the estimated average number of Laysan albatross taken every year was estimated to be between 46 birds (average low estimate) and 133 birds (average high estimate).

Direct Mortality from Vessel Strikes

According to the Observer Program records of bird-strikes from 1993-2000, Laysan albatross have been documented to strike vessels and rigging. Of the 120 recorded collisions, 21 Laysan albatross were involved in 15 incidents. Laysan's were also observed to collide with trawl "third wires". Monitoring these types of collisions is not part of the observer's normal duties so the true extent of this impact is not known. NOAA Fisheries is currently investigating the issue, especially as it relates to "third wires". During 2002, NOAA Fisheries evaluated the use of video as a tool to monitor "third wire" seabird interactions, and the report is in process. (NPFMC 2002c) NOAA Fisheries is investigating mitigation efforts for this problem, which may be as simple as hanging streamers from the wire (G. Balogh, USFWS, Anchorage, personal communication).

Assessment of Population-Level Effects

Recent evidence from population studies and modeling exercises suggest that the combination of domestic and foreign longline fisheries in the North and Central Pacific have had a negative impact on albatross populations (Cousins and Cooper 2000). Although the emphasis to date has been on the impacts of longline fishing operations on the black-footed albatross population, the modeling exercises can be applied to the Laysan albatross population and to all sources of anthropogenic mortality as well. One finding of the modeling exercises indicates that the sustained growth rate of an albatross population (without any fishing-related mortality) is in the range of zero to four percent. The modeling also showed that the growth rate of the population may be reduced by an equivalent percentage of the total number of birds killed in fisheries each year. Thus, if fisheries mortality is one percent of the total population (24,000 birds), then the population growth rate will be reduced by more than one percent (Cousins 2001). This estimated reduction in population growth is a robust estimate in that it is not sensitive to the ratio of juveniles to adults lost and thus includes the potentially greater impact of taking nesting adults.

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on Laysan albatross but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impacts of groundfish and other fisheries on the availability of prey to Laysan albatross are unknown. The ability of albatross to forage over huge areas is presumed to lessen the potential impact of localized depletion of prey.

- **Indirect effects through consumption of fishery discards.** Laysan albatross are attracted to fishing vessels and processors to eat discards and offal. Benefits of the food source are countered by increased risk of incidental take on longlines.

- **Indirect effects through plastics ingestion.** Species feeding primarily by surface-seizing or pursuit-diving, including Laysan albatross, have the highest frequencies of plastic ingestion (Sievert and Sileo 1993). Studies on Midway Island found that ingested plastic probably does not cause significant direct mortality in Laysan albatross chicks, but likely causes physiological stress as a result of satiation and mechanical blockages (Auman *et al.* 1997) and may affect chick survival when the volume of plastic ingested is high (Sievert and Sileo 1993).

- **Indirect effects through contamination by oil spills.** Surface-feeding pelagic seabirds, including Laysan albatross, are moderately sensitive to oil effects given their extreme reliance on open-water marine habitats for feeding and roosting, making them susceptible to incidents in these settings (King and Sanger 1979).

**Comparative Baseline**

The Laysan albatross is the most numerous albatross species in the BSAI and is also common in the GOA with a total population estimated to be about 2.4 million birds. However, the recent decline in breeding pairs at their largest nesting colony in Hawaii is cause for concern. According to population modeling exercises, the impact of mortality from incidental take in fisheries, especially longlines, may be contributing to recent declines at nesting colonies. The amount of incidental take from the BSAI and GOA groundfish fishery is relatively small compared to the estimated mortality from foreign fisheries. Seabird avoidance measures instituted for the BSAI and GOA longline fleet in 1997 have not reduced the numbers of Laysan albatross taken. The past and present effect on Laysan albatross are summarized in Table 3.7-7.

**Status for Cumulative Effects Analysis**

Incidental take of Laysan albatross is expected to continue under all alternatives and warrants consideration in the cumulative effects analysis. Because of the similarity of their fishery interactions and responses to management measures, Laysan albatross will be discussed in conjunction with black-footed albatross in the analysis of FMP Alternatives.

### 3.7.4 Short-Tailed Albatross (*Phoebastria albatrus)*

**Life History and Distribution**

The short-tailed albatross is a very large seabird with narrow, seven-foot-long wings adapted for soaring low over the ocean. Young birds are chocolate brown, gradually turning white as they grow older. Adult short-tailed albatross have an entirely white back, white or pale yellow head and back of neck, and black and white wings. Their large pink bill is hooked at the end with a blue tip. Short-tailed albatross mate for life, returning to the same nest sites in the breeding colony for many years. Presently, these birds nest only on two islands in Japan, Torishima and Minami-kojima. Single eggs are laid in October or November, chicks hatch in December through February, and the young fledge from May to July. Immature birds wander across the North Pacific until they begin breeding at 6 to 9 years old (ADF&G 1994).

Relatively little is known about seasonal movements or factors determining marine distribution of the short-tailed albatross (McDermond and Morgan 1993). It is believed that the species was formerly common off China, in the Sea of Japan, the Sea of Okhotsk, the Bering Sea north to the Bering Strait, and throughout the entire temperate North Pacific Ocean, from Alaska to Baja California (McDermond and Morgan 1993, USFWS 1998b). Areas of high food productivity, such as along the Pacific coast of North America, in the Aleutian Islands, and in the Bering Sea, were favored (Hasegawa and DeGange 1982). Over 90 percent of records are sightings of one or two birds (mostly single birds) and these sightings have been reported in all months of the year. For those sightings that recorded age(s), four times more non-adults (juvenile, immature, and subadult) than adults were sighted. Past observations indicate that as with other albatross, older short-tailed albatross are present in Alaska primarily during the summer and fall months along the shelf break from the Alaska Peninsula to the GOA. Recent satellite telemetry studies indicate that, following the breeding season, the tagged short-tailed albatross moved north along the coast of Japan to the southern tip of the Kamchatka Peninsula and then east to the western Aleutians. Records of sightings from the Observer Program and fishing vessels have been compiled to indicate their present distribution in Alaskan waters (Figure 3.7-7) (NPFMC 2002c).

The North Pacific Ocean and Bering Sea once supported millions of short-tailed albatross but they were decimated by commercial hunters in the early 1900s. Volcanic eruptions also destroyed significant amounts of nesting habitat. By 1949, there were no short-tailed albatross breeding at any of the 15 historically known breeding sites, including Torishima Island, and the species was reported to be extinct. Fortunately, this report was premature and several birds returned from the sea in 1950 to nest on Torishima. By 1954 there were 6 breeding pairs and 25 total birds seen on the island. Japan designated the albatross a protected species in 1958, prohibiting hunting and limiting access to the breeding colonies. These protection measures and extensive habitat enhancement work on Torishima has allowed the species to increase steadily (Fadely, 1999). In addition, Japan has been working to reestablish breeding colonies in areas that are not so susceptible to volcanic eruptions and mudslides. Small numbers of short-tailed albatross have also been observed on a regular basis at Midway Atoll in the Hawaiian Islands and this may become a future colony site (Fadely, 1999). Based on egg counts from 1980 to 1998, the population on Torishima is increasing at an annual rate of 7 to 8 percent, a level that appears to be near its maximum biological potential (J. Cochrane, USFWS, Grand Marais, personal communication). Based on data from site visits to the two known breeding colonies in 2001 and estimates of the fraction of adult and sub-adult birds that do not visit the breeding colonies, the current world population of short-tailed albatross is estimated at 1600 to 1700 individuals (NPFMC 2002c). No confidence intervals for this estimate are available at this time. The great majority of nesting occurs on Torishima Island with small numbers at Minami-kojima Island (H. Hasegawa, personal communication, 2001).

**Trophic Interactions**

Albatross seize small fish (e.g., larval and juvenile pollock and sablefish), squid, and zooplankton from the surface of the water or just below it. Short-tailed albatross forage along the edge of the continental shelf and on the outer shelf where upwellings bring their prey to the surface. They may forage at night as well as in daylight (Sherburne 1993). Since they range widely over the ocean and are opportunistic feeders, their diet varies with local availability. Albatross are attracted to fishery wastes released from fishing vessels and processors and are thus vulnerable to being caught in fishing gear, especially on baited hooks in the longline fisheries.

**Management Overview**

Wildlife management responsibility for the short-tailed albatross is under the jurisdiction of the USFWS. The short-tailed albatross was originally designated as "endangered" under the Endangered Species Conservation Act of 1969 as a foreign-listed species (because they do not nest in U.S. territory). In 1973, when the ESA replaced the 1969 Act, the short-tailed albatross was included as a foreign species but not as a native species. This created an administrative error by listing its status as endangered elsewhere except in the U.S. The USFWS corrected this administrative error by extending the species endangered status to include its range within the U.S. (USFWS 2000c). The proposed and final rules contain extensive information on the species life history, demographics, and population status (USFWS 1998a, 2000c). Despite the listing oversight, the short-tailed albatross has been treated as an endangered species in the EEZ since 1970.

At the time a species is proposed for listing under the ESA, critical habitat can also be proposed. Habitats outside of the U.S. are not eligible for critical habitat designation. Because the North Pacific Ocean and Bering Sea once supported millions of short-tailed albatross, USFWS scientists believe that this species is nowhere near its habitat carrying capacity, and that it would be some time before any feature of its marine habitat becomes a critical limiting factor to population growth. Further, because the species' precarious situation derives entirely from historical harvest of the birds themselves, not from actions that caused habitat degradation, and because marine habitat loss does not appear to be a factor limiting current population growth rate, NOAA Fisheries determined that designation of critical habitat within the U.S. would not be beneficial to the short-tailed albatross (USFWS 1998a, 2000c).

Under the requirements of the ESA Section 7, the USFWS is responsible for determining whether proposed federal actions are likely to jeopardize the recovery of the species. The resulting BiOps may contain mandatory and/or recommended mitigation procedures and may set limits on the number of birds that can be taken incidental to the proposed action. In 1989, NOAA Fisheries had its first consultation with USFWS concerning the effects of the BSAI and GOA groundfish fisheries on the endangered short-tailed albatross. Although the 1989 BiOp identified several possible adverse effects of fishing activities, it concluded that the

BSAI and GOA FMPs were not likely to jeopardize the continued existence of the short-tailed albatross (USFWS 1998a and 1998b). It did, however, establish a threshold number of incidental takes (two birds per year) that would be allowed in the fishery based on historical take estimates. If this threshold number was exceeded, USFWS would immediately initiate a review of the fishery and possibly require mitigation measures under Section 7 of the ESA. The 1989 BiOp also required NOAA Fisheries to begin monitoring incidental takes more closely and reduce them as much as possible. There are two interrelated challenges to this issue which are discussed below. The first is how to measure the number of birds actually caught in the fisheries and the second is to develop effective fishing techniques that avoid catching seabirds. Working in collaboration with NOAA Fisheries, NPFMC has addressed both aspects of this issue with amendments to the BSAI and GOA FMPs, specifically BSAI Amendments 13, 27, 37 and GOA Amendments 18 and 30 (see Appendix C and D). NOAA Fisheries continued to consult with the USFWS on both a formal Section 7 basis and informal basis during TAC-setting deliberations and amendments to the FMPs. The history of these consultations and NOAA Fisheries regulatory responses as of June 2003 are summarized in Table 3.7-8.

The mandatory and recommended measures established in the 1998 BiOp (USFWS 1998c) are listed in Tables 3.7-9 and 3.7-10. In the 1998 BiOp, the USFWS required NOAA Fisheries to actively monitor the numbers of seabirds taken incidentally in the groundfish fisheries, which it does through the Observer Program, educate fishers on the identification of short-tailed albatross and the applicable laws, report any takings of short-tailed albatross immediately, institute mandatory protective measures on the longline fleet, and research the effectiveness of those protective measures. The incidental take threshold for the groundfish fisheries was set at four birds taken in a two year period (USFWS 1999b).

After the Draft Programmatic SEIS was published (August 2003), the USFWS issued two new BiOps (September 2003) as part of their ESA Section 7 consultations on the federal groundfish fisheries. These documents are available on NOAA Fisheries' website: http://www.fakr.noaa.gov/protectedresources/seabirds.html. One BiOp takes a programmatic look at the impacts of the BSAI/GOA groundfish FMPs and associated fisheries on the endangered short-tailed albatross and the threatened Steller's eider (NPFMC 2003) while the other BiOp concerns the TAC-setting process for these fisheries (NPFMC 2003). These documents conclude that the fisheries would not likely jeopardize the continued existence or recovery of either the short-tailed albatross or Steller's eider and would not adversely modify Steller's eider critical habitat (no critical habitat has been designated for short-tailed albatross in U.S. waters). The TAC-setting BiOp included updated Incidental Take Statements for these species. For short-tailed albatross, incidental take on longline gear is anticipated to be the same as previous years, with up to four birds taken every two years. In addition, for the first time the USFWS included an anticipated take for short-tailed albatross through collisions with trawl gear. Unlike the situation with the longline fleet where there are over ten years of Observer Program data on take of albatross, the USFWS and NOAA Fisheries have only recently begun investigating how frequently albatross may be colliding with trawl gear. Because of this uncertainty, the Incidental Take Statement anticipates that up to two birds could be taken by the trawl fleet but the time period was left open until the BiOp is superceded by a new one. This open-ended period allows USFWS and NOAA Fisheries to continue gathering data on the potential risk of trawl gear before a new Section 7 consultation is initiated.

The TAC-setting BiOp also includes mandatory terms and conditions that NOAA Fisheries must follow in order to be in compliance with the ESA. The first of these is the implementation of seabird deterrent measures for the longline fisheries as proposed by NOAA Fisheries in February 2003 (68 FR 6386) and adopted as final regulations on January 13, 2004 (69 FR 1930). These regulations are in effect as of February 2004 and vary by length of vessel, area fished, type of gear, and other factors. They are available at NOAA Fisheries website: http://www.fakr.noaa.gov/protectedresources/seabirds.html. Other provisions include continued 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.

**Past and Present Effects and Management Actions**

Direct Mortality: Natural Events

Toroshima Island in Japan, the main breeding site of short-tailed albatross, is an active volcano and has erupted as recently as August 2002. While a volcanic eruption is a natural event, it could have a devastating impact on the population if it occurred while the birds were nesting. Monsoon rains have also caused mud slides and erosion that have destroyed nesting sites. Japanese biologists and technicians have worked very hard in the past thirty years to reclaim and protect nest sites on Torishima from these natural threats. Although diseases and parasitic infestations do not appear to be significant at present, the fact that the species is so restricted in its nesting locations makes it more susceptible to these natural mortality factors.

Because of the critically small population size of this endangered species, fishery-related mortality is a conservation concern. In consideration of this, USFWS recently noted that in the event of a major population decline resulting from a natural environmental catastrophe (such as a volcanic eruption on Torishima Island) or an oil spill, the effects of longline fisheries on short-tailed albatrosses could be significant under ESA (USFWS 2000c). If such a catastrophic event were to occur, it would constitute new information requiring the reinitiation of a Section 7 consultation under the ESA (USFWS 1999b).

Direct Mortality: Harvest and Other Intentional Take

Early Aleut and Eskimo hunters apparently preferred albatross for their meals because archeologists find hundreds of albatross bones in the remains of old houses and villages along the Bering Sea coast (Smithsonian's Arctic Studies Center 2002). Although these remains have not been identified to species, some of these birds may have been short-tailed albatross given the fact that the species was once much more abundant and widespread in the Bering Sea. No albatross were identified in recent Alaska Native subsistence hunts (Denlinger and Wohl 2001).

The most important factor affecting the short-tailed albatross population was their near extermination by commercial harvesting almost 100 years ago. From the late 1800s to the 1930s, hunters killed millions of short-tailed albatross in their breeding colonies for feathers, meat, and eggs (Hasegawa and DeGange 1982). Between 1885 and 1903, an estimated 5 million birds were killed on Torishima Island alone. As stated above, even though they are now protected from harvest, they are still extremely rare and this magnifies the importance of other potential impacts.

Direct Mortality from Incidental Take in External Fisheries

In general, seabirds are vulnerable to becoming entangled in derelict fishing gear. The magnitude of the impact on short-tailed albatross is unknown. Hasegawa (personal communication 1997) reports that three to four birds per year on Torishima come ashore entangled in derelict fishing gear, some of which die as a result. He also stated that some take by Japanese fishermen (handliners) may occur near the nesting colonies, although no such take has been reported. There is no additional information on the potential effects of fisheries near Torishima on the species. Lost or abandoned fishing gear could be a threat to the species throughout its range and is not restricted to the breeding colony around Torishima.

The issue that has received the most attention is the incidental take of short-tailed albatross on the baited hooks of longline fisheries throughout their range. Although short-tailed albatross are likely taken in several international fisheries, there is no quantitative information available on the numbers of birds taken. This situation is the result of several factors; relatively few fishermen can identify rare species of seabirds (especially subadult plumages), there is no international reporting center, and very few fishing vessels have trained observers on board to monitor seabird incidental take. The lack of reliable data is problematic for effective mitigation management.

The Pacific halibut fishery, managed by the IPHC and regulated by NOAA Fisheries, sets millions of hooks each year but does not have an observer program. Under the authority of the ESA, USFWS has required NOAA Fisheries to investigate all options for monitoring the incidental take of short-tailed albatross in the Pacific halibut fishery in waters off Alaska and to institute appropriate changes to the fishery as a result of its investigation. NOAA Fisheries has contracted with the IPHC to carry out this research and make recommendations for management actions. IPHC is evaluating the use of video as a monitoring tool, with cost comparison to deploying observers.

Direct Mortality from Incidental Take on Groundfish Longlines

Seven short-tailed albatross have been reported to be taken incidentally in Alaska fisheries since 1983 (Table 3.7-11), six from vessels using hook-and-line gear. For most seabird species, NOAA Fisheries uses sampling statistics to extrapolate the numbers of seabirds incidentally caught in the entire fishery from the portion of the fleet covered by the Observer Program. However, since they are so scarce, the situation for short-tailed albatross is more difficult and uncertain. Until 1995, no short-tailed albatross had even been taken within an observer sample. At the February 1999 NPFMC meeting, the SSC stated in its minutes that ". . . Because incidental catch is so small, estimation of the total take of short-tailed albatross is problematic. Uncertainty exists on how the known take of albatross should be expanded to the unobserved portion of the fishery."

In the NOAA Fisheries analysis of the 1993-2001 observer data, only three of the albatross taken were identified as short-tailed albatross and all were from the BSAI region (Tables 3.7-2 and 3.7-3). Of the albatross taken, not all were identified. This analysis of 1993-2001 data resulted in an estimated average of one short-tailed albatross being taken annually in the BSAI groundfish longline fishery and zero short-tailed albatross taken annually in the GOA longline fishery. The incidental take threshold, as established by USFWS, is based on the actual reported takes of short-tailed albatross and not on extrapolated takes.

The uncertainty in estimating actual numbers of short-tailed albatross taken, combined with their endangered species status, places a great deal of importance on the issue of avoiding seabird bycatch in general, especially for longliners. Fishermen have a natural interest in reducing or eliminating the ability of seabirds to get at their bait since any hook that has caught a seabird or had its bait stolen is not available to catch fish. However, no one technique can be applied to all fishing vessels and gear types and whatever technique is used has to meet basic safety standards and not hinder the deployment or retrieval of fishing gear. In conjunction with USFWS, NOAA Fisheries recommended a series of seabird protection measures to NPFMC In 1997, NPFMC reviewed these measures and requested NOAA Fisheries to enact regulations that required longliners to use at least one of several different options to avoid incidental seabird takes. Within a range of criteria, fishermen were allowed to experiment with different techniques to see what worked best for their fishing style (see Section 3.7.1). NOAA Fisheries then began to measure the effectiveness of various seabird avoidance measures through changes in the Observer Program which required observers to gather data on the techniques used and their effectiveness in avoiding seabird take. Data collection was expanded in 1999 and 2000 to incorporate more detailed information about the frequency of measures used during a fishing trip and specific characteristics of different avoidance measures.

