APPENDIX F

Seabird Protection Measures

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TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

BiOp	Biological Opinion
BSAI	Bering Sea and Aleutian Islands
CDQ	Community Development Quota
CFR	Code of Federal Regulations
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ft	Feet
FMP	Fishery Management Plan
FR	Federal Register
GOA	Gulf of Alaska
IFQ	Individual Fishing Quota
IPHC	International Pacific Halibut Commission
IRFA	Initial Regulatory Flexibility Analysis
LOA	Length Overall
MPA	Marine Protected Area
MBTA	Migratory Bird Treaty Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
nm	Nautical Mile
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fisheries Management Council
Observer Program	North Pacific Groundfish Observer Program
RIR	Regulatory Impact Review
RPA	Reasonable and Prudent Alternative
SAFE	Stock Assessment and Fishery Evaluation
SEIS	Supplemental Environmental Impact Statement
TAC	Total Allowable Catch
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service

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Section 1 Seabird Protection Measures

Over 70 species of seabirds occur over waters off Alaska and could potentially be affected by direct and indirect interactions with the Bering Sea Aleutian Islands and Gulf of Alaska (BSAI/GOA) groundfish fisheries. Thirty-eight of these species regularly breed in Alaska and waters of the Exclusive Economic Zone (EEZ). More than 1,600 seabird colonies have been documented, ranging in size from a few pairs to 3.5 million birds (USFWS 1998a; Figure 1 below). Breeding populations of seabirds are estimated at approximately 48 million birds and non-breeding migrant birds probably account for an additional 30 million birds (USFWS 1998a). Most of the migrant birds are present only during the summer months (May through September), although some non-breeding albatross have been sighted in all months of the year (USFWS 1999). The distributions of species that breed in Alaska are well known in summer, but for some species, winter distributions are poorly documented or completely unknown.

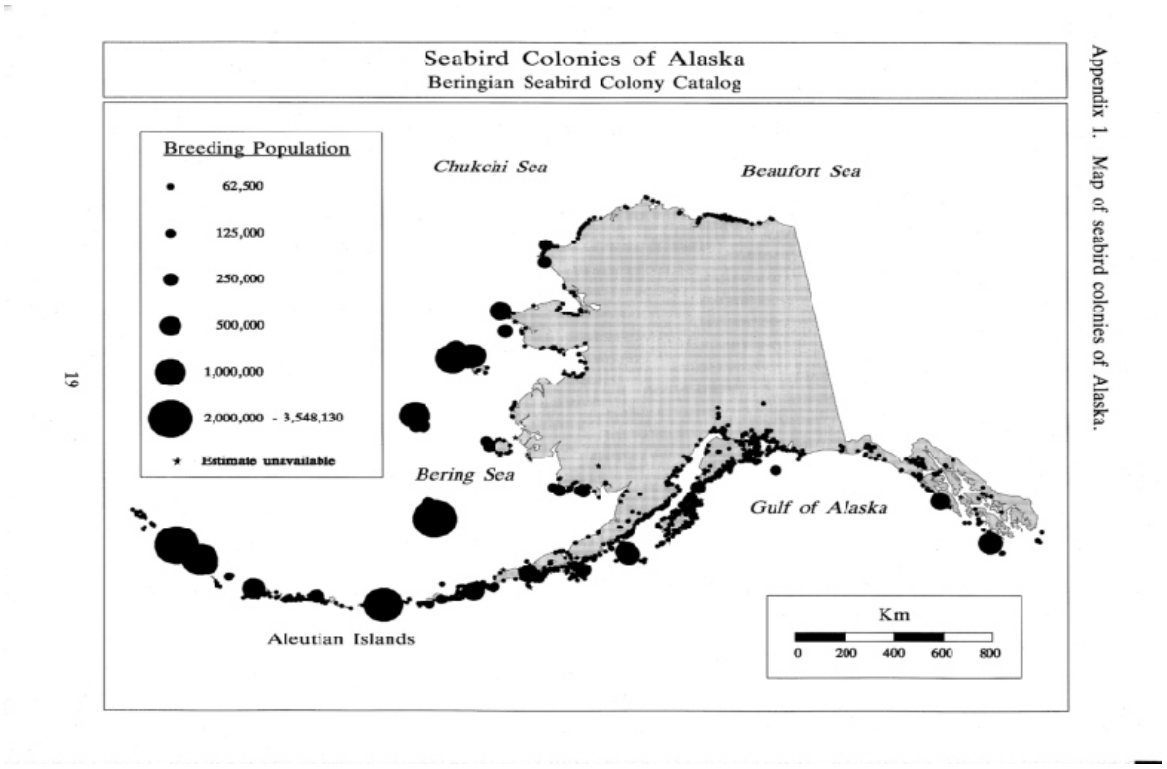

Figure 1. Seabird colonies of Alaska. Source: USFWS 1998a.