The seabird avoidance measures implemented in 1997 did not prevent additional takes of the short-tailed albatross. Two short-tailed albatross were taken in late September 1998 in the BSAI Pacific cod fishery and both vessels that hooked these birds were using the required seabird avoidance devices. However, the regulations do not include performance standards and, even though they were technically in compliance, reports from observers on these vessels indicated that the avoidance gear was set in a very ineffective configuration. There was a great deal of concern within the fishing industry at that point because they were close to reaching the incidental take threshold of four birds within a two year period established by USFWS. Under the regulations and authority of the ESA, exceeding this threshold would have required an immediate Section 7 consultation with USFWS to review the seabird protection measures. One possible, yet remote, outcome was that the fishery would have to close until new measures were in place, regardless of the economic impact. This concern prompted the longline industry to petition NPFMC to revise the existing seabird protection measures for the longline fisheries in the BSAI and GOA. At its April 1999 meeting, NPFMC recommended revising the existing regulations to make the most effective techniques mandatory. They also recommended that NOAA Fisheries undertake a comprehensive scientific study to test the effectiveness of these different techniques. This study was conducted by the Washington Sea Grant Program in 1999 and 2000 in the IFQ halibut and sablefish fishery and in the BSAI Pacific cod freezer-longliner fishery, with funding by NOAA Fisheries and USFWS and substantial support from the Observer Program and the longline industry. This research was carried out with the active cooperation and participation of the fishing industry to make sure that the techniques developed would meet with safety and "fishability" requirements.

The final report from the Washington Sea Grant study (Melvin *et.al.* 2001) indicates that use of paired streamer lines (with specified parameters) effectively eliminated all bycatch of Laysan albatross and northern fulmar without impacting catch rates of target species. While the study participants took special precautions when short-tailed albatross were sighted and none of these birds were caught during the study, the dramatic reduction of incidental take of similar-feeding species with the use of paired streamer lines indicates that the risk of incidental take to the endangered species would be greatly reduced if this avoidance measure was widely adopted. The use of single streamer lines was almost as effective as the paired streamer lines for overall seabird bycatch avoidance but Laysan albatross were caught five times as frequently with single versus paired streamer lines. The study concluded that the risk of hooking albatrosses, including short-tailed albatross, remains when only single streamer lines are used. Based on the results of their research (Melvin *et al.* 2001), the Washington Sea Grant Program, USFWS, and NOAA Fisheries jointly developed recommended changes to the existing seabird avoidance regulations required in the groundfish and halibut hook-and-line fisheries off Alaska. At its October and December 2001 meetings, NPFMC reviewed these recommendations, made some changes, and requested NOAA Fisheries to implement the necessary regulations. (See Section 3.7.1) The longline fleet has been very proactive in adopting these techniques and most vessels may already be in compliance in advance of the new regulations becoming legalized.

<u>Direct Mortality from Vessel Strikes</u>

Many trawl vessels deploy a cable ("third wire") from the vessel to the trawl net monitoring device (sonar transducers). There are 16 records of birds striking the "third wire" in the Observer Notes Database. These incidents involved 79 birds, mainly fulmars and Laysan albatross, with approximately 90 percent mortality (NPFMC 2002c). However, these cables are not typically monitored by groundfish observers and any birds killed by such collisions would not be likely to make their way into the trawl net and would therefore not be recorded in observers' haul samples. The distribution and extent of seabird mortalities or injuries by species is therefore unknown. NOAA Fisheries' AFSC is currently pursuing the possibility of using video technology to evaluate this issue. NOAA Fisheries and USFWS are presently trying to determine if this impact poses a threat to short-tailed albatross (USFWS 2000c). Solutions may be as simple as hanging streamers from the third wire (G. Balogh, USFWS, Anchorage, personal communication).

**Other Past and Present Effects**

In addition to potentially catastrophic natural events, the USFWS has identified several other human-induced impacts as potential threats to the species conservation and recovery (USFWS 2000c). Not enough information is available to assess the extent of these impacts quantitatively. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Direct mortality from incidental take in groundfish trawls.** No short-tailed albatross have been recorded as being taken in the groundfish trawl fishery but the similar Laysan albatross have been taken in trawls. The first recorded short-tailed albatross taken in Alaska fisheries was caught in a brown crab net (Table 3.7-11).

- **Indirect effects through changes in prey availability.** The impacts of groundfish and other fisheries on the availability of prey to short-tailed albatross are unknown. The ability of albatross to forage over huge areas is presumed to lessen the potential impact of localized depletion of prey. The fact that the short-tailed albatross population is growing at or near its theoretical maximum rate and that the environment used to support millions of them, it is thought that food availability is not limited at present (USFWS 2000c).

- **Indirect effects through consumption of fishery discards.** Short-tailed albatross are attracted to fishing vessels and processors to eat discards and offal. Benefits of the food source are countered by an increased risk of incidental take on longlines.

- **Indirect effects through plastics ingestion.** Species feeding primarily by surface-seizing, including short-tailed albatross, have the highest frequencies of plastic ingestion (Sievert and Sileo 1993). Dr. Hiroshi Hasegawa (personal communication 1997) reports that short-tailed albatross on Torishima commonly regurgitate large amounts of plastic debris. Hasegawa has observed a large increase in the occurrence of plastics in birds on Torishima over the last 10 years. His impression is that the vast majority of regurgitated plastics have been washed out to sea from land-based activities (USFWS 1998b). Plastic ingestion may cause physiological stress as a result of satiation and mechanical blockages (Auman *et al.* 1997) and may affect chick survival when the volume of plastic ingested is high (Sievert and Sileo 1993).

- **Indirect effects through contamination by oil spills.** Surface-feeding pelagic seabirds, including short-tailed albatross, are moderately sensitive to oil effects given their extreme reliance on open-water marine habitats for feeding and roosting, making them susceptible to incidents in these settings (King and Sanger 1979). Dr. Hiroshi Hasegawa (personal communication 1997) has observed some birds on Torishima with oil spots on their plumage. An oil spill in an area where a large number of individuals were rafting, such as near breeding colonies, could affect the population significantly.

**Comparative Baseline**

Short-tailed albatross were nearly exterminated by commercial hunting about 100 years ago but are making a comeback. The population appears to be increasing at a near-maximum rate. They are still one of the rarest species on earth with an estimated population of only 1600 to 1700 birds and are listed as "endangered" under the ESA. The need to protect this species from all sources of human-induced mortality has driven a great deal of research and regulation of seabird/fisheries interactions in the BSAI and GOA area. The institution of mandatory seabird protection measures for longliners in 1997 did not eliminate incidental take of this species but no incidental takes have been reported since September 1998. Recent scientific research indicates that new seabird avoidance techniques can greatly reduce the incidental take of species with similar feeding behavior as short-tailed albatross. NPFMC has recommended that these techniques be made mandatory for the groundfish longline fleet. NOAA Fisheries is currently in the process of implementing new seabird avoidance regulations for the longline fleet. The past and present effects on short-tailed albatross are summarized in Table 3.7-12.

**Status for Cumulative Effects Analysis**

Incidental take of short-tailed albatross remains a concern under all alternatives. The species' endangered status under the ESA requires that it receive consideration in the cumulative effects analysis. Because of its special status, it will not be grouped with any other species in the analysis of FMP Alternatives.

### 3.7.5 Northern Fulmar (*Fulmarus glacialis*)

**Life History and Distribution**

The northern fulmar has a wide range of color variations and looks similar to gulls but is actually related to the albatross. Fulmars are one of the few species in the tubenose family that breeds in Alaska. Nesting on remote, steep-sided island cliffs, both sexes share parental duties. The single egg is incubated for about eight weeks and the young fledge about seven weeks after they hatch.

The foraging range during nesting season is potentially large: the parents alternately depart from the colony every four to five days on foraging trips and are known to forage out to 100 km or more (Hatch and Nettleship 1998). They disperse throughout ice-free Alaskan waters and in the North Pacific Ocean in winter (Gould *et al.* 1982, Shuntov 1993). Fulmars do not reach breeding age until at least six years old and can live up to 50 years or longer.

Northern fulmars inhabit the northern oceans of the world, with separate populations in the Pacific and Atlantic (Harrison 1983). The estimated worldwide population of this species is 10 to 12 million individuals with an estimated population of 4 to 5 million individuals in the North Pacific (Hatch and Nettleship 1998). Ninety-nine percent of the Alaskan population nests in four colonies: Semidi Islands (GOA), Chagulak Island (Aleutian Islands), the Pribilof Islands (Bering Sea), and St. Matthew/Hall Islands (Bering Sea) (Hatch and Nettleship 1998). The estimated population is 1,500,000 fulmars in the BSAI area and 600,000 in the GOA area (Table 3.5-62).

Population trend data has been collected from permanent sample plots in several areas. The population of fulmars on the Pribilof Islands (St. George and St. Paul) was estimated at about 70,000 individuals in the 1970s (S. Hatch, personal communication, USGS, Alaska Biological Science Center). Permanent study plots for fulmars were established on St. George Island in 1976. The census for these plots was relatively consistent for the next twelve years but then rose dramatically from about 970 birds in 1988 to a high count of 1979 birds in 1992. The census for these plots then declined even more dramatically to 475 birds in 1999 (Dragoo *et al.* 2001). On nearby St. Paul Island, a much smaller colony, census plots showed a similar pattern of stability and then major increase to a high in 1992 and then a decline in subsequent years.

On Chowiet Island, the main fulmar colony in the Semidi Islands in the GOA, census numbers for permanent study plots show a similar pattern to that in the Pribilofs. After relatively stable counts from 1976 to 1991, numbers increased substantially to a maximum in 1993 and then declined by more than half that number in 1998 (Dragoo *et al.* 2001). There are no regularly censussed sample plots on the St. Matthew/Hall or Chagulak Island colonies.

**Trophic Interactions**

Northern fulmars forage on a variety of surface species including squid, jellyfish, crustaceans, other invertebrates, and small fish (including juvenile pollock in the Pribilof Islands) (Ainley and Sanger 1979, Hunt *et al.* 1981a, DeGange and Sanger 1986, Sanger 1987, Schneider *et al.* 1986, Baird 1990, Hatch 1993, Gould *et al.* 1997). Food is taken from the water surface or just beneath it, including at night when pelagic prey migrate close to the surface (Schneider *et al.* 1986, Hatch 1993). Fulmars probably do much of their foraging at night, and may use olfactory cues in locating food because their sense of smell is highly developed (Hatch and Nettleship 1998). Fulmars obtain food by dipping, surface-seizing, surface-plunging, pursuit-diving, and scavenging. They are apparently unable to pick up prey while on the wing.

Ranging over large areas of ocean, fulmars forage from the continental shelf to beyond the continental shelf break (Hunt *et al.* 1981c, Gould *et al.* 1982, Schneider and Hunt 1984, DeGange and Sanger 1986, Schneider *et al.* 1986, Hatch 1993). The outer front and shelf edge, where water from the continental slope is upwelled, is important to several surface-feeding seabird species, including fulmars. Availability of prey to these seabirds may vary with strength of the upwelling (Schneider *et al.* 1987).

Although the location of breeding sites influences seabird feeding distribution, fisheries also have a strong influence on the distribution of seabirds at sea (Garthe and Huppop 1994). Fulmars are common scavengers of discarded fish thrown overboard by commercial fishing boats, sometimes forming vast chattering groups of thousands of birds.

**Management Overview**

Wildlife management responsibility for the northern fulmar is under the jurisdiction of the USFWS. The species is protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

<u>Direct Mortality from Incidental Take in External Fisheries</u>

Past fisheries in the North Pacific, both foreign and domestic, have taken fulmars in the course of their operations. For most of these fisheries, the numbers of individual species taken were not recorded. One exception is the Japanese salmon mothership fishery where an average of 2,352 fulmars were taken every year between 1981-1984 (Jones and DeGange 1988). In 1977, the land-based Japanese salmon gillnet fishery killed an estimated 1,536 fulmars. In 1987, after substantial reductions in the fishing effort, an estimated 694 fulmars were taken (DeGange and Day 1991). The incidental take of fulmars in other current foreign gillnet fisheries is unknown. Since they usually forage at-sea, they are unlikely to be taken in coastal gillnet fisheries.

State-managed longline fisheries (cod, sablefish, rockfish) and halibut fisheries may contribute only a small amount to the overall incidental take of fulmars. The larger hooks used in the halibut fisheries presumably result in lower incidental catch rates than in the groundfish fisheries. In 1998, incidental takes of 57 fulmars were documented in the halibut fishery through interviews with fishermen (Trumble and Geernaert 1999). However, since the halibut and state-managed fisheries are not subject to the NOAA Fisheries Observer Program, there is no way to independently verify or quantify the numbers of particular species taken by these vessels.

<u>Direct Mortality from Incidental Take on Groundfish Longlines</u>

The numbers of fulmars that were caught in the BSAI and GOA groundfish longline fisheries between 1993-2001 were estimated from Observer Program data (Tables 3.7-2 and 3.7-3). Fulmars are taken incidentally on longlines far more frequently than any other species. In the BSAI, fulmars constitute an average of 60 percent of all birds taken and in the GOA, 46 percent are fulmars. Between 1993 and 2001, the estimated number of fulmars killed by longlines in the BSAI varied between 4,251 and 15,533 birds per year with an estimated average of 8,644 fulmars per every year (95 percent confidence interval is 8,252 - 9,036 birds). In the GOA, an estimated average of 479 fulmars were taken every year (95 percent confidence interval is 388 - 569 birds).

In an effort to reduce the incidental take of seabirds on longlines, NOAA Fisheries instituted mandatory seabird avoidance measures for the groundfish fleet in 1997 (62 FR 23176). These measures included some flexibility for captains to decide which options to use in order to accommodate their particular fishing vessels and techniques. Based on the observation that most seabirds fed during daylight hours, one of these options was to fish at night. Unfortunately, fulmars are an exception to that general rule and often feed at night. Prior to 1997, the average estimated numbers of fulmars taken in the BSAI were 6,087 birds per year. Between 1997and 2001, the estimated annual average take in the BSAI increased to 10,689 fulmars per year, with the two largest takes in 1997 and 1998. In contrast, the GOA 1993-1996 average was 569 fulmars per year and the 1997-2001 average decreased to 406 birds per year. It is not known what proportion of fishing effort was conducted at night as a seabird avoidance measure and whether the different responses in the BSAI and GOA were the result of different fishing strategies or other factors. During the Washington Sea Grant Program experimental tests of the efficacy of the various seabird avoidance measures, night sets of longline fishing gear showed significant increases of fulmar incidental catch over daytime sets (Melvin *et al.* 2001). This study also indicated that use of paired streamer lines (with specified parameters) effectively eliminated all bycatch of northern fulmars without impacting catch rates of target species. In response to the Washington Sea Grant results, NOAA Fisheries' pending new regulations eliminate night fishing as an optional seabird deterrent technique and require that paired or single streamer lines be used on all groundfish longline vessels longer than 26 ft LOA.

Several factors are likely to affect the risk of seabird incidental catch, including fishing effort (number of hooks per year), the distribution of effort by sub-area and season, the abundance and distribution of seabirds in the vicinity of fishing vessels, the nutritional condition of the birds (i.e. starving or not), and the use of seabird deterrents. The relative importance of these factors has not been fully studied. NOAA Fisheries analyzed the relationship between fishing effort and numbers of birds hooked in the BSAI and GOA longline fisheries and found that the relationship varies for different species groups (Figures 3.7-5 and 3.7-6, respectively). The data suggest that fishing effort in longline fisheries (number of hooks set) does play a strong role in determining how many fulmars are caught. This was not the case for the other major groups of seabirds that are taken.

Direct Mortality from Incidental Take in Groundfish Trawls

The combined BSAI and GOA trawl fishery took an estimated average of between 274 fulmars (low estimate) and 5,891 fulmars per year (high estimate) from 1997-2001 (Table 3.7-4).

Direct Mortality from Incidental Take in Groundfish Pot Gear

Fulmars are one of the few species that are caught in the pot fisheries and actually make up a large majority of birds caught (Table 3.7-5). Still, pot fisheries account for relatively few incidental takes. Between 1993 and 2001, an average of 33 fulmars were taken in the combined BSAI and GOA pot fisheries. Many of these birds may actually have been killed by collisions with the pot gear while it was on deck, rather than as it was fishing, with dead birds being caught in the gear before it was deployed.

Direct Mortality from Vessel Strikes

According to the Observer Program records of bird-strikes from 1993-2000, fulmars are the species most frequently observed to strike the vessel, rigging, or trawl “third wires”. Of the 120 recorded collisions, 564 fulmars were involved in 38 incidents. Monitoring these types of collisions is not part of the observer’s normal duties so the true extent of this impact is not known. NOAA Fisheries is currently investigating the issue, especially as it relates to “third wires” (NPFMC 2002c).

**Assessment of Population-Level Effects**

One major question for resource managers is whether a given level of incidental take is significant at the population-level. The Observer Program data has been combined from many different areas to give a broad, regional average for incidental take. Taken as a percentage of a regional population estimate, a given average level of incidental take may not appear to be a significant impact. However, if a majority of the fulmars taken annually in the groundfish fishery originate from one colony (such as St. George), and if a substantial proportion of the catch consists of adult birds, then it is possible that fishery incidental take could be contributing to population declines at specific colonies. As noted above, fulmar sample plots on St. George, St. Paul, and Chowiet islands all showed a similar pattern of stability in the 1970s and 1980s followed by a major increase in the early 1990s and an even larger decline thereafter (Dragoo *et al.* 2001). This pattern was especially dramatic on St. George. There is some question regarding the accuracy of the sample plots in reflecting actual population-level fluctuations. For instance, due to their conservative life history strategy, fulmars would not be expected to double their population over 4 years as did the sample plot numbers between 1988 and 1992 at St. George. If the count on St. George in 1992 was anomalously high (for some unexplained reason), the apparent subsequent ‘decline’ may be less meaningful in terms of actual population impacts. In order to address this uncertainty, the USGS/Biological Resource Division has recently begun to collect data on the at-sea foraging distribution of northern fulmars as well as identifying the colony of provenance of a sample of incidentally taken fulmars. Results will be used in the development of population models that may elucidate the potential for incidental take in groundfish fisheries to have colony-level population impacts. There are, of course, other factors besides fishing impacts that may cause population-levels to fluctuate, including variable environmental conditions, and these will be investigated as well.

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on northern fulmars but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impacts of groundfish and other fisheries on the availability of prey to fulmars are unknown. The ability of fulmars to forage over huge areas is presumed to lessen the potential impact of localized depletion of prey.

- **Indirect effects through consumption of fishery discards.** Fulmars are attracted to fishing vessels and processors to eat discards and offal. Benefits of the food source are countered by increased risk of incidental take on longlines.

- **Indirect effects through plastics ingestion.** Species feeding primarily by surface-seizing, including northern fulmar, have the highest frequencies of plastic ingestion (Sievert and Sileo 1993).

- **Indirect effects through contamination by oil spills.** Surface-feeding pelagic seabirds, including fulmars, are moderately sensitive to oil effects given their extreme reliance on open-water marine habitats for feeding and roosting, making them susceptible to incidents in these settings (King and Sanger 1979).

**Comparative Baseline**

Northern fulmars are abundant breeders and residents in the BSAI and GOA area with an estimated population of 2 million birds in the BSAI and GOA. They are strongly attracted to fishing vessels where they scavenge for fish processing waste and bait. Their numbers and behavior have contributed to their status as the bird species most frequently taken incidental to the groundfish fisheries. The institution of mandatory seabird protection measures for longliners in 1997 actually led to an increase of fulmars taken in the BSAI even though incidental take in the GOA decreased. Fulmars make up the majority of birds taken in the trawl fisheries with annual take in the thousands. Investigations into possible colony-level population impacts are currently underway. The past and present effects on northern fulmar are summarized in Table 3.7-13.

**Status for Cumulative Effects Analysis**

Incidental take of northern fulmars is expected to continue under all alternatives and warrants consideration in the cumulative effects analysis. Because of their status as the most frequently taken seabird species in all sectors of the groundfish fisheries, they will be discussed as a separate species in the analysis of FMP Alternatives.

### 3.7.6 Shearwaters

- Short-tailed shearwater (*Puffinus tenuirostris*)
- Sooty shearwater (*Puffinus griseus*)

**Life History and Distribution**

Shearwaters belong to the order Procellariiformes, the tubenoses, along with albatross, fulmars, and storm-petrels. Both species common to the BSAI and GOA, the short-tailed and sooty shearwaters, are dark gray with long, narrow wings and are difficult to distinguish from each other. Shearwaters breed in the Southern Hemisphere: short-tailed shearwaters in southeastern Australia and Tasmania, sooty shearwaters in New Zealand and in Chile along the South American coast. Both short-tailed and sooty shearwaters visit Alaskan waters from May through September. Short-tailed shearwaters are found in the Bering and Chukchi Seas as well as the GOA while sooty shearwaters range primarily south of the Aleutian Islands and in the GOA (Hunt *et al.* 1981b, Gould *et al.* 1982).

The total world population of short-tailed shearwaters, almost all of which spend the austral winter in the North Pacific, has been estimated at 23 million (Everett and Pitman 1993). The population of sooty shearwaters may exceed 30 million (Springer *et al.* 1999). The populations of these two species account for over 50 percent of all seabirds in Alaskan waters in summer (Sanger and Ainley 1988).

Three different time-series of pelagic bird abundance collected in disparate portions of the California Current revealed a 90 percent decline in sooty shearwater abundance between 1987 and 1994. The decline was negatively correlated with a concurrent rise in sea-surface temperatures (Veit *et al.* 1996 and 1997). The widely separated surveys suggest that this abundance change may be more than just a local change in distribution. An overall decreasing trend in sooty and short-tailed shearwater abundance at breeding colonies has occurred over the past 20 to 30 years. (Baduini, University of California, Irvine, personal communication 2000). The extent and mechanism(s) for these potential declines have not yet been established.

**Trophic Interactions**

Both short-tailed and sooty shearwaters forage on the surface or can dive to at least 60 m (Weimerskirch and Sagar 1996, Weimerskirch and Cherel 1998). Shearwaters depend on areas where prey are concentrated by upwellings, convergences, or bottom terrain features, especially along the inner front (boundary between wind-mixed and stratified water on the Bering Sea shelf) (Hunt *et al.* 1981b, Schneider *et al.* 1986, Hunt *et al.*1996c). The short-tailed shearwater eats primarily large euphausiids and some jellyfish and small schooling fish (Marchant and Higgins 1990). Diets of short-tailed shearwaters in spring varied by region in the western subarctic (Springer *et al.* 1999). This apparently reflects the availability of prey species rather than dietary preferences since elsewhere (e.g., Sea of Okhotsk and Bering Sea) other prey predominate (Ogi *et al.* 1980). Sooty shearwaters eat primarily small schooling fish, such as Pacific saury and myctophids, and their movements are believed to coincide with the movements of the sauries (Ogi 1984). Sooty shearwaters forage on squid on the outer shelf and shelf break (DeGange and Sanger 1986) and with increasing prominence at higher latitudes (Ogi 1984).

Shearwaters in the southeastern Bering Sea have, in the past, consumed a large biomass of euphausiids. Recent evidence (Baduini *et al.* 2000) suggests that, since 1997, short-tailed shearwaters over the southeastern Bering Sea shelf have been taking increasing amounts of fish. Inshore of the inner front, Pacific sand lance is taken, whereas most foraging flocks offshore of the inner front were focused on age-0 gadids, most likely pollock. This apparent dependence on age-0 pollock may occur when euphasiids are scarce over the middle domain (Hunt *et al.* 1998).

Short-tailed shearwaters occasionally die-off in large numbers during late summer, apparently due to widespread scarcity of prey during anomalous oceanographic conditions. Major die-offs were recorded in Alaska in 1983, 1986, and 1997 (Nysewander and Trapp 1984, Irons *et al.* 1986, Hatch 1987, Baduini *et al.* 1998, Mendenhall *et al.* 1998). In 1997, a die-off of short-tailed shearwaters, apparently from starvation, was estimated at 11 percent of the population surveyed (Baduini *et al.* 2000). This estimate was based on a count of floating carcasses in the southeast Bering Sea as a percent of the population surveyed. In 1998, anomalous climate conditions were repeated for a second consecutive year, with elevated water temperature, cross-shelf advection of zooplankton and larval fish, major changes in the structure of the zooplankton community, and an unprecedented second observation of a large-scale coccolithophorid phytoplankton bloom (Hunt *et al.* 1999a). Although no unusual mortality of short-tailed shearwaters was seen, birds were underweight. In both years, shearwater diets were broader than in previous years, with fish becoming a dominant prey in 1998.

The recent large-scale die-off of short-tailed shearwaters suggests that these birds are vulnerable to changes in the abundance or availability of their preferred foods in the southeastern Bering Sea (Vance *et al.* 1998). Changes in water temperature or productivity may influence the abundance of euphausiids either directly, through bottom-up effects, or indirectly through changes in the distribution of predators that compete with shearwaters for euphausiids. When euphausiids are scarce, shearwaters can use age 0 pollock, if they are present in high concentrations. Shearwater use of age 0 pollock may need to be considered in future management decisions (G.L. Hunt, Jr., University of California, Irvine, personal communication). Major changes in the zooplankton community will be likely to affect other higher trophic level species, including fish and whales (Hunt *et al.* 1999a).

**Management Overview**

Wildlife management responsibility for shearwaters is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

<u>Direct Mortality: Harvest and Other Intentional Take</u>

Shearwater chicks, called "muttonbirds" because of their high fat content, have been heavily harvested by subsistence and commercial hunters in the South Pacific for many years. In Australia alone, an estimated 700,000 short-tailed shearwater chicks are harvested every year (Everett and Pitman 1993).

<u>Direct Mortality from Incidental Take in External Fisheries</u>

Short-tailed and sooty shearwaters are attracted to fishing vessels throughout their range and have been taken incidentally in many different fisheries. The fact that they migrate between subarctic and subantarctic waters exposes them to a great variety of fisheries. High-seas driftnet fisheries for tuna, squid, and salmon have been identified as a major source of mortality for shearwaters in the past. The Japanese large-mesh driftnet fishery for tuna and swordfish dates back to 1905. This fishery peaked in 1982 with over 700 vessels but declined to only 70 vessels by 1991. There is no data on the incidental take of seabirds for most of this period except for the 1990-1991 season when over 3500 seabirds were estimated to be taken, including a large number of sooty shearwaters (DeGange *et al.* 1993). Between 1981 and 1984, the Japanese salmon mothership fishery took an average of 95,500 shearwaters each year, mostly short-tailed (Jones and DeGange 1988). In the Japanese land-based drift gillnet fishery, an estimated 80,000 shearwaters (again, mostly short-tailed) were killed in 1977. By 1987, fishing effort had been reduced and an estimated 27,500 shearwaters were killed (DeGange and Day 1991). These estimates do not include birds that fell out of the nets before being retrieved or birds that were released alive. Driftnet fisheries targeting flying squid were started in the late 1970s by Japan, Korea, and Taiwan. At their peak in the late 1980s, these fisheries deployed millions of kilometers of driftnet. Rough estimates of the total number of seabirds killed by the squid driftnet fisheries ranged between 875,000 and 1,660,000 seabirds annually. Up to 70 percent of these birds consisted of sooty shearwaters and over 100,000 birds were identified as short-tailed shearwaters (DeGange *et al.* 1993). Due to the tremendous amount of waste and ecosystem damage associated with the high-seas driftnet fisheries, they were outlawed by international agreement through United Nations Resolution (46/215) in December of 1992 (Paul 1994). Because shearwaters are such long-lived and slowly maturing species, high rates of mortality from the driftnet fisheries may have a lingering impact on the populations at present.

State-managed longline fisheries and halibut fisheries may contribute only a relatively small amount to the overall incidental take of shearwaters. In 1998, incidental take of 3 unidentified shearwaters were documented in the halibut fishery through interviews with fishermen (Trumble and Geernaert 1999).

Direct Mortality from Incidental Take on Groundfish Longlines

The estimated numbers of seabirds caught in the BSAI and GOA groundfish longline fisheries are listed in Tables 3.7-2 and 3.7-3. The two species are combined into one "shearwater" category and are probably also included to some extent in the "unidentified tubenoses" category. The combination of these categories averaged 674 birds per year between 1993 and 2001 in the BSAI and about 30 birds per year in the GOA.

In an effort to reduce the incidental take of seabirds on longlines, NOAA Fisheries instituted mandatory seabird avoidance measures for the groundfish fleet in 1997 (62 FR 23176). Prior to 1997, the average estimated number of identifiable shearwaters taken in the BSAI was 389 birds per year (not including "unidentified tubenoses"). Between 1997 and 2001, the estimated average take in the BSAI increased to 578 shearwaters per year. Much of this increased average take was due to an unusually high number of birds taken in 1998 (1,131 shearwaters). The reason this one year was so different than the others is not known but may be related to nutritional stress of the birds. In the GOA, the average take before and after the seabird avoidance measures were enacted declined from 35 shearwaters per year in 1993-1996 to 18 shearwaters per year in 1997-2001. Although the Washington Sea Grant Program results indicate that new seabird avoidance techniques could reduce overall incidental take of seabirds by 70-95 percent, incidental take of species such as shearwaters that can dive deep in pursuit of baited hooks were not reduced when single or paired streamer lines were employed (Melvin *et al.* 2001).

Direct Mortality from Incidental Take in Groundfish Trawls

The estimated number of shearwaters caught in the combined BSAI and GOA groundfish trawl fisheries varied considerably between years (Table 3.7-4). The average estimated number of shearwaters taken was between 271 birds per year (low estimate) and 1,327 birds per year (high estimate) in 1997-2001.

Direct Mortality from Vessel Strikes

According to preliminary analysis of the Observer Program records of bird-strikes from 1993-2000, sooty shearwaters were observed to strike the vessel or rigging on 6 occasions but these involved 526 birds. Collisions of large numbers of birds typically occur during the night or during storms or foggy conditions when bright deck lights are on, which can cause the birds to be disoriented (NPFMC 2002c).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on short-tailed and sooty shearwaters but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impacts of groundfish and other fisheries on the availability of prey to short-tailed and sooty shearwaters are unknown. The ability of short-tailed and sooty shearwaters to forage over huge areas is presumed to lessen the potential impact of localized depletion of prey.

- **Indirect effects through consumption of fishery discards.** Shearwaters are attracted to fishing vessels and processors to eat discards and offal. Benefits of the food source are countered by increased risk of incidental take on longlines and trawls.

- **Indirect effects through plastics ingestion.** Species feeding primarily by surface-seizing or pursuit-diving, including shearwaters, have the highest frequencies of plastic ingestion (Sievert and Sileo 1993).

- **Indirect effects through contamination by oil spills.** Diving pelagic seabirds, including shearwaters, are moderately sensitive to oil effects given their extreme reliance on open-water marine habitats for feeding and roosting, making them susceptible to incidents in these settings (King and Sanger 1979).

**Comparative Baseline**

Short-tailed and sooty shearwaters are by far the most abundant seabirds in Alaska, even though they do not breed here. They have been hunted in huge numbers on their breeding grounds and taken incidentally in various fisheries throughout their range. Increasing ocean water temperatures and changing ocean currents have apparently altered their prey availability and caused periodic massive die-offs due to starvation. Both species may have experienced population declines in the past twenty years but they continue to be very abundant. The numbers of shearwaters taken in the BSAI and GOA groundfish fisheries is relatively small. The past and present effects on shearwaters are summarized in Table 3.7-14.

**Status for Cumulative Effects Analysis**

Incidental take of shearwaters is expected to continue under all alternatives and warrants consideration in the cumulative effects analysis. Because of the similarity of their fishery interactions and responses to management measures, sooty and short-tailed shearwaters will be discussed together in the "shearwater" group in Chapter 4.

### 3.7.7 Storm-Petrels

- Leach's storm-petrel (*Oceanodroma leucorhoa*)
- Fork-tailed storm-petrel (*Oceanodroma. furcata*)

**Life History and Distribution**

Storm-petrels are tubenoses and are thus related to albatross, fulmars, and shearwaters. Two species breed in Alaska: Leach's storm-petrel and fork-tailed storm-petrel. Both are robin-sized birds with forked tails. Leach's is dark gray with a white rump and the fork-tailed is mostly whitish-gray with darker wings. Both species nest on islands in burrows that they dig or in crevices in the rocks. They lay one egg in June, incubate it for about 40 days, and fledge chicks about 70 days later. These species are active at the colony only at night, and often stay at sea during the day or on moonlit nights (Boersma and Groom 1993).

Both the Leach's and fork-tailed storm-petrels breed on islands from the western Aleutians through the GOA, but not farther north (USFWS 1998a). These species winter over the deep ocean, including the Bering Sea Basin (Shuntov 1993). Populations of most seabirds that nest in burrows and crevices, including these two storm-petrels, have not been adequately counted at any season. Population estimates are extremely crude and may only indicate their numbers within an order of magnitude (Boersma and Groom 1993). Although difficult to count, these species appear to be quite abundant in the BSAI and GOA. USFWS (1998a) estimates that there are 4.5 million Leach's storm-petrels in the BSAI and 1.5 million in the GOA. Fork-tailed storm-petrels are thought to number 4.5 million in the BSAI and 1.2 million in the GOA (Table 3.5-62).

USFWS conducts annual surveys of the populations of storm-petrels on three islands in Alaska: St. Lazaria (southeast), Aiktak (eastern Aleutians), and Buldir (western Aleutian Islands) (Figure 3.7-1). Breeding populations are indexed by counting burrow holes on permanent plots. Since they cannot be distinguished reliably, burrows made by Leach's and fork-tailed storm-petrels are combined for a total storm-petrel population index. On all three islands, the density of burrow holes has generally increased since counts were begun in the early 1990s (Dragoo *et al.* 2001).

**Trophic Interactions**

Storm-petrels seize prey from the water's surface and forage at night. They have well-developed olfactory senses and find their food and perhaps nest sites by scent (Boersma and Groom 1993). Storm-petrels feed on small fishes, particularly juvenile lantern fish, squid, and euphausiids (Springer *et al.* 1999), but in some areas, fork-tailed storm-petrels may depend on capelin (Ainley and Sanger 1979, Baird and Gould 1986, DeGange and Sanger 1986).

Storm-petrels forage at distances of more than 100 km from breeding colonies and typically forage over the shelf edge and deep water (Springer *et al.* 1999). Leach's storm-petrels forage from the shelf-break seaward (Ainley and Sanger 1979, Hunt *et al.* 1981b, Gould *et al.* 1982, Schneider *et al.* 1986). Fork-tailed storm-petrels most typically forage over the outer shelf and adjacent ocean. This species has also been observed feeding on the southeast Bering Sea shelf near the Slime Bank area and in large groups in Resurrection Bay coming out of Seward (C. Baduini, University of California, Irvine, personal communication).

**Management Overview**

Wildlife management responsibility for storm-petrels is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

Direct Mortality from Incidental Take in External Fisheries

Storm-petrels are attracted to fishing vessels throughout their range and have been taken incidentally in many different fisheries. Between 1981 and 1984, the Japanese salmon mothership fishery took an estimated annual average of 94 Leach's storm-petrels and 954 fork-tailed storm-petrels (Jones and DeGange 1988). In the Japanese land-based drift gillnet fishery, an estimated 1,843 fork-tails were killed in 1977 and 578 were killed in 1987 (DeGange and Day 1991). No estimates of incidental take are available for the high seas squid gillnet fisheries of Japan, Korea, and Taiwan.

Direct Mortality from Incidental Take in the Groundfish Fisheries

Storm-petrels are not identified by species in the Observer Program data (Tables 3.7-2 through 3.7-5) but are presumably included in the "unidentified tubenoses", "other", and "unidentified seabird" categories. Storm-petrels account for an unknown fraction of these totals.

Direct Mortality from Vessel Strikes

According to the Observer Program records of bird-strikes from 1993-2000, storm-petrels strike the vessel or rigging on a regular basis. Of the 120 recorded collisions, 631 storm-petrels were involved in 19 incidents. It is not known what proportion of these birds were killed or injured (NPFMC 2002c).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on storm-petrels but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impacts of groundfish and other fisheries on the availability of prey to storm-petrels are unknown. The ability of storm-petrels to forage over large areas is presumed to lessen the potential impact of localized depletion of prey.

- **Indirect effects through contamination by oil spills.** Storm-petrels are moderately sensitive to oil effects given their extreme reliance on open-water marine habitats for feeding and roosting, making them susceptible to incidents in these settings (King and Sanger 1979).

- **Indirect effects by introducing mammalian predators to nesting islands.** Burrowing seabirds, including storm-petrels, were decimated or seriously reduced on many islands in the Aleutian chain and GOA after the introduction of arctic and red foxes by fox farmers. Storm-petrels have begun to re-colonize some of those islands after the removal of the foxes but populations are probably still depressed from pre-fox levels. (Bailey and Kaiser 1993). At present, rats pose the greatest predator threat to seabirds breeding in Alaska, especially for burrow and crevice nesters such as storm-petrels. It is not known what proportion of fishing vessels carry rats. The USFWS in Alaska has an extensive program to reduce the threat of new rat invasions.

**Comparative Baseline**

Leach's and fork-tailed storm-petrels are abundant in the BSAI and GOA area. Reliable population estimates and trends are not available for these species. These species are probably taken occasionally by groundfish vessels, at least through vessel strikes. They are not gregarious at sea and can forage long distances from their breeding colonies and are thus not likely to be impacted by potential local depletion of forage species. The past and present effects on storm-petrels are summarized in Table 3.7-15.

**Status for Cumulative Effects Analysis**

The frequency of interaction between storm-petrels and the groundfish fleet warrants further consideration in the cumulative effects analysis. Due to the lack of quantitative information on fishing impacts on these species, they will be included in the "other planktivorous species" group in the following analysis of FMP Alternatives.

### 3.7.8 Cormorants

– Pelagic cormorant (*Phalacrocorax pelagicus*)
– Red-faced cormorant (*Phalacrocorax urile*)
– Double-crested cormorant (*Phalacrocorax auritus*)

**Life History and Distribution**

Cormorants are large, dark, heavy-bodied birds with long necks and tails. There are four species that breed in Alaska. The pelagic cormorant breeds throughout the BSAI and GOA, the red-faced cormorant breeds in the BSAI north to the Pribilofs and the GOA west of PWS, and the double-crested cormorant breeds in the Aleutian Islands and GOA. Brandt's cormorant (*P. penicillatus*) primarily breeds south of Alaska but has two small colonies in southeastern Alaska and one near the entrance to PWS (USFWS 1998a). It does not regularly interact with the groundfish fisheries and is not described further here. The other three species nest on rocky island ledges in relatively small colonies and lay 3-5 eggs. Both sexes share parental duties. Eggs hatch in 20-25 days and young fledge in 45-60 days.

Cormorants usually range within 20 km of shore (Schneider and Hunt 1984). Winter distributions are similar to their breeding distribution except that birds will move to ice-free coasts and protected waters. Rough estimates of cormorant numbers indicate that they are not nearly as numerous as many other seabird species. In the BSAI, there are an estimated 80,000 pelagics, 90,000 red-faced, and 9,000 double-crested. In the GOA, there are an estimated 70,000 pelagics, 40,000 red-faced, and 8,000 double-crested (Table 3.5-62). Population trends are difficult to ascertain for cormorants because they are known to shift nesting locations between years. Variation in nest counts on survey plots may reflect this tendency to nest in different places rather than indicate changes in population-level. Given this caveat about interpreting the limited sample plot data, pelagic cormorant colonies in the BSAI appear to be relatively stable or decreasing over the past 20 years, decreasing in the GOA, and increasing in southeast Alaska. Red-faced cormorants are surveyed separately in only one location, Chiniak Bay (GOA), and appear to be decreasing. No trend data are available for double-crested cormorants (Dragoo *et al.* 2001).

## Trophic Interactions

Cormorants are basically small fish eaters that will also take some crustaceans and other invertebrates. Cormorant species in Alaska are known to take capelin, herring, sandlance, pollock, and other small fish (Siegel-Causey and Litvinenko 1993). Cormorants forage by diving as deep as 40 m (DeGange and Sanger 1986).

## Management Overview

Wildlife management responsibility for cormorants is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

## Past and Present Effects and Management Actions

<u>Direct Mortality from Incidental Take in Fisheries</u>

The incidental take of cormorants in worldwide fisheries is unknown. Given their preference for nearshore waters, cormorants are more likely to be taken in coastal gillnet fisheries than offshore groundfish fisheries. Cormorants are not distinguished by species in the Observer Program data of incidental take in the groundfish fisheries. It is not known how many cormorants might be included in the "unknown" or "other" categories in the various sectors (Tables 3.7-2 through 3.7-5).

<u>Direct and Indirect Effects through Contamination by Oil Spills</u>

A great deal of research has been conducted on the impacts of *Exxon Valdez* oil spill in 1989 on affected species, including cormorants. Carcasses of 838 cormorants were recovered following the oil spill, including 418 pelagic, 161 red-faced, 38 double-crested, and 221 unidentified cormorants. Many more cormorants probably died as a result of the spill, but their carcasses were not found. Counts on the outer Kenai Peninsula coast suggested that the direct mortality of cormorants due to oil resulted in fewer birds in this area in 1989 compared to 1986. In addition, there were statistically-significant declines in the estimated numbers of cormorants (all three species combined) in the oiled portion of PWS based on pre- and post-spill boat surveys in July 1972-1973 compared to 1989-1991. More recent surveys (through 1998) have not shown an increasing population trend since the oil spill, and for that reason these species are considered to be not recovered in the spill area. (EVOS Trustee Council 2002).