1.1 Overview of the Issue

Potential fisheries impacts on a given seabird species could theoretically be measured by changes in survival or reproductive rates and ultimately by changes in the population. For all of these biological parameters, one would expect fluctuations in time and space as part of "normal" or natural conditions. The ability to distinguish these natural fluctuations from potential human-caused fluctuations requires reasonably accurate measurements of several parameters over a long time period and in many different areas. Although the United States Fish and Wildlife Service (USFWS) surveys a number of large seabird colonies every year, present population estimates for most species are not precise enough to detect anything but the largest fluctuations in numbers. This is especially true for species that do not nest in dense concentrations. For some species, like the burrow and crevice-nesting alcids and storm-petrels, field methods for censussing populations are not available and require additional budgetary support for development (Dragoo *et al.* 2001).

Seabirds can interact with fisheries in a number of direct and indirect ways. Direct effects occur at the same time and place as the fishery action. Seabirds are attracted to fishing vessels to feed on prey churned up in the boat's wake, fish escaping from trawl nets, baited hooks of longline vessels, and offal discharged from trawl, pot, and longline vessels. In the process of feeding, seabirds sometimes come into contact with fishing gear and are caught incidentally. A direct interaction is usually recorded as the injury or killing of a seabird and is referred to as an "incidental take." Information on the numbers of birds caught incidentally in the various gear types comes from the North Pacific Groundfish Observer Program (Observer Program) and is summarized in the seabird section of "Ecosystem Considerations for 2003" report (Stock Assessment and Fishery Evaluation [SAFE] [NPFMC 2002], Tables 8,9,11, and 12).

Another direct fishery effect is the striking of vessels and fishing gear by birds in flight. Some birds fly away without injury but others are injured or killed and are thus considered incidental take. The Observer Program does not collect data on vessel strikes in a systematic way, but there are some records of bird-strikes that have been collected on an opportunistic basis. These sporadic observations of vessel strikes from 1993-2000 have been entered into the Observer Notes Database, which is maintained by the USFWS, but have only received preliminary statistical analysis (seabird section of "Ecosystem Considerations for 2003," NPFMC 2002).

Indirect effects refer to either positive or negative impacts on the reproductive success or survival of seabirds that may be caused by the fishery action but are separated in time or geographic location. The indirect effect which has received the most attention is the potential impact of fisheries competition or disturbance on the abundance and distribution of prey species that seabirds depend on, thus affecting seabird foraging success. Of particular note would be those effects on breeding piscivorous (fish-eating) seabirds that must meet the food demands of growing chicks at the nest colony. Reproductive success in Alaskan seabirds is strongly linked to the availability of appropriate fish (Piatt and Roseneau 1998, Suryan *et al.* 1998a, Suryan *et al.* 2000, Golet *et al.* 2000). Although seabird populations remain relatively stable during occasional years of poor food and reproduction, a long-term scarcity of forage fish leads to population declines. Other potential indirect effects on seabirds include physical disruption of benthic foraging habitat by bottom trawls, consumption of processing wastes and discarded offal, contamination by oil spills, introductions of nest predators (i.e., rats) to nesting islands, and ingestion of plastics released intentionally or accidentally from fishing vessels. Some of these potential impacts are related more to the presence of fishing vessels rather than to the process of catching fish.

The quantitative effect of all past fishery impacts, if known, and other issues of concern are discussed for individual species and species groups in Section 3.7 of the Programmatic Supplemental Environmental Impact Statement (SEIS). The purpose of this paper is to compare the management measures specifically designed to protect seabirds as dictated by the alternative management policies and their associated FMP frameworks. Although many other management measures may influence the intensity of indirect impacts on seabirds, such as the ban on directed fishing for forage fish, the following discussion will focus on protection measures that are designed to reduce the incidental take of seabirds in fishing gear. Changes in other management measures that directly impact the effectiveness of the seabird protection measures will be briefly discussed.

1.2 Statutory Protection for Seabirds

There are two major laws that protect seabirds and require the North Pacific Fisheries Management Council (NPFMC) to address seabird conservation in their Fishery Management Plans (FMPs). The first is the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-712), as amended over the years. This law pertains to all of the seabird species found in the BSAI/GOA area (66 Federal Register [FR] 52282) and governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts and nests. The definition of "take" in the MBTA is "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 Code of Federal Regulations [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 MBTA, 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 the 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 MBTA, 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. National Marine Fisheries Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) and USFWS are currently developing this framework document which will incorporate seabird protection measures designed for specific fisheries (K. Rivera, NMFS National Seabird Coordinator, personal communication).