## Comparative Baseline

Cormorants are widely distributed in the BSAI and GOA but are not abundant anywhere. These species have not been studied in great detail so there are many unknowns regarding their ecosystem and anthropogenic interactions. No quantitative data is available on their interaction with the groundfish fisheries. The past and present effects on cormorants are summarized in Table 3.7-16.

**Status for Cumulative Effects Analysis**

Since these species do not interact very often with the groundfish fisheries and there is no quantitative data on either their population trends or impacts of the fisheries, these species will not be carried forward for cumulative effects analysis except in the general category of fish-eating (piscivorous) birds.

### 3.7.9 Spectacled Eider (*Somateria fischeri*)

**Life History and Distribution**

Spectacled eiders are large diving sea ducks that spend most of the year in marine waters and nest in coastal tundra. Like the other eider species, spectacled eiders are dimorphic; males are mostly white and black while females are mottled brown, making them very difficult to see as they tend the nest. In contrast to the conservative reproductive strategy of alcids and other seabird species, spectacled eiders can lay up to 8 eggs per year and reach sexual maturity in their second year, but may live for only 10 years (Terres 1980). After breeding, the adults travel to protected marine waters where they undergo a complete molt of their flight feathers. Two principal molting and staging areas have been identified off coastal Alaska (Ledyard Bay and eastern Norton Sound) and two off coastal Russia (Petersen *et al.* 1999).

Spectacled eiders congregate during the winter in exceedingly large and dense flocks in polynyas in the pack ice in the central Bering Sea between St. Lawrence and St. Matthew Islands. Spectacled eiders from all three known breeding areas (in Alaska, Canada, and Russia) use this wintering area. Because nearly all individuals of this species may spend each winter occupying an area of ocean less than 50 km (31 miles) in diameter, they may be particularly vulnerable to chance events during this time (USFWS 2000a).

The North American Waterfowl Breeding Pairs Survey indicates that the numbers of spectacled eiders breeding on the Yukon-Kuskokwim Delta dropped from about 48,000 pairs in the 1970s to less than 2,500 pairs by 1992, a 95 percent decline (Ely *et al.* 1994, Stehn *et al.* 1993). Recent surveys suggest the Yukon-Kuskokwim Delta population has stabilized or increased and now stands at about 4,000 pairs (Bowman *et al.* 1999, Eldridge and Dau 1999, USFWS 2000a). Biologists estimate that about 9,000 pairs currently nest on Alaska's arctic coastal plain and at least 40,000 pairs nest in arctic Russia. The current worldwide population estimate is 360,000 birds, which is derived from winter surveys in the Bering Sea and includes non-breeding birds (USFWS 1999c).

**Trophic Interactions**

While at sea, spectacled eiders appear to be primarily bottom feeders, eating mollusks and crustaceans at depths of up to 70 m in the wintering area (Dau and Kitchinski 1977, USFWS 1999a). They may also forage on pelagic amphipods that are concentrated along the seawater-pack ice interface (Kessel 1989). On their nesting grounds, insect larva and aquatic vegetation dominates the diet (Kistchinski and Flint 1974). Spectacled eiders nest in arctic tundra areas where they are susceptible to predation by arctic fox and several predatory birds. Predation at sea is unknown.

## Management Overview

Spectacled eiders, similar to other sea ducks, are co-managed by the USFWS and the ADF&G under the Migratory Bird Treaty Act. Bag limits for sport hunting are set by the USFWS. The ADF&G, Division of Subsistence, monitors subsistence harvest of eiders along with other species of sea ducks.

Spectacled eiders have also been listed as "threatened" under the ESA (May 10, 1993, 58 FR 27474), primarily due to a rapid decline in their breeding population on the Yukon-Kuskokwim Delta. Under the requirements of the ESA Section 7, the USFWS is responsible for determining whether proposed federal actions are likely to jeopardize the recovery of the species. In 1992, while it was a candidate species for the ESA, NOAA Fisheries had its first consultation with the USFWS concerning the effects of the BSAI and GOA groundfish fisheries on spectacled eiders (USFWS 1992). The resulting BiOp concluded that the groundfish fishery would not adversely affect spectacled eiders, based primarily on the lack of spatial/temporal overlap between the marine ranges of the eiders and the groundfish harvest. The USFWS made the same determination (not likely to adversely affect) for the 1993 and 1994 groundfish TAC specifications (USFWS 1993b, USFWS 1994) and decided that it would restrict further consultations on the fishery to the endangered short-tailed albatross.

At the time the species was listed under the ESA, the USFWS determined that it would not be prudent to designate critical habitat for spectacled eiders (USFWS 1993a). After a series of legal challenges, the USFWS reversed its decision and designated critical habitat for spectacled eiders on Feb. 6, 2001, including parts of the Yukon-Kuskokwim Delta and nearby marine waters, Norton Sound, Ledyard Bay, and an area of marine water between St. Lawrence Island and St. Matthew Island (66 FR 9146) (Figure 3.7-8).

## Past and Present Effects and Management Actions

<u>Direct Mortality from Harvest and Other Intentional Take</u>

Spectacled eiders have been used for subsistence hunting and egging purposes by local Native residents for centuries. The USFWS estimated that at least 3.75 percent of the breeding adult spectacled eiders on the Yukon-Kuskokwim Delta are taken by subsistence hunters each year, but it is not known what effect this level of harvest has on the population. Take of spectacled eiders on the North Slope are not currently known (Larned *et al.* 2001).

<u>Direct Mortality from Incidental Take in Fisheries</u>

The Observer Program does not distinguish sea ducks by group or by species so there is no data on incidental take of spectacled eiders. However, spectacled eiders are not likely to be directly affected by the BSAI groundfish fisheries because the winter distribution of spectacled eiders occurs within the ice pack in the northern Bering Sea and at other times they are either in nearshore waters for molting or inland to nest.

<u>Indirect Effects through Changes in Prey Availability</u>

Disturbance of marine benthic feeding areas by commercial bottom-trawl fisheries as well as bottom-feeding walruses and gray whales have been identified as possible reasons for the decline of spectacled eider populations (USFWS 1993a, USFWS 1999c). Although there is no direct evidence for adverse impacts of bottom-trawling, the USFWS has recommended that the fisheries avoid disturbing or harvesting benthic communities in eider molting and wintering areas during any time of year (USFWS 1999c).

Indirect Effects through Contamination by Oil Spills and Other Toxic Compounds

Consumption of lead shot in the Yukon-Kuskokwim Delta breeding grounds was identified as a likely contributing factor in the decline of this species (Flint *et al.* 1997). The use of lead shot for hunting was made illegal but lead shot already present on the breeding grounds remains available to birds and poses a continuing risk of toxic contamination.

The tendency of spectacled eiders to congregate in dense flocks on the water makes them particularly susceptible to localized oil spills. The USFWS has recommended several measures to minimize the chances of such spills occurring in eider critical habitat (USFWS 1999c).

**Comparative Baseline**

Spectacled eiders were listed as threatened under the ESA in 1993 due to major declines in their Alaska breeding populations. Although there appears to be almost no spatial/temporal overlap with the groundfish fisheries and marine waters used by spectacled eiders, the potential effects of BSAI groundfish bottom-trawling on the benthic habitat of eider prey has been cited as one of several possible reasons for the declining population. Specific evidence of adverse impacts from the fishery have not been demonstrated. The breeding population of spectacled eiders on the Yukon-Kuskokwim Delta appears to be increasing in recent years. The current worldwide population estimate is 360,000 birds, including non-breeding birds. The past and present effects on spectacled eiders are summarized in Table 3.7-17.

**Status for Cumulative Effects Analysis**

The impact of the groundfish fisheries on the feeding ecology and survival of spectacled eiders at sea is largely unknown but remains a concern under all FMP Alternatives. The status of spectacled eiders as threatened under the ESA warrants further consideration in the cumulative effects analysis. Because of the similarities in their conservation concerns and status under the ESA, spectacled eiders will be considered in conjunction with Steller's eiders in the analysis of FMP Alternatives.

### 3.7.10 Steller's Eider (*Polysticta stelleri*)

**Life History and Distribution**

Steller's eiders are the smallest species of eider. Like the other eider species, Steller's eiders are dimorphic; males are mostly white and black while females are mottled brown. Females can lay up to 10 eggs per year (Terres 1980). After the nesting season, Steller's eiders return to protected marine waters where they undergo a complete molt of their flight feathers. Concentrations of molting Steller's eiders have been noted in Russia, near St. Lawrence Island in the Bering Sea, and along the northern shore of the Alaska Peninsula.

There are two geographical populations of Steller's eiders, one that winters in the North Atlantic Ocean and one in the Pacific. Most of the Pacific population inhabits the maritime tundra of northeast Siberia (Solovieva 1997), and a smaller population nests in Alaska on the Yukon-Kuskokwim Delta (Flint and Herzog 1999) and the arctic coastal plain (USFWS 1999a). The Pacific population winters primarily along the Alaska Peninsula, from the eastern Aleutian Islands to southern Cook Inlet, in shallow nearshore waters (Palmer 1976). In spring, large numbers concentrate in Bristol Bay before migration. Along open coastline, Steller's eiders usually remain within about 400 m of shore in water less than 10 m deep but they can also be found in waters well offshore in shallow bays and lagoons or near reefs (USFWS 1997, USFWS 2000b).

Population data for Steller's eiders is sketchy due to several reasons; they nest predominately in remote areas of Russia, they do not appear to have many consistent concentration areas, and they have never received much wildlife management attention because they are not an important duck hunting species. Historical accounts of "enormous flocks" of Steller's eiders in the early 1900s were noticeably reduced by the 1950s (USFWS 1997). While recent aerial surveys indicate that the Russian-nesting Pacific population still contains 100,000 to 150,000 birds (USFWS 1999a), the Alaska-nesting population has decreased substantially since the1920s. On the Yukon-Kuskokwim Delta, where they were once described as being widespread and "common" nesters, they currently number only in the tens or hundreds (USFWS 1997, Flint and Herzog 1999). On the arctic coastal plain, Steller's once nested all the way from Wainwright east to the Canadian border but their nesting range has been greatly reduced (Kertell 1991). Aerial surveys of the arctic coastal plain during breeding season averaged 4,800 pairs from 1990 to 1998 (USFWS 1999a). There is evidence that molting and wintering populations of Steller's eiders along the Alaska Peninsula have declined since the 1960s, indicating that the Russian-nesting population is also in decline (Jones 1965, Kertell 1991, USFWS 1999a).

**Trophic Interactions**

Steller's eiders spend the majority of the year in shallow, near-shore marine waters where they feed by diving and dabbling for clams, polychaete worms, snails and amphipods (Petersen 1980, USFWS 1997). They are opportunistic feeders and will modify their diet according to what is available. A diet study of Steller's eiders conducted in Nelson Lagoon from April to October in 1977 and 1979 indicated that bivalves and amphipods were the primary food items, specifically blue mussels (*Mytilus edulis*), clams (*Macoma balthica*), and gammarid amphipods (Petersen 1981). In freshwater, they commonly feed on insect larvae (Cottom 1939).

**Management Overview**

Steller's eiders, like other sea ducks, are co-managed by the USFWS and the ADF&G under the Migratory Bird Treaty Act. Bag limits for sport hunting are set by the USFWS. The ADF&G, Division of Subsistence, monitors subsistence harvest of eiders along with other species of sea ducks.

Steller's eiders were listed as "threatened" under the ESA on June 11, 1997 (62 FR 31748) due to a substantial decrease in its nesting range in Alaska. Under the requirements of the ESA Section 7, the USFWS is responsible for determining whether proposed federal actions are likely to jeopardize the recovery of the species. In 1992, while it was a candidate species for the ESA, NOAA Fisheries had its first consultation with the USFWS concerning the effects of the BSAI and GOA groundfish fisheries on Steller's eiders (USFWS 1992). The resulting BiOp concluded that the groundfish fishery would not adversely affect Steller's eiders, based primarily on the lack of spatial/temporal overlap between the marine habitats of the eiders and the groundfish harvest. The USFWS made the same determination (not likely to adversely affect) for the 1993 and 1994 groundfish TAC specifications (USFWS 1993b, USFWS 1994). In the most recent BiOps (USFWS 2003), the USFWS concluded that the fisheries would not likely jeoparidze the continued existence or recovery of Steller's eider and would not adversely modify Steller's eider critical habitat.

At the time the species was listed under the ESA, the USFWS determined that it would not be prudent to designate critical habitat for Steller's eiders (USFWS 1993a). After a series of legal challenges, the USFWS reversed its decision and designated critical habitat for Steller's eiders on Feb. 2, 2001 (66 FR 8849), including breeding habitat on the Yukon-Kuskokwim Delta , and marine waters in northern Kuskokwim Bay, Seal Islands, Nelson Lagoon, and Izembek Lagoon on the north side of the Alaska Peninsula (Figure 3.7-9).

**Past and Present Effects and Management Actions**

Direct Mortality from Harvest and Other Intentional Take

Steller's eiders have probably been taken in small numbers for subsistence and sport hunting for many years. An average of 31 Steller's eiders were taken every year for subsistence purposes between 1987 and 1997 (Paige and Wolfe 1999).

Direct Mortality from Incidental Take in Groundfish Fisheries

The Observer Program does have a species code for Steller's eiders but none have been recorded to be taken in the groundfish fisheries. Steller's eiders are not likely to be taken by the BSAI and GOA groundfish fisheries because they are not attracted to fishing vessels and prefer to forage in nearshore waters. The one area where there is regular overlap of the fishery and the eiders involves the yellowfin sole bottom trawl fishery in the northern portion of Kuskokwim Bay and this fishery only involved two vessels in 2001.

Indirect Effects through Changes in Prey Availability

There is no direct competition by eiders for species targeted by the groundfish fisheries so any potential impact would have to be through ecosystem-level mechanisms. Non-specific changes in the marine ecosystem have been cited as a possible cause of the population decline but whether those changes were brought about by natural or anthropogenic factors is not known (USFWS 1997). No studies have been made to determine if the yellowfin sole fishery in Kuskokwim Bay or any other area directly affects prey availability or habitat used by the eiders.

Indirect Effects through Contamination by Oil Spills and Other Toxic Compounds

Consumption of lead shot in the Yukon-Kuskokwim Delta breeding grounds is a potential contributing factor in the decline of this species (USFWS 1997). The use of lead shot for hunting is now illegal but lead shot already present on the breeding grounds remains available to birds and poses a continuing risk of toxic contamination.

The concentration of Steller's eiders during molting and migration makes them particularly susceptible to localized oil spills in those situations. The USFWS has recommended several measures to minimize the chances of such spills occurring in eider critical habitat (USFWS 1999a).

**Comparative Baseline**

No reliable overall population estimates are available but there appear to be over 100,000 Steller's eiders nesting in Russia. Steller's eiders were listed as threatened under the ESA in 1997 due to major declines in their Alaska breeding populations. Although there appears to be no direct competition for prey and very little spatial/temporal overlap with the groundfish fisheries and marine waters used by Steller's eiders, the contribution of the fishery to changes in the marine environment has been cited as one of several possible reasons for the declining population. Specific evidence of adverse impacts from the fishery has not been demonstrated. The past and present effects on Steller's eider are summarized in Table 3.7-18.

**Status for Cumulative Effects Analysis**

The impact of the groundfish fisheries on the feeding ecology and survival of Steller's eiders at sea is largely unknown but remains a concern under all FMP Alternatives. The status of Steller's eiders as threatened under the ESA warrants further consideration in the cumulative effects analysis. Because of the similarities in their conservation concerns and status under the ESA, Steller's eiders will be considered in conjunction with spectacled eiders in the analysis of FMP Alternatives.

### 3.7.11 Jaegers

- Long-tailed jaeger (*Stercorarius longicaudus*)
- Parasitic jaeger (*Stercorarius parasiticus*)
- Pomarine jaeger (*Stercorarius pomarinus*)

**Life History and Distribution**

Jaegers are dark, gull-like birds that spend most of the year at sea, coming ashore only to nest on arctic islands, coasts, and tundra areas throughout the northern hemisphere. They spend their winters on the oceans of the southern hemisphere. They traverse the waters of the BSAI and GOA during their spring and fall migrations. All three species of jaegers have similar life-history strategies. All three species nest on tundra or wet grasslands, lay 2 to 3 eggs, and share parental duties. Jaegers are very fast and agile fliers and often chase gulls and terns until they drop food items.

Population trends for jaegers are unknown. All three species are considered "uncommon" or "rare" during migration in the BSAI and GOA area, with estimated relative abundance in the 10,000 to less than 1000 range (Table 3.5-62).

**Trophic Interactions**

The principal marine foods for jaegers are small schooling fish such as capelin and Pacific sand lance, either caught by themselves or taken from other seabirds (Gabrielson and Lincoln 1959, DeGange and Sanger

1986). While nesting they usually forage over land and are efficient predators on small birds, mammals, and insects.

**Management Overview**

Wildlife management responsibility for jaegers is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

Direct Mortality from Incidental Take in Fisheries

The incidental take of jaegers in worldwide fisheries is unknown. Jaegers are not distinguished by species or as a group in the Observer Program data on incidental take by the groundfish fisheries. It is not known how many jaegers might be included in the "unknown seabird" categories in the various sectors (Tables 3.7-2 through 3.7-5).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on jaegers but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impacts of groundfish and other fisheries on the availability of prey to jaegers are unknown. The ability of jaegers to forage over huge areas, as well as their ability to force other seabirds to disgorge their food, is presumed to lessen the potential impact of localized depletion of prey.

**Comparative Baseline**

Jaegers migrate through the BSAI and GOA area in relatively small numbers. There is essentially no data on the interactions of these species with the groundfish fleet or their ecology in Alaska waters. The past and present effects on jaegers are summarized in Table 3.7-19.

**Status for Cumulative Effects Analysis**

Since these species do not interact very often with the groundfish fisheries and there is no quantitative data on either their population trends or impacts of the fisheries, these species will not be carried forward for cumulative effects analysis except in the general category of fish-eating (piscivorous) birds.

### 3.7.12 Gulls

- Glaucous-winged gull (*Larus glaucescens*)
- Glaucous gull (*Larus hyperboreus*)
- Herring gull (*Larus argentatus*)
- Mew gull (*Larus canus*)
- Bonaparte's gull (*Larus philadelphia*)
- Sabine's gull (*Xema sabini*)

**Life History and Distribution**

These six species, plus the two kittiwake species considered separately, are the commonly encountered gulls in the BSAI and GOA area. Adults are mostly gray and white while immatures are various shades of brown. The three largest species, glaucous-winged, glaucous, and herring gulls, all take four years to reach adult plumage. Mew gulls take three years and the two smallest species, Bonaparte's and Sabine's, are two-year gulls (Harrison 1983). The large number of immature plumages plus the fact that many of these species regularly hybridize with other gulls means that there is a great deal of plumage variability in these birds. It requires extensive training and practice to distinguish the different species in the field, especially for non-adult plumages. For this reason, observations and data on the interactions of these species with fisheries are usually lumped together under a common "gull" category.

Glaucous-winged gulls breed from the central Bering Sea southeastward through the GOA. Glaucous gulls breed from Bristol Bay northward. Herring gulls are widespread in North America and breed along the Alaska coast as well as inland. Mew gulls also breed along the Alaska coast and inland. Bonaparte's and Sabine's gulls breed from the Alaska Peninsula northward (Sibley 2000). At sea, gulls forage both near shore and at the shelf edge during the summer. In winter, most gulls disperse across the shelf from the ice edge to the deep ocean (Gould *et al.* 1982, DeGange and Sanger 1986, Schneider *et al.* 1986, Shuntov 1993). The edge of the ice pack and polynyas within it provide important winter and spring habitat for large gulls that forage on zooplankton and fish of the ice-edge system (Hunt 1991, Hunt *et al.* 1996b).