The second law is the Endangered Species Act (ESA), which provides broad protection for species that are listed as threatened or endangered. Presently, there are three species listed under the ESA that spend all or part of their time in the BSAI/GOA and that may be affected by the groundfish fisheries: short-tailed albatross (endangered), Steller’s eider (threatened), and spectacled eider (threatened). Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of habitat important to the continued existence of the species (critical habitat). For ESA-listed seabirds, the USFWS is the agency responsible for conducting an assessment of the proposed action and preparing the appropriate Section 7 document, a “Biological Opinion” (BiOp). If the BiOp concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or

adversely modify its critical habitat, then the agency must develop Reasonable and Prudent Alternatives (RPAs) to minimize or mitigate the effect of the action. Even if a "no jeopardy" determination is made, as has been done for all three listed species in the BSAI/GOA, the agency may require and/or recommend that certain mitigation measures be adopted. In addition, the agency may establish a threshold number of incidental takes that would trigger a new Section 7 consultation to reexamine the required mitigation measures. In the case of the short-tailed albatross, the number of incidental takes that could be reasonably expected, given the designated mitigation measures, has been adopted as a threshold value and is described in the Incidental Take Statement attached to the BiOp (USFWS 1999). These provisions of the ESA, as applied to the short-tailed albatross, have played a major role in the development of seabird protection measures for the longline sector of the BSAI/GOA groundfish fishery.

USFWS may designate critical habitat areas for each species under the ESA if it can determine that those areas are important to the continued existence of the species. Critical habitat may only be designated in United States (U.S.) territory, including waters of the EEZ. Short-tailed albatross do not nest in U.S. waters but have been sighted throughout the BSAI/GOA area. No critical habitat has been designated for this species. Spectacled and Steller's eiders each have designated critical habitats in the BSAI where they concentrate in winter and during flightless molting periods (66 FR 9146 and 66 FR 8850, respectively; February 2001). Critical habitat designations do not automatically restrict human activities like fishing. They do require the lead agency, in this case the USFWS, to monitor activities that may degrade the value of the habitat for the listed species.

1.3 Management Measures Used to Address Seabird Impacts

Seabird protection measures in the BSAI/GOA groundfish fisheries were initiated in the 1990s and have focused primarily on collecting seabird-fishery interaction data and on requiring longliners to use specific types of gear and fishing techniques to avoid seabird incidental take. This emphasis on longline gear restrictions has been driven by conservation concerns for the endangered short-tailed albatross as well as other species. The history of these regulations is outlined in the next section. Although observers collect incidental take data in the trawl and pot sectors of the fishery and NOAA Fisheries is conducting research on some kinds of effects, there have been no regulatory or FMP-level efforts to mitigate seabird incidental take in these sectors.

For species listed as threatened or endangered under the ESA, the USFWS may establish a threshold number of incidental takes that are allowed before mitigation measures are reviewed and perhaps changed. Although this is sometimes viewed as a "limit" on the number of birds (e.g., short-tailed albatross) that can be taken, the result of exceeding this threshold number is a formal consultation process between NOAA Fisheries and USFWS, not an immediate shutdown of the fishery.

For non-ESA seabird species, NOAA Fisheries, in consultation with the NPFMC and USFWS, could theoretically establish a maximum number of a particular species that could be taken incidentally in the fisheries, similar to what is done for bycatch of prohibited fish species. The intent of this hypothetical management tool would be to slow the fishery or redirect it to other areas and times if that "limit" is approached. However, reducing take by redirecting fishing effort would require much better data on the spatial and temporal distribution of seabird species than presently exists and may require an expansion of the Observer Program. In addition, establishing an incidental take "limit" on biological grounds would require the determination of a quantifiable threshold of mortality above which a significant population-level

impact occurred. The present scale of the USFWS seabird population monitoring program does not provide precise enough abundance estimates or trend information to allow such a minimum mortality threshold to be calculated for any other species besides the short-tailed albatross.

Another management tool that may affect incidental take of seabirds is the regulation of who is allowed to fish. Limited entry and rationalization programs such as Individual Fishing Quota (IFQ) and Community Development Quota (CDQ) may impact seabird incidental take if the number or size of fishing vessels change, because regulations on protective measures are based on the size of the vessel. Since different types of fishing gear are more prone to take different kinds and numbers of seabirds, allocation of total allowable catch (TAC) among the different gear sectors can also have a substantial impact on incidental take.

Spatial/temporal restrictions of fishing effort could potentially be used to protect concentrations of seabirds from fishery interactions. This management tool would be most effectively applied around seabird colonies during the breeding season, since that is where most species are consistently concentrated and when they are most susceptible to food shortages, especially given the increased demands of raising chicks. However, many species can forage over large distances, even during the breeding season, so they are less susceptible to the localized and temporary disruptions of their prey fields that may be caused by fishing activities.

Food web impacts can be addressed with several management tools. The NPFMC has designated particular species and size classes of fish as being important prey for seabirds and marine mammals and has prohibited directed fisheries on these forage fish (BSAI FMP amendment 36 and GOA amendment 39). The NPFMC may also manage the allocation, biomass, and species of fish targeted by the industry through the TAC-setting process. These factors impact the food web and could thus alter the availability of food to seabirds. While more information is available for the dynamics of fish populations than for invertebrate prey, food web interactions are very complicated, and there is a great deal of scientific uncertainty regarding the specific effects of different management options.

Each of the management tools listed above requires reliable data to monitor the extent of fishery interactions and the effectiveness of mitigation efforts in accordance with management policy objectives. The NPFMC established the Observer Program in order to collect fishery information. Beginning in 1993, the Observer Program was modified to provide information on seabird/fishery interactions. Observers are presently required on vessels 125 feet (ft) or more in length overall (LOA) for 100 percent of their fishing days and aboard vessels 60-124 ft LOA for 30 percent of their fishing days. Vessels less than 60 ft LOA do not have to carry observers.

Observers receive training in seabird identification, at least to the level of being able to place birds into the categories requested by the USFWS. Some of these categories identify individual species and others lump species under generalized groups (e.g., “unidentified alcid.”). In many cases, birds that were caught as the gear was being deployed have soaked at depth for hours and have been eaten by invertebrates. By the time they are retrieved on board they may be identifiable only to a generalized group level. NOAA Fisheries is currently working to improve the training of its observers in identifying birds from their feet and bills, which are often the only parts of the bird that are recognizable (S. Fitzgerald, Observer Program, personal communication). When the Observer Program data is analyzed and reported (as in the Ecosystem Considerations reports in SAFE documents), individual species with relatively few records are often lumped into larger categories. For example, the “gull” category contains many “unidentified gulls” but also various

numbers of five different gull species that observers have identified to species. Similarly, the "alcid" group contains separate records of seven different alcid species.

For those vessels operating without observers, regulations require captains to report the taking of any ESA-listed species and to retain and deliver the body to USFWS for positive identification. Unfortunately, such self-reporting is unreliable due to the inability or unwillingness of some crews to identify and retain species of concern. Other existing fishery record-keeping and reporting requirements provide data on the distribution of fishing effort which could potentially be used in conjunction with directed research to analyze potential food web and seabird population impacts. Electronic monitoring of fishing vessel locations could also be used to monitor and enforce spatial/temporal restrictions of the fleet if such measures were implemented.

1.4 Historic Trends and Applications of Management Tools

USFWS issued its first BiOp concerning the effects of the BSAI/GOA groundfish fisheries on the endangered short-tailed albatross in 1989. It identified several possible adverse effects of fishing activities, including incidental take, oil pollution, and contribution to plastics ingestion, but concluded that the BSAI/GOA FMPs were not likely to jeopardize the continued existence of the short-tailed albatross (USFWS 1989a and 1989b). The BiOp did, however, establish a threshold number of incidental takes (two birds per year) that would be allowed in the fishery and required NOAA Fisheries to begin monitoring incidental takes more closely and reduce them as much as possible. NOAA Fisheries began collecting seabird-fisheries interaction data through its Observer Program in 1993 and expanded that coverage in the 1997, 1999, and 2000 seasons in consultation with the NPFMC and USFWS.

Although the ESA has provided some statutory motivation for the NPFMC to address seabird protection measures, agency biologists, longline fishing associations, and non-governmental conservation organizations have all advocated for more research and mitigation of seabird-fisheries interactions. There are many fishermen who have a strong sense of stewardship and work to conserve the natural resources of the sea, including species that they do not harvest. They have developed many ways over the years to avoid or deter seabirds from attacking their baited hooks. Effective methods get passed around among the fleet and are further refined and adapted for particular vessels. NOAA Fisheries has worked with longliners to develop the existing seabird avoidance techniques, relying on their experience of what works and what is safe and workable. Many of the measures, once proven to be effective, were proposed to the NPFMC where they were revised and approved, and implemented by NOAA Fisheries.