The USFWS has made no effort to systematically census gull populations in Alaska. In the BSAI and GOA area, very rough abundance estimates have been made at seabird colonies for some gull species (USFWS 1998a). These data only provide an "order of magnitude" approximation of breeding numbers and should not be used to assess population-level effects. These estimates do not include birds that nest and reside over the mainland rather than in marine areas of the BSAI and GOA (Table 3.5-62). The number of glaucous-winged gulls is estimated to be 150,000 in the BSAI and 300,000 in the GOA. Glaucous gulls are less numerous with an estimated 30,000 in the BSAI and 2,000 in the GOA. Herring gulls rarely nest on the islands and coasts of the BSAI and GOA area and are barely represented in the population estimates. Mew gulls are rare in the BSAI colonies, with only an estimated 700 birds, but have 40,000 in the GOA. Bonaparte's are listed as "rare" (less than 1000 birds) in the BSAI and "uncommon" (1,000 to 10,000 birds) in the GOA. Sabine's are listed as "uncommon" in both the BSAI and GOA.

Population trend data are available for only one species, glaucous-winged gulls, which are censussed on permanent USFWS sample plots on an annual or semi-annual basis. On Buldir Island (western Aleutians), the numbers have declined steadily since the plot was established in 1992. At Middleton Island (GOA), nesting glaucous-winged gulls have increased dramatically since counts were begun in 1974. On four other islands in the BSAI and GOA, numbers have fluctuated but show no consistent pattern of increase or decrease. (Dragoo *et al.* 2001).

**Trophic Interactions**

Most gulls are highly opportunistic and omnivorous feeders, taking a wide variety of prey from near the surface of the water, including small schooling fish such as capelin, Pacific sand lance, and herring. They will also eat invertebrates and carrion wherever they find them, often while scavenging among floating debris and on beaches. Large gulls also prey on the eggs and young of waterfowl and seabirds (Swartz 1966, Baird and Gould 1986, Bowman *et al.* 1997). They are strongly attracted to bait and discards behind fishing vessels, which exposes them to the risk of incidental take. Gulls can switch to invertebrate prey or scavenging when schooling fish decline during the breeding season, but reproductive success suffers (Murphy *et al.* 1984).

**Management Overview**

Wildlife management responsibility for gulls is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

Direct Mortality: Harvest and Other Intentional Take

Breeding colonies of gulls have been used for subsistence purposes by Native peoples of the BSAI and GOA for thousands of years. Harvest of adult birds from breeding colonies continues to the present time in some coastal communities, most commonly by means of shotguns and motorized boats (Denlinger and Wohl 2001). Egg collection is a widespread activity that provides a significant source of high quality food in early summer and is an important cultural tradition for many coastal communities (Lowenstein 1986). Historical catch data were not recorded but recent community surveys by the ADF&G, USFWS, and tribal governments have provided some indication of the scope of seabird harvests (Denlinger and Wohl 2001). In 1996, communities in the BSAI and GOA area reported takes of 1,571 unspecified gulls, mostly from the St. Lawrence Island/Diomede Islands, Yukon-Kuskokwim Delta, and Bristol Bay areas. In 1995, about 115,000 seabird eggs were collected in the BSAI and GOA area, including a large proportion of unspecified gull eggs. Gull eggs were the most commonly collected eggs in Bristol Bay and the northern Alaska Peninsula regions (Paige and Wolfe 1997). These estimates are considered to be minimal given the nature of post-harvest user surveys. They do not include any estimates of the numbers of eggs that may have been lost during collection activities, either by falling off the cliffs when adults were disturbed or to predatory gulls and ravens when left unprotected.

Direct Mortality from Incidental Take in External Fisheries

Gulls are attracted to fishing and processing vessels to scavenge on fishery wastes. Data on incidental take of gulls has not been recorded for most fisheries or has been included in “unidentified” categories. Although they are likely taken in many types of longline and net gear, in both nearshore and offshore fisheries, the frequency of take appears to be relatively infrequent or rare.

Direct Mortality from Incidental Take on Groundfish Longlines

The numbers of gulls taken in the BSAI and GOA groundfish longline fisheries in 1993- 2001 are estimated in Tables 3.7-2 and 3.7-3. Observers have individual species codes for the large gulls and kittiwakes plus an "unidentified gull" category but for analysis and reporting purposes, all species are combined in one "gull" category. An unknown number of them are also included in the "unidentified seabird" category. For just the gull category, the estimated average take was 2,707 birds per year in the BSAI and 114 birds per year in the GOA between 1993-2001.

In an effort to reduce the incidental take of seabirds on longlines, NOAA Fisheries instituted mandatory seabird avoidance measures for the groundfish longline fleet in 1997 (62 FR 23176). Prior to 1997, the average estimated take of gulls (not including "unidentified seabirds") in the BSAI was 2,007 birds per year. Between 1997 and 2001, the estimated average take in the BSAI increased to 3,268 gulls per year. Much of that increase was derived from high takes in 1998 and 2000 which may have been related to a general shortage of natural food in those years. In the GOA, the number of gulls taken from 1993-1996 was 74 birds per year but that average increased to 147 gulls per year from 1997-2001. It is not clear whether the increase in average takes after 1997 was due to ineffective deployment of seabird deterrent techniques, at least on some vessels, or whether the nutritional state of the birds (i.e., starvation) may have changed the behavior of the birds so that the deterrence was less effective.

Direct Mortality from Incidental Take in Groundfish Trawls

The estimated number of gulls caught in the combined BSAI and GOA groundfish trawl fisheries varied considerably between years, with two years showing zero take (Table 3.7-4). The average estimated number of gulls taken was between 150 birds per year (low estimate) and 398 birds per year (high estimate) in 1997-2001.

Indirect Effects through Consumption of Fishery Discards

Scavenging of fishing discards and processing wastes can have population-level effects for gulls. Scavenged processing wastes and other artificial foods may not be adequate foods for rearing chicks successfully (Murphy *et al.* 1984, Baird and Gould 1986, Irons *et al.* 1986, DeGange and Sanger 1986). On the other hand, abundant scavenging during winter may increase gull populations because survival of immature birds is enhanced (Patten and Patten 1982). Larger gull numbers can reduce local populations of other birds through increased competition for nest sites and predation pressure on their young, although scientists disagree about the magnitude of this problem (Spaans and Blokpoel 1991). Hunt (1972) found that herring gulls on the coast of Maine that used discarded waste had increased breeding success. Studies on two gull species in Spain indicate that a dependence on discards from commercial fishing activities may be a limiting factor in the breeding success of these species (Oro *et al.*1995, Oro 1996). Fishery wastes may have lower caloric density than the best of the forage fishes, but when good-quality forage fish are scarce, food from discards, offal, and garbage may be important for successful reproduction (G. L. Hunt, Jr., University of California, Irvine, personal communication). In the Atlantic Ocean, about 30 percent of total food consumed by seabirds in the North Sea is estimated to be discards (including offal) (Tasker and Furness 1996). Numerous instances are cited showing potential relationships between discards in diets and changes in breeding populations (Garthe *et al.* 1999) but no data are available on these effects in Alaska.

In many areas of the world, fishery discards appear to have benefitted large, aggressive, and predatory seabird species. For example, in the North Sea, populations of great skuas (*Catharacta skua*) and black-backed gulls (*Larus marinus*) have increased due to use of fishery discards, and these birds prey on other seabird species. Sudden withdrawal of discards might cause the predatory species to increase pressure on kittiwakes, puffins, sea ducks, and guillemots long before the skuas and gulls decline to previous levels (Furness 1999).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on gulls but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impact of groundfish fisheries on the availability of prey to gulls is likely to only be a factor if it leads to localized depletion of prey around breeding colonies. The extent of this potential impact on gulls is unknown. NPFMC has prohibited directed fisheries on forage fish to minimize any indirect impact on seabirds (BSAI FMP Amendment 36 and GOA Amendment 39).

**Comparative Baseline**

The Alaska populations of the different species of gulls are not surveyed on a regular basis so it is essentially impossible to assess population-level impacts of natural or anthropogenic phenomena. Highly variable plumages makes identification of the different gull species difficult so they are often lumped together in Observer Program data. Average incidental take of gulls on longlines has increased in the BSAI and GOA since seabird avoidance regulations were enacted in 1997. The past and present effects on gulls are summarized in Table 3.7-20.

**Status for Cumulative Effects Analysis**

Incidental take of gulls is expected to continue under all alternatives and warrants consideration in the cumulative effects analysis. Because there is no species specific quantitative data on either their population trends or impacts of the fisheries, these species will be discussed in conjunction with the fish-eating (piscivorous) birds in Chapter 4.

### 3.7.13 Kittiwakes

- Black-legged kittiwake (*Rissa tridactyla*)
- Red-legged kittiwake (*Rissa brevirostris*)

**Life History and Distribution**

Kittiwakes are small gray and white gulls with black wing tips. Their names tip off their leg color. Kittiwakes are gregarious at all times and nest in dense colonies on steep-sided cliffs. They build nests of mud and vegetation and typically lay 1-2 eggs. Both sexes look alike and share parental duties. Eggs incubate for about a month and chicks fledge in about 45 days. Black-legged kittiwakes take three years to reach adult plumage while red-leggeds take only two years (National Geographic 1999).

The black-legged kittiwake is a holarctic species that breeds in coastal waters throughout Alaska except for southeast. The red-legged kittiwake is restricted to the Bering Sea and North Pacific and breeds only in four colonies in the BSAI (USFWS 1998a). Black-legged kittiwakes forage over the entire continental shelf and shelf break. Red-legged kittiwakes forage from the shelf break seaward. The foraging range during the breeding season is 100 km or more (Schneider and Hunt 1984, Schneider *et al.* 1986, Hatch 1993). Both also forage locally near the coast if schooling prey are available (Schneider *et al.*1990, Suryan *et al.* 1998b, Suryan *et al.* 2000). Black-legged kittiwakes require a shelf several tens of kilometers wide, where prey items are concentrated by upwellings, and are few or absent in colonies with a very narrow shelf (Springer *et al.* 1996, Byrd *et al.* 1997). Black-legged kittiwakes winter over the shelf and deep ocean (Gould 1983, Shuntov 1993). The wintering area of the red-legged kittiwake includes the waters south of the Aleutians and the western GOA (Harrison 1983, Sibley 2000).

The total number of black-legged kittiwakes from hundreds of colonies are estimated to be around 800,000 in the BSAI and 1 million in the GOA. Red-legged kittiwakes are easier to survey since they are limited to only a few colonies in the BSAI. They are estimated to number around 150,000, almost 80 percent of which nest on St. George Island in the Pribilofs (Table 3.5-62).

Kittiwake population trends, as opposed to population totals, are measured by censussing permanent sample -plots on an annual or semi-annual basis. Trends differ among regions of the state (Table 3.7-21, Hunt and Byrd 1999, Dragoo *et al.* 2001). Populations of both species declined steeply on the Pribilof Islands after 1976 (the year when monitoring began). Red-legged kittiwakes on the sample plots have declined to approximately half their original numbers. Black-leggeds declined by almost 75 percent on St. Paul and 65 percent on St. George. Although it appeared that black-legged kittiwake populations on St. George Island had stabilized by 1996 (Hunt and Byrd 1999), later counts continued the overall pattern of decline (Dragoo *et al.* 2001). It is not clear if the population of red-legged kittiwakes on St. Paul Island has stabilized (Hunt and Byrd 1999, Dragoo *et al.* 2001). In contrast, both species have increased in the smaller colonies of the western Aleutian Islands (Agattu and Buldir) from the mid-1970s until the present. Black-legged kittiwakes are stable or increasing in the northern Bering Sea (Bluff colony), Aleutian Islands, and parts of the northern GOA. However, populations are declining in Cook Inlet, Kodiak Island, and parts of Bristol Bay. At their largest colony in the GOA, Middleton Island, black-leggeds have declined on sample plots by almost 85 percent from their high in 1981. (Table 3.7-21; Dragoo *et al.* 2001).

**Trophic Interactions**

Prey are taken at the surface or by dives within a meter of the surface. Both species consume small schooling fish and zooplankton, relying primarily on fish when feeding their young. These species appear to depend on fatty species of forage fish as well as age-0 and age-1 pollock for successful reproduction (Hunt *et al.* 1996a).

The principal fish prey of black-legged kittiwakes are capelin and Pacific sand lance, herring or small cods in some locations, and myctophids (lanternfish) as well as juvenile pollock in the central Bering Sea. Black-legged kittiwakes also consume processing wastes in the North Sea when larger seabirds are not numerous near vessels (Furness and Ainley 1984). Little is known about the extent of scavenging by this species in Alaska. Red-legged kittiwakes consume the same fish but with more emphasis on myctophids and zooplankton (Hunt *et al.*1981a, Springer *et al.* 1984, Springer *et al.* 1986, Springer *et al.* 1987, Sanger 1987, Hatch 1993). Myctophids and probably zooplankton are taken primarily at night (Hatch 1993).

Capelin and Pacific sand lance vary greatly in availability among years, and breeding success in most areas is correlated with abundance of one or the other species in the diet (Troy and Baker 1985, Baird and Gould 1986, Springer *et al.* 1987, Baird 1990). Similarly, the availability of juvenile herring affects kittiwake foraging efforts and breeding success in PWS (Suryan *et al.* 2000). For kittiwake colonies in low productivity areas, the availability of all three forage species (capelin, Pacific sand lance, and herring) may be important to maintaining productivity (Suryan *et al.* 2000). Consumption of juvenile pollock, although prominent in kittiwake diets in the Pribilof Islands in some years, results in slower chick growth than other principal forage fish, which have a higher energy content (Romano *et al.* 1998). Winter diets are poorly known; both species probably rely more on invertebrates in winter than when feeding young (Hatch 1993).

Factors that limit the food availability to seabirds have been investigated primarily during the past ten years, and directed research is recent. Intensive work on the diets of kittiwakes, along with other species, has taken place in the southeastern Bering Sea (Springer *et al.* 1986, Schneider *et al.* 1990, Hunt *et al.* 1981a, Hunt *et al.* 1981b, Decker *et al.* 1995); northern Bering and Chukchi Seas (Springer *et al.* 1987, Elphick and Hunt 1993, Kinder *et al.* 1983); and Cook Inlet and PWS (Piatt *et al.* 1998, Suryan *et al.* 1998a, Suryan *et al.* 1998b, Suryan *et al.* 2000). In each place, only part of the factors affecting bird forage availability have been explored. All studies were restricted to summer. Limiting factors in areas that have not yet been studied are likely to differ in type and importance, and they may be completely different in winter when forage species and locations are different. Most critical is the lack of information on how events beyond a seabird's foraging range may influence prey availability. Such factors may include environmental changes, fluctuations in regionwide stocks of forage and non-forage species, and commercial fishery harvests.

**Management Overview**

Wildlife management responsibility for kittiwakes is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

The red-legged kittiwake is a USFWS "species of management concern" because 80 percent of its worldwide population nests in only one colony, St. George Island, and because its recent severe population decline has not been explained (USFWS 1995b). For these reasons, the species was recently assigned "vulnerable" status on the World Conservation Union's *Red List of Threatened Species* (IUCN 2000).

**Past and Present Effects and Management Actions**

Direct Mortality: Harvest and Other Intentional Take

Breeding colonies of seabirds have been used as a source of meat, eggs, and skins for clothing by Native peoples of the BSAI and GOA for thousands of years. Kittiwakes are not usually distinguished from other gull species in accounts of these traditional harvests but they probably never accounted for a large percentage of the take because of their small size and relatively inaccessible nests. Recent community harvest surveys estimate that in 1996, 476 black-legged kittiwakes and 688 red-legged kittiwakes were taken in the BSAI and GOA area, almost all of which were from the Aleutian and Pribilof Islands (Denlinger and Wohl 2001). Those same survey results indicate that over 100,000 seabird eggs were taken in the BSAI and GOA area in 1995 but there is no estimate what fraction of these, if any, were kittiwake eggs.

Direct Mortality from Incidental Take in External Fisheries

Past fisheries in the North Pacific, both foreign and domestic, have taken kittiwakes in the course of their operations. For most of these fisheries, the numbers of individual species taken were not recorded. One exception is the Japanese salmon mothership fishery where an estimated average of 95 black-legged kittiwakes (out of a total average of 165,000 birds) were taken every year between 1981-1984 (Jones and DeGange 1988). Although the land-based Japanese salmon gillnet fishery was responsible for millions of seabird deaths from 1952-1992, no kittiwakes were identified in those totals (DeGange and Day 1991). The incidental take of kittiwakes in the current foreign gillnet and longline fisheries is unknown.

Direct Mortality from Incidental Take on Groundfish Longlines

The numbers of seabirds caught in the BSAI and GOA groundfish longline fisheries are estimated from Observer Program data in Tables 3.7-2 and 3.7-3. Observers have individual species codes for the two kittiwakes but they are included in the "gull" category for analysis and reporting purposes. An unknown number of kittiwakes are also probably included in the "unidentified seabird" category. For just the gull category, the estimated average take was 2,707 birds per year in the BSAI and 114 birds per year in the GOA between 1993-2001.

Direct Mortality from Incidental Take in Groundfish Trawls

The numbers of seabirds caught in the combined BSAI and GOA groundfish trawl fisheries are estimated from Observer Program data in Table 3.7-4. Kittiwakes "other" are included in the "gull" category for analysis and reporting purposes. An unknown number of kittiwakes are also probably included in the "unidentified seabird" category. For just the gull category, the estimated average take was between 150 birds per year (low estimate) and 398 birds per year (high estimate) between 1997 and 2001.

Indirect Effects through Changes in Prey Availability.

Birds that breed in Alaska and prey on forage fish, including kittiwakes, may be impacted by indirect fishery effects on prey abundance and availability. Given the wide variety of foods used by kittiwakes and the extensive areas over which they forage, it seems unlikely that they are very susceptible to localized depletion of prey during the non-breeding season. However, while nesting, kittiwakes are more limited in their options and are more susceptible to localized depletions of prey around their colonies. Variability in food supplies around the colonies is likely to impact reproductive success rather than survival of adult birds but may effect survival if the depletion is severe.

The energy content of prey has recently been found to influence the growth of seabird chicks and reproductive success at the colony level (Hunt *et al.* 1996a, Kitaysky 1999, Kitaysky *et al.* 1999, Golet *et al.* 2000). Fish with high lipid and low water content provide the most efficient food "package" for growing seabird chicks; such fish include myctophid, capelin, Pacific sand lance, and larger age groups of herring. Energy-poor forage species include pollock and benthic fish. Slow-growing young birds in colonies may ultimately starve in the nest or be more vulnerable to post-fledgling stresses than well-fed young. For instance, kittiwakes are able to raise chicks on age-0 and age-1 pollock in the Pribilof Islands, where capelin and Pacific sand lance has declined dramatically since the mid-1970s (Hunt *et al.*1996c, Hunt *et al.* 1981a, Schneider and Hunt 1984). However, kittiwake breeding success is relatively low in these colonies compared with other parts of Alaska (Hatch *et al.* 1993), and the kittiwake populations have recently declined on the Pribilof Islands.

Black-legged kittiwakes occasionally die-off in large numbers during late summer, apparently due to widespread scarcity of prey at the surface during anomalous oceanographic conditions. Major die-offs were recorded in Alaska in 1983 and 1997 (Nysewander and Trapp 1984, Hatch 1987, Mendenhall *et al.* 1998). It has been hypothesized that the failure of the seabird populations on the Pribilof Islands to show enhanced reproductive performance subsequent to the reduction of breeding populations suggests that the carrying capacity of the southeastern Bering Sea declined for seabirds in the early 1980s and was reset at a new, lower level than had existed in the mid-1970s. Because kittiwake populations were apparently only affected at the Pribilof Islands, the mortality must have occurred when birds would have been near their colonies (Hunt and Byrd 1999). The cause(s) for this decrease in carrying capacity, whether due to climatic conditions and/or ecosystem effects related to commercial fishing, are being investigated. NPFMC has addressed fishery impacts on forage fish by prohibiting directed fisheries on this size class and group of species that are important to seabirds and some marine mammals (BSAI FMP Amendment 36 and GOA Amendment 39).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on kittiwakes but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through consumption of fishery discards.** Kittiwakes are attracted to fishing vessels and processors to eat discards and offal. Benefits of the food source are countered by increased risk of incidental take on longlines and trawls.

- **Indirect effects by introducing mammalian predators to nesting islands.** Cliff nesting species like kittiwakes are susceptible to predation by introduced rats. The USFWS has an extensive program to reduce the threat of new rat invasions. Efforts include maintaining networks of poison-bait boxes at ports on rat-free islands; training local communities to monitor and counteract rats aboard ships and on land; conducting public outreach programs to encourage operation of rat-free vessels in Alaskan waters; and training emergency-response teams to attack rats when they are found at remote shipwrecks. Some of the most intensive efforts in this regard have been carried out on the Pribilof Islands (A. Sowls, USFWS, personal communication).

**Comparative Baseline**

Black-legged kittiwakes are widespread and abundant in the BSAI and GOA. Red-legged kittiwakes are much less numerous and far more restricted in their breeding locations with the great majority nesting on St.

George Island. Substantial declines in their population have led to their classification as a USFWS species of management concern and "vulnerable" status under international conservation standards. Commercial fishing does not appear to have much direct impact on these species (i.e., through incidental take) but substantial population declines at some colonies in recent years, coupled with documented declines in forage fish, have instigated research on whether the fisheries are impacting fish-eating seabird species indirectly or whether the observed declines are attributable to natural environmental fluctuations. The past and present effects on kittiwakes are summarized in Table 3.7-22.

**Status for Cumulative Effects Analysis**

The frequency with which both species interact with the groundfish fisheries warrants further consideration in the cumulative effects analysis. Since some alternative FMPs call for special management goals for species of management concern, red-legged kittiwakes will be considered along with other species of management concern (marbled and Kittlitz's murrelets) in Chapter 4. Black-legged kittiwakes will be discussed in conjunction with the fish-eating (piscivorous) birds in Chapter 4.

### 3.7.14 Terns

- Arctic tern (*Sterna paradisaea*)
- Aleutian tern (*Sterna aleutica*)

**Life History and Distribution**

Terns are fork-tailed and sharp-winged relatives of the gulls that have a distinctive "floating" flight pattern. Arctic terns range all over the globe, migrating between the arctic and antarctic twice a year, and are common inland as well as in marine waters. Aleutian terns are more marine in nature and appear to be restricted to the North Pacific although their winter range is not known. Both species breed in coastal areas throughout the BSAI and GOA area.

The arctic tern population is roughly estimated to include 7,000 breeding birds in the BSAI and 20,000 in the GOA. Aleutian terns are estimated to number 9,000 breeding birds in the BSAI and 25,000 in the GOA (Table 3.5-62). Populations trends are not monitored in Alaska.

**Trophic Interactions**

Terns forage in coastal waters within a few miles of their colonies. They feed on the surface, or just beneath it, on small schooling fish (capelin, Pacific sand lance) and zooplankton. Fish are essential diet components when terns are feeding their young (Hunt *et al.* 1981c, Baird and Gould 1986, DeGange and Sanger 1986, Baird 1990).

Stratification of the water column can be disadvantageous to species that depend on complete mixing of the water column. In summer, lack of wind and strong solar heating can result in higher surface temperatures, which may in turn cause certain prey species to seek deeper water and be unavailable to such surface-feeding birds as terns (Baird 1990). The influence of stratification on tern foraging in most specific areas is unknown. Breeding success and population trends of kittiwakes, which have similar feeding habits as terns, are correlated with years when schools of Pacific sand lance are available (Springer *et al.* 1987, Hayes and Kuletz 1997). Schools must be at or near the surface in order for kittiwakes and terns to reach them. These birds are usually observed feeding on shoals of Pacific sand lance in years when reproductive success is high (Baird 1990).

**Management Overview**

Wildlife management responsibility for terns is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

<u>Direct Mortality: Harvest and Other Intentional Take</u>

Terns are taken in small numbers by Alaska Native subsistence hunters in the Bristol Bay area. An unknown number of tern eggs are also taken in this area and around Kodiak (Denlinger and Wohl 2001).

<u>Direct Mortality from Incidental Take in Fisheries</u>

There are no specific records of terns being taken in any fisheries of the North Pacific, including the groundfish fisheries of the BSAI and GOA. There may be some terns included in “unidentified” seabird incidental take records from these fisheries but the extent of that take is unknown. Given the predominantly off-shore distribution of the groundfish fleet and the in-shore foraging habits of breeding terns, potential direct impacts of the fisheries appear to be minimal.

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on terns but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impact of groundfish fisheries on the availability of prey to terns is likely to only be a factor if it leads to localized depletion of prey around breeding colonies. The extent of this potential impact on terns is unknown. NPFMC has prohibited directed fisheries on forage fish to minimize any indirect impact on seabirds (BSAI FMP Amendment 36 and GOA Amendment 39).

**Comparative Baseline**

Arctic and Aleutian terns are uncommon breeders in the BSAI and GOA that appear to have very little interaction with the groundfish fisheries. No population trend information is available in the project area. The past and present effects on terns are summarized in Table 3.7-23.

**Status for Cumulative Effects Analysis**

Since these species do not interact very often with the groundfish fisheries and there is no quantitative data on either their population trends or impacts of the fisheries, these species will not be carried forward for cumulative effects analysis except in the general category of fish-eating (piscivorous) birds.

### 3.7.15 Murres

- Common murre (*Uria aalge*)
- Thick-billed murre (*Uria lomvia*)

**Life History and Distribution**

Murres are the largest species in the Alcidae family, which also includes guillemots, murrelets, auklets, and puffins. Like the other alcids, murres use their wings to "fly" underwater and can dive to great depths. They are also fast fliers in the air, beating their relatively small, narrow wings very quickly. They are gregarious throughout the year and will come together on the water in very dense "rafts" prior to crowding onto their rocky nesting cliffs. They do not actually build a nest but lay their single egg directly on the rock. If an egg is lost early in the season, it will often be replaced, but only once. Both sexes look alike and share parental duties. Eggs are laid in late June, hatch about a month later, and chicks jump off the cliffs into the water, still unable to fly, by the end of August or early September. The parents continue to care for their chick at sea for some time, bringing fish to the surface until the chick is big enough to dive and catch fish on its own.

Both murre species are widespread in the North Pacific and Atlantic oceans. In Alaska, common murres breed on rocky coasts and islands throughout the BSAI and GOA. Thick-billed murres breed mostly in the BSAI and north of the Bering Strait but have some smaller colonies in the GOA (USFWS 1998a). Birds from colonies north of the Bering Strait winter in the central Bering Sea (Shuntov 1993, Hatch *et al.* 1996). The edge of the ice pack and polynyas within it provide important winter and spring habitat for murres and other seabirds that forage on zooplankton and fish of the ice-edge system (Hunt 1991, Hunt *et al.* 1996b).

The USFWS has compiled population estimates of seabirds, including both species of murres, from many researchers at many colonies throughout Alaska in the Beringian Seabird Colony Catalog (USFWS 1998a). Many of these estimates are rated as "poor" or "fair" in quality and the resultant population totals cannot be considered reliable for anything but the most generalized discussions. They are certainly not sufficient for documenting anything but the most extreme changes in population-levels. With that caveat, the total numbers of common murres from hundreds of colonies are estimated to be around 3 million in the BSAI and 2 million in the GOA. Thick-billed murres are estimated to number 5 million in the BSAI and 200,000 in the GOA (Table 3.5-62).

Murre population trends are determined by an index method using permanent sample plots in different colonies (Figure 3.7-1, Dragoo *et al.* 2001). Both species are monitored together in some areas because they are too difficult to distinguish reliably under common survey conditions. Trends differ between regions and sometimes between nearby colonies. In the northern Bering Sea (Bluff and Hall Island), common murre numbers have remained relatively stable since the early 1980s. Common murre trends have varied in the southeastern Bering, with steady declines at St. Paul Island, Cape Newenham, and Cape Pierce, and an increasing trend on St. George Island (Dragoo *et al.* 2001). No counts are made of just common murres in the Aleutians (combined counts with thick-bills are described below). In the GOA where separate common murre counts are made, numbers have either increased (E. Amatuli and Gull Islands) or remained stable (Nord Island). Thick-billed murres show a similarly mixed set of trends. In the northern Bering Sea (Hall Island), thick-billed murres have decreased since the early 1980s. At the Pribilofs, thick-bills decreased in the 1970s but have remained relatively stable since the early 1980s. Thick-bills have increased substantially on Buldir Island (western Aleutians) since the mid 1970s. No separate counts of thick-bills are made in the GOA. Among the colonies where common and thick-billed murres are counted together, Agattu Island (western Aleutians) had increasing numbers in the 1970s and 1980s and remained stable in recent years (Hunt and Byrd 1999). In the GOA, combined counts of murres have remained stable at Aiktak Island, increased at Chowiet Island, and decreased at Puale Bay, Middleton Island, and St. Lazaria Island (Dragoo *et al.* 2001).Table 3.7-21 summarize this trend data.

**Trophic Interactions**

Murres use their wings to propel themselves underwater and can dive as deep as 210 m to catch fish and other prey (Croll *et al.* 1992). Common murres consume small fish, especially energy-rich species such as capelin and Pacific sand lance, and will take juvenile pollock and cod as well as various kinds of zooplankton. Thick-billed murres eat the same fish and also myctophids (lanternfish). They will take larger numbers of zooplankton and other invertebrates than do common murres (Hunt *et al.* 1981a, Vermeer *et al.* 1987, Sanger 1987, Elliott *et al.* 1990, Schneider *et al.* 1990). Thick-billed murres nesting in the western Aleutian Islands feed primarily on squid (Springer *et al.* 1996). Both species are highly dependent on densely schooling prey (Cairns and Schneider 1990, Piatt 1990, Mehlum *et al.* 1996). During the breeding season, common murres have a foraging range of approximately 50 to 80 km while thick-bills range up to 100 km from the colonies (Schneider and Hunt 1984, Bradstreet and Brown 1985, Piatt and Nettleship 1985, Hatch *et al.* 1996).

Murres forage over the continental shelf, particularly in small areas where benthic terrain, currents, or upwellings create local prey concentrations. The inner front (boundary between wind-mixed and stratified water on the Bering Sea shelf) is associated with an upwelling 5 to 15 km in width, which tends to concentrate some zooplankton and their predators and is heavily used by murres (Schneider *et al.* 1987, Brodeur *et al.* 1997, Decker and Hunt 1996). Unusually high concentrations of both species of murres are known to regularly forage on euphausiids over a submarine ridge on the east side of St. George Island (Coyle *et al.* 1992). Thick-billed murres also forage over the outer shelf and shelf edge (Hunt *et al.* 1981b, Kinder *et al.* 1983, Schneider and Hunt 1984, Schneider *et al.* 1986, Schneider *et al.* 1990, Shuntov 1993, Decker and Hunt 1996). Common murres require a shelf at least several tens of kilometers wide and are few or absent in colonies with a very narrow shelf. In contrast, thick-billed murres tend to occupy areas near a shelf edge, although they also breed in a few northern colonies on broad shelves (Springer *et al.* 1996, Byrd *et al.* 1997, USFWS 1998a).

Upwellings also occur where tides or currents move water from the deep ocean onto the shelf, such as tidal upwellings onto the shelf between islands in the Pribilof Islands (Coyle *et al.* 1992) and the Aleutian Islands (Hunt *et al.* 1998), or the Anadyr Current west of St. Lawrence Island (Hunt *et al.* 1990). Upwelling of deep water onto the shelf north of the Barren Islands and in the western GOA supports large colonies of murres (Piatt and Anderson 1996). At the Pribilofs Islands, the currents that influence prey availability are mostly tidal, though zooplankton are advected from offshore (Hunt *et al.* 1996b, Stabeno *et al.* 1999). Currents that run parallel to the shelf break along the 100-m and 200-m isobaths, which spawn eddies that cross onto the shelf, are likely to be most important (Stabeno and van Meurs 1999). These currents may also be important for the transport of age-0 pollock to the Pribilofs, suggesting that pollock spawning events near Unimak Pass may influence prey availability at the Pribilofs (G. L. Hunt, Jr., University of California, Irvine, personal communication).

Murres can forage deeper than any other seabird species, which buffers them against changes in vertical distribution of their prey. However, their need for dense aggregations of prey may make them vulnerable to occasional die-offs when prey are scattered or otherwise unavailable (Piatt and van Pelt 1997). During the breeding season, murres can increase their daily foraging time away from the colony in order to obtain scarce or distant prey, and they sometimes are able to maintain breeding success under poor conditions.

Common murres occasionally die-off in large numbers during winter and early spring, apparently due to widespread scarcity of prey. Major die-offs of up to an estimated 120,000 birds were recorded in Alaska in 1970, 1993, and 1998 (Bailey and Davenport 1972, Piatt and van Pelt 1997, Mendenhall *et al.* 1998). Major shifts in seabird food habits occurred at the Pribilof Islands between the mid-1970s and the late 1980s. These diet shifts coincided with the decline of murre and kittiwake populations there, and with the decline of forage fishes and age 1 pollock in the bottom trawl surveys around the Pribilof Islands (Decker *et al.* 1995, Hunt *et al.* 1996a, 1996b). It has recently been hypothesized that declines in thick-billed murres at the Pribilof Islands were caused by large die-offs of adults from this population (Hunt and Byrd 1999).

**Management Overview**

Wildlife management responsibility for murres is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*). In 1999, protocol amendments to the Migratory Bird Treaty Act were ratified that mandated participation of subsistence users and their traditional knowledge in a co-management relationship between Native, Federal, and State of Alaska representatives. This co-management group is charged with developing conservation, research, and management plans for all species taken in subsistence harvests, including murres (Denlinger and Wohl 2001).

**Past and Present Effects and Management Actions**

<u>Direct Mortality: Harvest and Other Intentional Take</u>

Breeding colonies of murres have been used as a source of meat, eggs, and skins for clothing by Native peoples of the BSAI and GOA for thousands of years. An account from the mid-1800s describes the widespread use of baleen nooses to capture birds on the steep cliffs of the Aleutian Islands. These methods were efficient enough to cause noticeable declines in breeding populations, at least at colonies that were accessible from settlements (Veniaminov 1840). Harvest of adult birds from breeding colonies continues to the present time in some coastal communities, most commonly by means of shotguns and motorized boats (Denlinger and Wohl 2001). Egg collection is also a traditional early summer activity, usually conducted in family groups. Egging is limited to a short period of time when eggs are freshly laid but it provides a significant source of high quality food and is an important cultural tradition for many coastal communities (Lowenstein 1986). Historical catch data were not recorded but recent community surveys by the Alaska

Dept. of Fish and Game, USFWS, and tribal governments have provided some indication of the species-specific scope of seabird harvests (Denlinger and Wohl 2001). In 1996, communities in the BSAI and GOA area reported takes of 9,743 common murres, 433 thick-billed murres, and 150 unidentified murres. The great majority of these birds were taken in the St. Lawrence Island/Diomede Islands area. In 1995, about 100,000 seabird eggs were collected in the BSAI and GOA area, including an unknown number of murre eggs. Murre eggs were the most commonly collected eggs in the Seward Peninsula area but these totals also include large numbers of tern and gull eggs. These estimates are considered to be minimal given the nature of post-harvest user surveys. They do not include any estimates of the numbers of eggs that may have been lost during collection activities, either by falling off the cliffs when adults were disturbed or to predatory gulls and ravens when left unprotected.

Direct Mortality from Incidental Take in External Fisheries

Murres are not attracted to fishing vessels like many of the surface-feeding seabirds and are rarely caught by longline fisheries. They are more susceptible to being caught in trawl and drift nets which hang down into the water column where murres dive for fish. Past fisheries in the North Pacific, both foreign and domestic, have taken murres in the course of their operations. For most of these fisheries, the numbers of individual species taken were not recorded. One exception is the Japanese salmon mothership fishery where an average of 14,175 thick-billed murres and 1,850 common murres were taken every year between 1981-1984 (Jones and DeGange 1988). The land-based Japanese salmon gillnet fishery was responsible for an estimated 8 million seabird deaths from 1952-1987 (DeGange and Day 1991). In 1977 alone, this fishery killed an estimated 17,245 thick-billed and 2,150 common murres. In 1987, after substantial reductions in fishing effort, an estimated 4,625 thick-bills were taken along with 580 commons (DeGange and Day 1991). On the Russian side of the Bering Sea, Japanese salmon gillnet fisheries took an estimated 1.1 million seabirds between 1993 and 1998, 62 percent of which were alcids, and may have had population-level impacts on thick-billed murre colonies (Artukhin *et al.* 2000). The incidental take of murres in other current foreign gillnet fisheries is unknown.

State-managed salmon and herring gillnet fisheries in Alaska take murres incidentally on a regular but infrequent basis. Based on the perceptions of one bird-observant fisherman, the total number of murres taken in these coastal fisheries are probably less than 1000 birds per year in the entire BSAI and GOA (DeGange *et al.* 1993).

Direct Mortality from Incidental Take on Groundfish Longlines

The numbers of seabirds caught in the BSAI and GOA groundfish longline fisheries are estimated from Observer Program data in Tables 3.7-2 and 3.7-3. Observers have individual species codes for the two murres but they are included in the “alcid” category for analysis and reporting purposes. An unknown number of murres may also be included in the “unidentified seabird” category. The alcids accounted for an average of 15 birds per year taken in the BSAI between 1993 and 2001 and one bird per year in the GOA.

Direct Mortality from Incidental Take in Groundfish Trawls

The BSAI and GOA trawl fishery took between 178 alcids per year (low estimate) and 340 alcids per year (high estimate) between 1997 and 2001 (Table 3.7-4). The numbers of murres in these totals is unknown.

Indirect Effects through Contamination by Oil Spills

All types of oil and fuel are dangerous, and only a few drops of oil are enough, under some situations, to kill a seabird. The species at most risk are diving seabirds, which spend more time resting on the water than do surface-feeders (King and Sanger 1979). More specifically, alcids are considered to be the most vulnerable to oil of all bird groups. The EVOS Trustee Council (EVOS Trustee Council 2002e) reports that about 22,000 carcasses of oiled murres (mostly common murres) were picked up in the first four months following the oil spill in 1989. Piatt and Ford (1996) used drift recovery data to estimate that only 15 percent of seabirds that died as a result of EVOS were actually recovered as carcasses. By this estimate, about 146,000 murres were killed. Based on surveys of breeding colonies in the spill area, murre populations may have declined by about 40 percent following the spill. In addition to direct losses of murres, there is evidence that the timing of reproduction was disrupted and productivity reduced. Post-spill monitoring at the breeding colonies in the Barren Islands indicated that reproductive success was again within normal bounds by 1993, and it has stayed within these bounds each breeding season since then (EVOS Trustee Council 2002e).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on murres but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impact of groundfish fisheries on the availability of prey to murres is likely to only be a factor if it leads to localized depletion of prey around breeding colonies. The density and distribution of fish schools may change with the overall abundance of many forage fish species. The issue is whether particular fluctuations in forage fish populations are the result of natural environmental cycles or whether they are caused or compounded either directly or indirectly by fishing pressure. The complexity of the system is such that there will always be a great deal of scientific uncertainty regarding causality of such fluctuations. In the face of this uncertainty, NPFMC prohibited directed fisheries on forage fish to minimize any indirect impact on seabirds (BSAI FMP Amendment 36 and GOA Amendment 39, 1997).

- **Indirect effects by introducing mammalian predators to nesting islands.** Cliff nesting species like murres were decimated or seriously reduced on many islands in the Aleutian chain and GOA after the introduction of arctic and red foxes by fox farmers from the 1700s to the 1930s (Bailey and Kaiser 1993). The USFWS has exterminated foxes from many of these islands and murres have begun to recolonize them. At present, murres are susceptible to predation by introduced rats. The USFWS has an extensive program to reduce the threat of new rat invasions. Some of the most intensive efforts in this regard have been carried out on the Pribilof Islands which host large murre colonies (A. Sowls, USFWS, personal communication).

**Comparative Baseline**

Common and thick-billed murres are abundant in the BSAI and GOA. Population trends at breeding colonies are varied throughout the area with some colonies expanding while others are stable or decreasing. Food abundance and availability appear to be major factors in population fluctuations. Murres are hunted for meat and eggs by Alaska Natives and have been taken incidentally in various fisheries. The specific numbers of murres taken in the groundfish fisheries are not reported but the numbers appear to be rather small relative to their overall population-levels. The past and present effects on murres are summarized in Table 3.7-24.

**Status for Cumulative Effects Analysis**

The frequency with which common and thick-billed murres interact with the groundfish fisheries warrants further consideration in the cumulative effects analysis. Because there is no species specific quantitative data on the impacts of the fisheries, these species will be discussed in conjunction with the fish-eating (piscivorous) birds in Chapter 4.

### 3.7.16 Guillemots

- Black guillemot (*Cepphus grylle*)
- Pigeon guillemot (*Cepphus columba*)

**Life History and Distribution**

Guillemots are medium-sized alcids with black and white bodies and bright orange-red feet. They are much less gregarious than other alcids and generally nest in the vicinity of only a few other pairs of birds. Nest sites are in crevices, burrows, or among the rocks of seaside cliffs. These two species (along with *Synthliboramphus* murrelets) are unique among the alcids in that they can lay up to two eggs in a clutch. This may be an adaptation to compensate for high rates of predation on both young and adults (Piatt and Naslund 1995). Eggs are laid on the bare ground and tended by both parents in turn. Incubation and fledging each takes about one month (Terres 1980).

Black guillemots are circumpolar in distribution, breeding north of the Bering Strait and ranging into the Bering Sea in winter. Pigeon guillemots are restricted to Pacific waters, breeding in the entire BSAI and GOA area, and ranging into the central Pacific waters in winter. Black guillemots winter at sea in and near the pack ice while most pigeon guillemots prefer ice-free coastal waters (Ewins *et al.* 1993, Carter *et al.* 1995, Shuntov 1993).

The Beringian Seabird Colony Catalog (USFWS 1998a) includes an estimate of 100,000 pigeon guillemots in the BSAI and 100,000 in the GOA (Table 3.5-62). Since guillemots are highly dispersed, rather than concentrated in dense breeding colonies like most alcids, totals of their populations should be considered very rough estimates. Another estimate places their numbers in all Alaska waters (BSAI and GOA combined) at only 40,000 birds (Ewins *et al.* 1993). Black guillemots do not nest in the project area and are considered rare visitors in winter. Pigeon guillemot population trends are monitored only in PWS, where the population has declined over the past two decades, possibly due to reductions in prey availability (Hayes and Kuletz 1997).

**Trophic Interactions**

The foraging ecology of pigeon guillemots has been studied in detail in PWS. The diet is diverse and includes small schooling fish such as capelin, sand lance, and herring, as well as bottom-dwelling fish and invertebrates (DeGange and Sanger 1986, Kuletz 1983, Golet *et al.* 2000). Benthic fish are a reliable food source but support only modest reproductive success. Schooling fish allow higher reproductive success (because their abundance and energy content are higher), but their availability fluctuates in time and space (Kuletz 1983, Golet *et al.* 2000). Pigeon guillemot chick growth and reproductive success are correlated with the availability of schooling species (Golet *et al.* 2000).

Guillemots forage in coastal waters during the breeding season, within 10 km of the colony (Ewins *et al.* 1993, G. Golet, USFWS, unpublished data). Black guillemots dive to approximately 50 m (Piatt and Nettleship 1985) and pigeon guillemots up to 45 m (Ewins *et al.* 1993).

**Management Overview**

Wildlife management responsibility for guillemots is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*).

**Past and Present Effects and Management Actions**

Direct Mortality from Incidental Take in External Fisheries

Almost no species-specific data exists on the direct impact of past and present fisheries on guillemot populations. Since these are diving birds, they are more likely to be caught in drift and trawl nets than on longlines. In the Japanese land-based drift gillnet fishery, pigeon guillemots made up a small fraction of the seabirds caught, including an estimated 307 in 1977 and decreasing to 116 in 1987 (DeGange and Day 1991). Offshore fisheries have probably taken many fewer guillemots since they prefer nearshore waters. The Japanese high-seas salmon driftnet fishery only took an estimated annual average of 13 pigeon guillemots between 1981-1984 (Jones and DeGange 1988). Inshore gillnet fisheries probably take guillemots incidentally but there is no data on how many birds are caught in Alaska (Ewins *et al.* 1993).

Direct Mortality from Incidental Take in Groundfish Fisheries

The numbers of seabirds caught in the BSAI and GOA groundfish fisheries are estimated from Observer Program data (Tables 3.7-2 through 3.7-5). Guillemots are included in the “alcid” and perhaps the”unidentified seabird” categories. Although alcids are taken more frequently in trawls than in either longline or pot fisheries, the numbers of guillemots taken is unknown. Given their nearshore preferences and less gregarious behavior, it is unlikely that guillemots are taken regularly in any of the MSA groundfish fisheries.

Indirect Effects through Contamination by Oil Spills

The nearshore, benthic foraging behavior of pigeon guillemots and their tendency to socialize on intertidal rocks makes them susceptible to being killed in disproportionate numbers by oil spills (Oakley and Kuletz 1996). An estimated 10-15 percent of the population in the EVOS area died immediately following the spill. Pigeon guillemot populations still had not recovered from the EVOS disaster nine years later, probably because foraging conditions were inadequate to support an increase in the population (Hayes and Kuletz 1997).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on guillemots but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impact of groundfish fisheries on the availability of prey to guillemots is unknown. The density and distribution of fish schools may change with the overall abundance of many forage fish species. The issue is whether particular fluctuations in forage fish populations are the result of natural environmental cycles or whether they are caused or compounded either directly or indirectly by fishing pressure. The complexity of the system is such that there will always be a great deal of scientific uncertainty regarding causality of such fluctuations. In the face of this uncertainty, NPFMC prohibited directed fisheries on forage fish to minimize any indirect impact on seabirds (BSAI FMP Amendment 36 and GOA Amendment 39, 1997).

**Comparative Baseline**

Guillemots are distributed widely in the BSAI and GOA, especially in nearshore waters, but are not found in large concentrations anywhere. Overall population estimates are uncertain and population trends are monitored only for pigeon guillemots in PWS, where they have been decreasing. Guillemots are susceptible to changes in the local distribution and abundance of forage fish and have been impacted by past oil spills. Their direct interactions with the groundfish fleet are probably minimal. The past and present effects on guillemots are summarized in Table 3.7-25.

**Status for Cumulative Effects Analysis**

Because there is no species specific quantitative data on either their population trends (outside PWS) or impacts of the fisheries, these species will be discussed in conjunction with the fish-eating (piscivorous) birds in Chapter 4.

### 3.7.17 Murrelets

- Marbled murrelet (*Brachyramphus marmoratus*)
- Kittlitz's murrelet (*Brachyramphus brevirostris*)
- Ancient murrelet (*Synthliboramphus antiquus*)

**Life History and Distribution**

Murrelets are medium-sized alcids that share the ability to "fly" underwater with other members of the family. These three species have very different nesting sites and reproductive strategies that impact conservation efforts. Marbled and Kittlitz's murrelets are unique among the alcids in having a mottled brown, cryptic coloration in their breeding plumage. This is an indication that predation on adults (by raptors and possibly corvids) plays a major role in their life history strategy (Piatt and Naslund 1995). Other clues to the importance of predation include the fact that nest sites are dispersed, rather than colonial, and that parent birds travel to and from their nests only under low light conditions, a habit which has made it very difficult to locate nests. Marbled murrelets nest predominately on moss-covered limbs of huge trees, sometimes up to 70 km from the sea, and are thus associated with old-growth forests (Piatt and Ford 1993). Kittlitz's murrelets also nest away from the water but choose nest sites on rocky slopes of high alpine areas, especially in areas close to glaciers (Piatt *et al.* 1999). The remote, hidden, and dispersed nesting habits of these two species has greatly restricted research on their reproductive biology. Ancient murrelets are colonial, dig burrows under boulders, tree roots, or dense vegetation, and nest on islands free of mammalian predators. They are unusual among the alcids (along with guillemots) in having the capacity to lay up to two eggs in a clutch. This may have evolved as a way to compensate for high rates of predation and helps stabilize the population from other adult mortality factors (Piatt and Naslund 1995).

Marbled murrelets breed from the Aleutian Islands east along the coast of Alaska and south to the coast of California. Kittlitz's murrelets breed in selected areas throughout the BSAI and GOA. Ancient murrelets breed from the southern Bering Sea south and east to British Columbia. Ancients, more than the other two species, are more likely to winter offshore in deep waters.

Population estimates for seabird species with dispersed, well-hidden nests are best made from at-sea survey data. However, the reliability of these census techniques for population trend analysis is still under investigation (Ralph *et al.* 1995). For marbled murrelets, the total North American population is estimated to be about 300,000 birds, 85 percent of which breed along the coast of the GOA and in PWS (Ralph *et al.* 1995). An estimated 2,400 marbled murrelets breed in the BSAI (Piatt and Naslund 1995). The worldwide estimate for Kittlitz's murrelet was about 20,000 birds in 1993, 90 percent of which were in the GOA area (van Vliet 1993). Another estimate in 1993 put the figure in the 25,000-100,000 range (Ewins *et al.* 1993), although the upper limit has been challenged (Day *et al.* 1999). Ancient murrelet populations have been estimated at breeding colonies. Rough estimates of these underground nesters include 200,000 birds in the BSAI and 600,000 in the GOA (USFWS 1998a) (Table 3.5-62). No population trend data are available for ancient murrelets.

As stated above, population trend data are somewhat tenuous for marbled and Kittlitz's murrelets and are best documented in PWS due to the amount of research in that area following the EVOS in 1989. Based on Christmas Bird Count data from northern GOA communities, marbled murrelets are estimated to have declined by at least 50 percent between 1972 and 1992 (Piatt and Naslund 1995). Boat surveys in PWS, conducted in many areas and in both winter and summer, indicate that combined counts of the two *Brachyramphus* species declined by 67-73 percent between the early 1970s and late 1980s (Piatt and Naslund 1995). Numbers appeared to stabilize between 1989 and 1993 but then declined further in 1996 and 1998 (Agler and Kendall 1997 and 1998, Lance *et al.* 1999).

One early estimate for the Kittlitz's murrelet population in PWS concluded that there were about 60,000 birds in 1972 (Isleib and Kessel 1973). This estimate is much higher than recent estimates and its methodology has been challenged (Day and Nigro 1999). However, standardized surveys since the Exxon Valdez oil spill have also shown major and continuing declines in two major concentrations of Kittlitz's murrelets. In PWS, Kittlitz's numbers declined an average of over 14 percent per year from 1989-1998 (Lance *et al.* 1999). In Glacier Bay, the population of Kittlitz'z murrelets has declined by almost 80 percent between 1991 and 1999 and they have disappeared from areas where they were once common (USGS 2001).

These studies have been cited in a recent petition to the USFWS to list the species as "endangered" under the ESA (Center for Biological Diversity *et al.* 2001).

The typical alcid life history strategy is to compensate for low reproductive potential (one-egg clutches) with high adult survivorship and long life. Marbled and Kittlitz's murrelets have taken this to an extreme. Although there are no data on adult survival rates, there is evidence that reproduction rates are very low and impacted to a large extent by predation. This means that these populations may be especially sensitive to changes in natural mortality rates and additional anthropogenic sources of mortality (Piatt and Naslund 1995).

**Trophic Interactions**

Diets of murrelets are dominated by small schooling fish such as capelin and Pacific sand lance. Some zooplankton and other invertebrates are also consumed by Kittlitz's murrelet and especially by ancient murrelets (Sanger 1987, Ewins *et al.* 1993, Springer *et al.* 1993, Gaston 1994). All three murrelets forage by diving. Marbled murrelets dive in water primarily less than 20 m deep (Nelson 1997).

Marbled murrelets forage in shallow waters within 5 km of shore and are associated with sites of upwellings or small fronts that might make prey available (Nelson 1997, Kuletz *et al.* 1995). Kittlitz's murrelets prefer inlets and forage near glaciers where available (Sanger 1987, Ostrand *et al.* 1998, Day *et al.* 1999a, Day and Nigro 2000). Ancient murrelets forage over the shelf and shelf break, but also occur near land at sites of tidal upwellings (Gaston 1994). Some murrelets winter in ice-free bays throughout the state; others apparently move south or offshore to unknown areas (Ewins *et al.* 1993, Carter *et al.* 1995).

**Management Overview**

Wildlife management responsibility for murrelets is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*). In 1999, protocol amendments to the Migratory Bird Treaty Act were ratified that mandated participation of subsistence users and their traditional knowledge in a co-management relationship between Native, Federal, and State of Alaska representatives. This co-management group is charged with developing conservation, research, and management plans for all species taken in subsistence harvests, including murrelets (Denlinger and Wohl 2001).

In 1990, marbled murrelets were listed as "threatened" in British Columbia by the Canadian government because of significant population declines and loss of nesting habitat. For similar reasons, the species was listed as "threatened" under the ESA for California, Oregon, and Washington in 1993. Marbled murrelets are not listed under the ESA in Alaska. However, in 1995, the USFWS designated marbled and Kittlitz's murrelets as "species of management concern" (USFWS 1995b). These species are of concern because of 1) documented or apparent population declines, 2) small or restricted populations, or 3) dependence on restricted or vulnerable habitats. The Fish and Wildlife Conservation Act of 1980, as amended in 1988, requires the designation of concern for species that, without additional conservation action, are likely to become candidates for listing under the ESA. On May 9, 2001, a group of non-governmental organizations petitioned the Secretary of the Interior to list Kittlitz's murrelet as "endangered" under the ESA, citing evidence of major and consistent population declines in their core breeding areas in southeast Alaska (Center for Biological Diversity *et al.* 2001).

**Past and Present Effects and Management Actions**

Direct Mortality: Harvest and Other Intentional Take

Seabirds have been hunted by the Native peoples of Alaska for thousands of years. There are no historical records of the numbers of murrelets taken but the impact was probably small and limited to birds hunted on the water. In recent community surveys by the ADF&G, USFWS, and tribal governments, 30 ancient murrelets were taken in 1996, all from the Aleutian/Pribilof Islands District (Denlinger and Wohl 2001). No marbled or Kittlitz's murrelets were identified in the surveys but there were a reported 1,246 "unidentified seabirds" taken in 1996 from southeast Alaska, the area most likely to be harvesting murrelets.

Direct Mortality from Incidental Take in External Fisheries

Murrelets are not attracted to fishing vessels like many of the surface-feeding seabirds and are not likely to be caught by longline fisheries. They are more susceptible to being caught in trawl and drift nets which hang down into the water column where they dive for fish and other prey. Past fisheries in the North Pacific, both foreign and domestic, have taken murrelets in the course of their operations. For most of these fisheries, the numbers of individual species taken were not recorded. Some data is available from the Japanese salmon mothership fishery where an average of 1,533 ancient murrelets were taken every year between 1981-1984 (Jones and DeGange 1988). The land-based Japanese salmon gillnet fishery, active from 1953-1992, was responsible for killing an estimated 307 ancient murrelets in 1977. In 1987, after substantial reductions in the fishing effort, an estimated 116 ancient murrelets were taken (DeGange and Day 1991). On the Russian side of the Bering Sea, Japanese salmon gillnet fisheries took an estimated 1.1 million seabirds between 1993 and 1998, 62 percent of which were unspecified alcids (Artukhin *et al.* 2000). The incidental take of murrelets in other current foreign gillnet fisheries is unknown.

Because murrelets spend most of their time in nearshore waters, especially during the breeding season, they are susceptible to being caught in nearshore gillnet fisheries (i.e., state-managed fisheries). Largely anecdotal evidence suggested that perhaps thousands of murrelets were killed annually in coastal Alaska gillnet fisheries in the 1970s (Carter and Sealy 1984, DeGange *et al.* 1993). Based on quantitative seabird bycatch data from salmon fisheries in PWS, an estimated annual average of 690 marbled and 130 Kittlitz's murrelets were killed in 1990 and 1991 (Piatt and Naslund 1995). Extrapolating from the number of 1989 drift net permits and PWS bycatch rates, Piatt and Naslund (1995) estimate that 3,300 *Brachyramphus* murrelets are killed annually in Alaskan gillnet fisheries. Kittlitz's murrelets appear to be particularly susceptible to being caught. Kittlitz's represent only 7 percent of all murrelets in PWS but represent 30 percent of all murrelets caught (Day and Nigro 1999). Since most of these birds are adults and population dynamics of seabirds are typically driven by adult survival rates, this amount of mortality is a significant conservation concern. These estimates also do not include suspected mortality in set nets, pound nets, or seine nets (Piatt and Naslund 1995). Gillnet fisheries have also been shown to cause significant amounts of mortality in ancient murrelets in British Columbia (Bertram 1995) but no data exists for Alaska fisheries.

Direct Mortality from Incidental Take in Groundfish Fisheries

The numbers of seabirds caught in the BSAI and GOA groundfish fisheries are estimated from Observer Program data (Tables 3.7-2 through 3.7-5). Marbled and Kittlitz's murrelets have individual species codes under the observer protocol but are included in the "alcid" category for analysis and reporting purposes. An unknown number may also be included in the and "unidentified seabird" category. Alcids are taken more frequently in trawls than in either longline or pot fisheries but the numbers of murrelets taken is unknown. Given their nearshore preferences and less gregarious behavior, it is unlikely that murrelets are taken regularly in any of the MSA groundfish fisheries.

Indirect Effects through Contamination by Oil Spills

The threat of both catastrophic and chronic oil spills to seabirds is well-known (Piatt *et al.* 1990, Burger and Fry 1993, Piatt and Ford 1996, Huguenin *et al.* 1996). All types of oil and fuel are dangerous, and only a few drops of oil are enough, under some situations, to kill a seabird. The species at most risk are diving seabirds, which spend more time resting on the water than do surface-feeders, and marbled and Kittlitz's murrelets are rated as two of the most susceptible species in the state (King and Sanger 1979). More specifically, alcids are considered to be the most vulnerable to oil of all bird groups. Based on the actual numbers of birds recovered on beaches after the Exxon Valdez oil spill and estimates of carcass recovery rates, the spill killed an estimated 8,400 marbled murrelets and perhaps as many as 1000-2000 Kittlitz's, representing about 3 percent and 5 to 10 percent of their respective estimated Alaska populations (Piatt and Naslund 1995, van Vliet and McAllister1994).

Indirect Effects through Disturbance by Fishing Vessels

Although many surface-feeding birds are attracted to fishing vessels (Furness 1999), murrelets are disturbed by nearby boats (of all types) and may be displaced from forage areas by vessel activity (Kuletz 1996). Dramatic declines in Kittlitz's murrelets in Blackstone Bay in PWS may be attributable in part to the high numbers of recreational boaters in the area (Day and Nigro 1999). The popularity of tidewater glacier tours from cruise ships is also growing and since these areas are also preferred by Kittlitz's, there is growing concern about this disturbance impact.

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on murrelets but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** Highly dispersed, non-colonial birds such as marbled and Kittlitz's murrelets may be particularly well adapted to patchy, highly dispersed prey in low-density schools (Ostrand *et al.* 1998, Kuletz 1999). However, in PWS, reproductive success of marbled murrelets correlated with years and sites of relative abundance of forage fish species (Kuletz unpublished data). The big unanswered question for murrelets, as with all piscivores, is whether variations in their food supplies are caused by human activities or are predominately natural cycles. Despite intensive and ongoing research into the factors that determine the composition, abundance, and availability of forage fish, it is still not clear how much impact various fisheries have in relation to climate and oceanography-driven changes in primary productivity and food web dynamics (Piatt and Anderson 1996, Agler *et al.* 1999, Anderson and Piatt 1999). In the face of this uncertainty, NPFMC prohibited directed fisheries on forage fish to minimize any indirect impact on seabirds (BSAI FMP Amendment 36 and GOA Amendment 39 1997).

- **Indirect effects by introducing mammalian predators to nesting islands.** Burrowing seabirds, including ancient murrelets, were decimated or seriously reduced on many islands in the Aleutian chain and GOA after the introduction of arctic and red foxes by fox farmers from the 1700s to the 1930s (Bailey and Kaiser 1993). The USFWS has exterminated foxes from many of these islands and ancient murrelets have begun to recolonize them. At present, ancient murrelets are susceptible to predation by introduced rats. The USFWS has an extensive program to reduce the threat of new rat invasions.

- **Indirect effects from logging.** Due to their nesting ecology, marbled murrelets also face the threat of habitat loss from logging operations, a rather unique threat for seabirds. This issue is addressed in great detail in the U.S. Forest Service's Tongass National Forest Land and Resource Management Plan (USDA 1997).

**Comparative Baseline**

Population data for all three murrelet species are imprecise. Marbled and Kittlitz's murrelets are species of management concern in Alaska due to recent dramatic declines in their numbers in core habitats in southeast Alaska. The numbers of murrelets taken in the groundfish fisheries is unknown due to lack of differentiation among alcids in the Observer Program. Several factors external to the groundfish fisheries have been identified as conservation concerns for marbled and Kittlitz's murrelets. Ancient murrelets are taken in small numbers by pelagic fisheries but there are no population trend data for this species which might be used to monitor or model impacts. The past and present effects on murrelets are summarized in Table 3.7-26.

**Status for Cumulative Effects Analysis**

Even though they do not appear to interact with the groundfish fisheries very regularly, the status of marbled and Kittlitz's murrelets as species of management concern warrants further consideration in the cumulative effects analysis. Since some Alternative FMPs call for special management goals for seabird species of management concern, marbled and Kittlitz's murrelets will be considered with the other species of management concern (red-legged kittiwakes) in Chapter 4. Because population trend data for ancient murrelets are not available and there is no species specific quantitative data on the impacts of the fisheries, ancient murrelets will be discussed in conjunction with the fish-eating (piscivorous) birds in Chapter 4.

### 3.7.18 Auklets

- Cassin's auklet (*Ptychoramphus aleutica*)
- Parakeet auklet (*Aethia psittacula*)
- Least auklet (*Aethia pusilla*)
- Whiskered auklet (*Aethia pygmaea*)
- Crested auklet (*Aethia cristatella*)

**Life History and Distribution**

Auklets are small (6 to 10 inches long) members of the Alcidae family, which also includes the murres and puffins. Like the other alcids, these birds are highly adapted to life at sea and come to land only to nest. They use their short, narrow wings to "fly" underwater in pursuit of prey. All of these auklets, except parakeet, are usually found in flocks at sea. Sometimes those flocks are huge and dense with thousands of birds. There are differences in their preferred nest sites but they all basically nest in crevices, burrows, or within rock piles. Parakeet auklets are the exception again in that they do not nest in dense aggregations like the others. All species lay just one egg on the bare ground and the sexes take turns incubating and brooding the young.

These auklets are all North Pacific birds and, with the exception of Cassin's auklet, breed only in the BSAI and GOA area. Cassin's nest from the Aleutians south to California. Whiskered auklets only breed in the central and western Aleutians. The other three species nest from the GOA north and west to the Bering Strait. Cassin's and parakeets are concentrated in northern waters but range south to California in winter. The other three species are restricted to waters around the Aleutians and Alaska Peninsula in winter.

Population estimates for these five auklet species are not very reliable because of their underground or hidden nesting habits. Numbers listed in the Beringian Seabird Colony Catalog (USFWS 1998a) should be used for only the most generalized discussions and are not sufficient for documenting anything but the most extreme changes in population-levels. Still, this is one of the most abundant groups of birds in the Bering Sea (Table 3.5-62). Cassin's auklets are estimated to number 250,000 in the BSAI and 750,000 in the GOA. Parakeets have an estimated 800,000 in the BSAI and 150,000 in the GOA. Least auklets are the most abundant species with an estimated 9 million birds, essentially all in the BSAI. There are only about 30,000 whiskered auklets, all in the BSAI. Crested auklets are abundant with an estimated 3 million in the BSAI and 50,000 in the GOA.

Population trends of auklets are poorly known at present because monitoring of their underground nests is extremely difficult. Least auklets have been monitored on Kasatochi Island (central Aleutians) since 1991 and have fluctuated but do not exhibit any consistent trend (Dragoo *et al.* 2001). Least auklets may be increasing in the central and northern Bering Sea (Springer *et al.* 1993). Crested auklets have been monitored at the same sites and appear to be stable or increasing (Table 3.7-21, Springer *et al.* 1993, Dragoo *et al.* 2001).

**Trophic Interactions**

The abundance and diversity of small auklets is much higher in the Bering Sea than elsewhere in the world, owing to the large-scale advection of oceanic zooplankton onto the shelf in areas such as the Aleutian passes and Bering Strait (Springer and Roseneau 1985). They seek water structures that concentrate small prey at depths of 5 to 30 m, such as pycnoclines, fronts, or tide rips over shallow sills (Hunt 1990, Hunt *et al.* 1990, Hunt *et al.* 1993). All forage by pursuit diving (Ashmole and Ashmole 1967). Cassin's auklets take a variety of zooplankton along with squid and some small fish. Parakeet auklets eat a diverse diet of small schooling fish such as Pacific sand lance and juvenile pollock, jellyfish, squid, other invertebrates, and zooplankton (Hunt *et al.* 1993, Springer *et al.* 1993, Hunt *et al.* 1998). Least auklets depend exclusively on zooplankton, especially *Neocalanus plumchrus*, a type of copepod (Hunt 1997). Whiskered auklets also depend exclusively on zooplankton. Crested auklets eat zooplankton and other invertebrates, especially the euphausid, *Thysanoessa raschii* (Hunt *et al.* 1998).

A recent study conducted in the shallow passes of the Aleutian Islands demonstrated that least, crested, and parakeet auklets timed their foraging in a pass to correspond with the presence of strong tidal currents. The diets of these three auklet species differed in composition despite the proximity of the areas in which they foraged. The researchers concluded that the three auklet species exhibited strong preferences for particular prey types, and that these prey preferences resulted in small-scale differentiation of preferred foraging sites. The strong tidal currents provided the energy for enhancing the availability of different prey (Hunt *et al.* 1998).

Numerous studies highlight the foraging ecology of auklets and relationships to physical oceanographic processes (Hunt and Harrison 1990, Russell and Hunt 1992, Hunt 1997, Hunt *et al.* 1998, Russell *et al.* 1999). Upwellings occur where tides or currents move water from the deep ocean onto the shelf, such as between the islands in the Pribilofs (Coyle *et al.* 1992), the Aleutian Islands (Hunt *et al.* 1998), or the Anadyr Current west of St. Lawrence Island (Hunt *et al.* 1990). Auklets nest abundantly in these areas because upwellings bring oceanic zooplankton to shallow waters nearby (Springer and Roseneau 1985, Hunt *et al.* 1993).

It has been suggested that auklet population trends are due in part to food-web changes following reductions in plankton-eating whales or other predators (Springer 1991b, Springer 1992, Springer *et al.* 1993). Other studies, however, indicate that decadal changes in primary productivity of northern versus southern Pacific waters have altered zooplankton abundance, which has not always resulted in population increases of seabirds (Francis *et al.* 1998, McGowan *et al.* 1998).

**Management Overview**

Wildlife management responsibility for auklets is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*). In 1999, protocol amendments to the Migratory Bird Treaty Act were ratified that mandated participation of subsistence users and their traditional knowledge in a co-management relationship between Native, Federal, and State of Alaska representatives. This co-management group is charged with developing conservation, research, and management plans for all species taken in subsistence harvests, including auklets (Denlinger and Wohl 2001).

**Past and Present Effects and Management Actions**

Direct Mortality: Harvest and Other Intentional Take

Auklets have been hunted for their meat, skins, and decorative beaks by Native peoples in the BSAI and GOA area for thousands of years. These hunts are usually done in family groups and are significant subsistence and cultural traditions. Harvest of adult birds from breeding colonies continues to the present time in some coastal communities, most commonly by means of shotguns and motorized boats. Recent community surveys by the ADF&G, USFWS, and tribal governments indicate that crested auklets are the most frequently taken seabird in subsistence hunts (Denlinger and Wohl 2001). In 1996 alone, an estimated 12,300 crested auklets were taken, all from the St. Lawrence/Diomede Islands area. A few hundred parakeet and least auklets were also taken in that year as well as about 4,700 unidentified auklets. Most of these birds are taken in the northern Bering Sea but they are also hunted in the Aleutians and Kodiak Island area (Denlinger and Wohl 2001).

Direct Mortality from Incidental Take in External Fisheries

Auklets are not attracted to fishing vessels because of fish scraps like many of the surface-feeding seabirds and are rarely caught by longline fisheries. They are more susceptible to being caught in trawl and drift nets which hang down into the water column where auklets dive for zooplankton and fish. Past fisheries in the North Pacific, both foreign and domestic, have taken auklets in the course of their operations. For most of these fisheries, the numbers of individual species taken were not recorded. Some data is available for the Japanese salmon high-seas driftnet (mothership) fishery where an average of 304 Cassin's, 583 parakeet, 219 least, and 5,565 crested auklets were taken every year between 1981-1984 (Jones and DeGange 1988). The land-based Japanese salmon gillnet fishery was responsible for millions of seabird deaths between 1952-1987, including an estimated 7,079 parakeet and 307 crested auklets in 1977. By 1987, fishing effort had been reduced and catch rates declined to an estimated 1,966 parakeet and 116 crested auklets (DeGange and Day 1991). On the Russian side of the Bering Sea, Japanese salmon gillnet fisheries took an estimated 1.1 million seabirds between 1993 and 1998, 62 percent of which were unidentified alcids (Artukhin *et al.* 2000). The incidental take of auklets in other current foreign gillnet fisheries is unknown.

Direct Mortality from Incidental Take on Groundfish Longlines

The numbers of seabirds caught in the BSAI and GOA groundfish longline fisheries are estimated from Observer Program data in Tables 3.7-2 and 3.7-3. Auklets are included in the "alcid" and "unidentified seabird" categories. The alcids accounted for an average of 15 birds per year taken in the BSAI between 1993 and 2001 and one bird per year in the GOA.

Direct Mortality from Incidental Take in Groundfish Trawls

The BSAI and GOA trawl fishery took between 178 alcids per year (low estimate) and 340 alcids per year (high estimate) between 1997 and 2001 (Table 3.7-4). The numbers of auklets in these totals is unknown.

Direct Mortality from Vessel Strikes

Crested auklets do not seem to strike fishing vessels very frequently but when they do, the incidents often involve large numbers of birds. According to preliminary analysis of the observer records of bird-strikes from 1993-2000, 1,305 crested auklets were involved in 7 recorded collisions. In one historical account, approximately 6,000 crested auklets were attracted to lights and collided with a fishing vessel near Kodiak Island during the winter of 1977 (Dick and Donaldson 1978). Monitoring these types of collisions is not part of the observer's normal duties so the true extent of this impact is not known (NPFMC 2002c).

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on auklets but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** Although parakeet auklets take some fish, auklets are primarily plankton feeders and are much more likely to be affected by changes in the primary productivity of the ecosystem (due to climactic or ocean current shifts) rather than top-down effects. However, the relationship between the abundance and distribution of commercial fish stocks, most of which are also plankton feeders at some point in their life cycle, and food web dynamics is poorly understood.

- **Indirect effects through contamination by oil spills.** Alcids are considered to be the most vulnerable of all bird groups to the risk of chronic and acute oil contamination from all sources (King and Sanger 1979).

- **Indirect effects through plastics ingestion.** Parakeet auklets are among the species with the highest recorded frequencies of plastic ingestion even though most alcids ingest little or no plastic (Sievert and Sileo 1993).

- **Indirect effects by introducing mammalian predators to nesting islands.** Burrowing and cliff-nesting seabirds, including auklets, were decimated or seriously reduced on many islands in the Aleutian chain and GOA after the introduction of arctic and red foxes by fox farmers from the 1700s to the 1930s (Bailey and Kaiser 1993). The USFWS has exterminated foxes from many of these islands and auklets have begun to recolonize them. At present, auklets are susceptible to predation by introduced rats. The USFWS has an extensive program to reduce the threat of new rat invasions.

**Comparative Baseline**

The five species of auklets common to the BSAI and GOA area are generally abundant and widely distributed in the project area. Their population numbers and trends are poorly known. Direct auklet interactions with the groundfish fisheries appear to be infrequent and minor in scale except for the occasional mass collision of crested auklets with fishing vessels in poor weather. The specific numbers of auklets taken in the groundfish fisheries are not recorded by the Observer Program but the numbers appear to be rather small relative to their overall population-levels. The past and present effects on auklets are summarized in Table 3.7-27.

**Status for Cumulative Effects Analysis**

Because population trend data for these species are very limited and there is no species specific quantitative data on the impacts of the fisheries, these species will be discussed in conjunction with the "other planktivorous species" group in Chapter 4.

### 3.7.19 Puffins

- Rhinoceros auklet (*Cerorhinca monocerata)*
- Horned puffin (*Fratercula corniculata*)
- Tufted puffin (*Fratercula cirrhata*)

**Life History and Distribution**

Puffins are familiar to many people as the birds with the large, colorful bills that are frequently depicted on Alaska tee shirts and advertisements. The rhinoceros auklet is included in this account because it is much closer in size, behavior, and anatomy to the two puffins than to the other auklets. These three alcid species are all about the same size, 15 inches in length, and are more brightly colored in the summer than winter. They dig burrows for their nest sites on the tops of islands or less frequently nest within rock crevices. Following the conservative seabird pattern, they lay only one egg and take turns with parental care. They are usually seen singly or in small numbers at sea but can be abundant on waters around their colonies.

Rhinoceros auklets breed and winter along the coast from the Aleutian Islands to California. Horned puffins breed along the Alaska coast in the entire BSAI and GOA area and winter in the North Pacific. Tufted puffins have a similar range but will also breed in coastal waters south to California.

Population estimates for the puffin species are not very reliable because of their underground or hidden nesting habits. Numbers listed in the Beringian Seabird Colony Catalog (USFWS 1998a) are not sufficient for documenting anything but the most extreme changes in population-levels. There are an estimated 200,000 rhinoceros auklets in Alaska, essentially all of which nest in the GOA. Horned puffins have an estimated 500,000 in the BSAI and 1.5 million in the GOA. Tufted puffins are the most abundant species with an estimated 2.5 million birds in the BSAI and 1.5 million in the GOA (Table 3.5-62).

Population trends for burrow nesting species are very difficult to determine with any accuracy. Rhinoceros auklets are monitored on permanent sample plots in only one location, St. Lazaria Island (southeast Alaska). Since 1994, the density of burrow holes has fluctuated but shows no clear trend. Plots have been set up to monitor horned puffins on Buldir Island but no acceptable sampling method has been developed to date. The density of tufted puffin burrows have increased slightly on Bogoslof and Aiktak Islands (central and eastern Aleutians) and shows no obvious trend on E. Amatuli in the GOA or St. Lazaria. (Table 3.7-21, Dragoo *et al.* 2001).

## Trophic Interactions

Rhinoceros auklets and the puffins forage both near shore and over the shelf, although rhinoceros auklets primarily feed near shore and the puffins primarily feed on the shelf (DeGange and Sanger 1986, Schneider *et al.* 1986, Sanger 1987). All three species dive for small schooling fish such as capelin, Pacific sand lance, and herring. Horned and tufted puffins also consume pollock, squid, and zooplankton. The rhinoceros auklet may forage more often at twilight than other puffins. The tufted puffin has the most diverse diet of the three and consumes the largest proportion of invertebrates (DeGange and Sanger 1986, Vermeer *et al.* 1987, Hatch and Sanger 1992, Byrd *et al.* 1997). Tufted puffin populations in PWS may be partly limited by low prey densities (Piatt *et al.* 1997).

## Management Overview

Wildlife management responsibility for puffins is under the jurisdiction of the USFWS. These species are protected under the U.S. Migratory Bird Treaty Act (16 USC 703 *et.seq.*). In 1999, protocol amendments were ratified that mandated participation of subsistence users and their traditional knowledge in a co-management relationship between Native, Federal, and State of Alaska representatives. This co-management group is charged with developing conservation, research, and management plans for all species taken in subsistence harvests, including puffins (Denlinger and Wohl 2001).

## Past and Present Effects and Management Actions

<u>Direct Mortality: Harvest and Other Intentional Take</u>

Puffins have been hunted for their meat, skins, and decorative beaks by Native peoples in the BSAI and GOA area for thousands of years. An account from the mid-1800s describes the widespread use of baleen nooses to capture birds on the steep cliffs of the Aleutian Islands. These methods were efficient enough to cause noticeable declines in breeding populations of puffins, at least at colonies that were accessible from settlements (Veniaminov 1840). These hunts are usually done in family groups and are significant subsistence and cultural traditions. Harvest of adult birds from breeding colonies continues to the present time in some coastal communities, most commonly by means of shotguns and motorized boats. Recent community surveys by the ADF&G, USFWS, and tribal governments indicate that puffins make up a small part of the harvest (Denlinger and Wohl 2001). In 1996, an estimated 48 horned puffins, 65 tufted puffins, and 115 unidentified puffins were taken in the BSAI area. It is not known whether any puffins were taken in the GOA that year (Denlinger and Wohl 2001).

<u>Direct Mortality from Incidental Take in External Fisheries</u>

Puffins are not attracted to fishing vessels like many of the surface-feeding seabirds and are not likely to be caught by longline fisheries. They are more susceptible to being caught in trawl and drift nets which hang down into the water column where they dive for fish. Past fisheries in the North Pacific, both foreign and domestic, have taken puffins in the course of their operations. For most of these fisheries, the numbers of individual species taken were not recorded. Some data is available for the Japanese salmon high-seas (mothership) fishery where an average of 19 rhinoceros auklets, 8,249 horned puffins, and 38,600 tufted puffins were taken every year between 1981-1984 (Jones and DeGange 1988). The land-based Japanese salmon gillnet fishery, operating from 1952-1992, was responsible for killing an estimated 4,929 rhinoceros auklets, 1,229 horned puffins, and 31,403 tufted puffins in 1977. In 1987, after substantial reductions in the fishing effort, an estimated 1,387 rhinoceros auklets were taken along with 462 horned puffins and 9,481 tufted puffins (DeGange and Day 1991). Driftnet fisheries targeting flying squid were started in the late 1970s by Japan, Korea, and Taiwan. At their peak in the late 1980s, these fisheries deployed millions of kilometers of driftnet. Rough estimates of the total number of seabirds killed by the squid driftnet fisheries were between 875,000 and 1,660,000 seabirds annually, including up to 250,000 tufted puffins and 100,000 horned puffins per year (DeGange *et al.* 1993). Due to the tremendous amount of waste and ecosystem damage associated with the high-seas driftnet fisheries, they were outlawed by international agreement through United Nations Resolution (46/215) in December of 1992 (Paul 1994). On the Russian side of the Bering Sea, Japanese salmon gillnet fisheries took an estimated 1.1 million seabirds between 1993 and 1998, 62 percent of which were unidentified alcids (Artukhin *et al.* 2000). The incidental take of puffins in other current foreign gillnet fisheries is unknown.

Direct Mortality from Incidental Take on Groundfish Longlines

The numbers of seabirds caught in the BSAI and GOA groundfish longline fisheries are estimated from Observer Program data in Tables 3.7-2 and 3.7-3. Rhinoceros auklet and both puffins have individual species codes in the observer protocols but are included in the "alcid" category for analytical and reporting purposes. An unknown number of these species may also be included in the "unidentified seabird" category. The alcids accounted for an average of 15 birds per year taken in the BSAI between 1993 and 2001 and one bird per year in the GOA.

Direct Mortality from Incidental Take in Groundfish Trawls

The BSAI and GOA trawl fishery took between 178 alcids per year (low estimate) and 340 alcids per year (high estimate) between 1997 and 2001 (Table 3.7-4). The numbers of puffins in these totals is unknown.

**Other Past and Present Effects**

The following issues have been identified as having potential impacts on puffins but not enough information is available to assess the extent of these impacts quantitatively or at a population-level. The nature of these effects are outlined in the introduction to seabirds (see Section 3.7.1).

- **Indirect effects through changes in prey availability.** The impact of groundfish fisheries on the availability of prey to puffins is unknown. The big unanswered question for puffins, as with all piscivores, is whether variations in their food supplies are caused by human activities or are predominately natural cycles. In the face of this uncertainty, NPFMC prohibited directed fisheries on forage fish to minimize any indirect impact on seabirds (BSAI FMP Amendment 36 and GOA Amendment 39, 1997).

- **Indirect effects through contamination by oil spills.** Alcids are considered to be the most vulnerable of all bird groups to the risk of chronic and acute oil contamination from all sources (King and Sanger 1979).

- **Indirect effects by introducing mammalian predators to nesting islands.** Burrowing and crevice-nesting seabirds, including puffins, were decimated or seriously reduced on many islands in the Aleutian chain and GOA after the introduction of arctic and red foxes by fox farmers from the 1700s to the 1930s (Bailey and Kaiser 1993). The USFWS has exterminated foxes from many of these islands and auklets have begun to recolonize them. At present, puffins are susceptible to predation by introduced rats. The USFWS has an extensive program to reduce the threat of new rat invasions.

**Comparative Baseline**

All three puffin species are common or abundant in the BSAI and GOA area. Population trend data for these species are either unavailable or very limited. These species were impacted heavily by the now illegal high-seas drift fisheries. The numbers of puffins taken in the groundfish fisheries is unknown due to lack of differentiation among alcids in the Observer Program but the numbers appear to be rather small relative to their overall population-levels. The past and present effects on puffins are summarized in Table 3.7-28.

**Status for Cumulative Effects Analysis**

Because population trend data for these species are very limited and there is no species specific quantitative data on the impacts of the fisheries, these species will be discussed in conjunction with the fish-eating (piscivorous) birds in Chapter 4.

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