In 1997, the USFWS amended its 1989 BiOp on short-tailed albatross by revising the incidental take threshold to four birds per two-year period (rather than two per year). It also added two RPAs that required NOAA Fisheries to institute mandatory seabird protection measures for the BSAI/GOA longline fleet and to test the effectiveness of seabird avoidance measures (USFWS 1997). Based on the recommendations of NOAA Fisheries biologists and the longline fleet, the NPFMC directed NOAA Fisheries to enact regulations that required longliners to use at least one of several different options to avoid incidental seabird takes. These regulations were published in 1997 (62 FR 23176) and amended in 1998 (63 FR 11161). While this action was prompted primarily by concern over the short-tailed albatross, all surface-feeding and shallow-diving species that are attracted to these vessels are afforded some protection from these measures. In fact, the species that likely benefit the most from these protection measures are northern fulmar, Laysan albatross, and black-footed albatross, since they are the most frequently taken species.

Within a range of criteria, fishermen were allowed to experiment with different techniques to see what worked best for their fishing style. As of the end of the 2002 fishing 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 LOA, must employ one or more of the next 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.

The Observer Program was changed in 1998 to collect data on the seabird avoidance techniques that different vessels used and their effectiveness in avoiding seabird incidental take. 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 could be exceeded, the longline fleet petitioned the NPFMC to improve the seabird avoidance measures and to specify performance standards for their deployment. In 1999, the NPFMC recommended revising the existing regulations to make the most effective avoidance techniques mandatory. They also recommended that NOAA Fisheries undertake a comprehensive scientific study to experimentally determine the effectiveness of seabird deterrent measures for the first time. This research 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. This research 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.

The final report from the Washington Sea Grant study (Melvin *et al.* 2001) indicates that paired streamer lines of specified performance and material standards successfully reduced seabird incidental take in both years and in all regions and fleets by 88 to 100 percent relative to controls with no deterrent. These reductions in incidental take occurred without impacting catch rates of target species. Single streamer lines of specified performance and material standards were slightly less effective than paired streamer lines, reducing overall 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.

Although spectacled and Steller's eiders are listed as threatened under the ESA and have designated critical habitats in the BSAI, the USFWS has determined that they do not interact with the groundfish fisheries to a significant extent and have not established any restrictions on the groundfish fishery to protect these species (USFWS 1993 and 1994).

Section 2 Overview of Policy Alternatives

Four policy alternatives are under consideration by the NPFMC. Each policy alternative contains two bookends with a range of management measures that illustrate how the framework could be implemented. These bookends provide a level of detail that allows analysis and provides contrasting policies. They also provide a means to commit the NPFMC to action in implementing an alternative, while allowing the NPFMC, under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the flexibility to adaptively manage the fishery through FMP amendments.

Alternative 1 – Continue Management Under Existing (Updated) Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing results in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. The seabird-related goals are to continue working with USFWS to protect ESA-listed species and to conserve/restore other seabird species while maintaining sustainable fisheries. Under this management strategy, fishery impacts to seabirds are mitigated as scientific evidence indicates that the fishery is adversely impacting particular species.

Alternative 2 – Less Precautionary Management Policy: A less precautionary management policy (i.e., more aggressive harvest policy) would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases. For this reason, protection for non-ESA-listed species is not considered in this alternative. Both ends of the Alternative 2 policy spectrum, FMP 2.1 and FMP 2.2, include the same seabird protection measures mandated by the ESA to protect short-tailed albatross from incidental take on longline gear.

Alternative 3 – More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community- or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting the environment, not just a population of a given species. The seabird-related goals of the Alternative 3 policy are to continue working with USFWS to protect ESA-listed species, to initiate non-ESA-mandated efforts to conserve or restore other seabird species, and to increase research on fishery-impacted seabird populations and ecosystem interactions.

Alternative 4 – Highly Precautionary Management Policy: This policy would require that the user of the resource demonstrate that the intended use would not have a detrimental effect on the environment before significant fishing could be allowed. The policy, as illustrated by its FMP framework, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when additional, reliable scientific information became available. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public, but decreased emphasis would be placed on industry and community concerns, and more emphasis would be

placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts. For seabirds, this means that protective measures would be implemented immediately for all species. Research would be initiated to evaluate current population estimates for all seabird species that interact with the groundfish fisheries. The goal of research on seabird avoidance techniques would be to develop, in cooperation with the fishing industry, measures that reduce incidental takes to levels approaching zero for all threatened or endangered species and for USFWS's list of species of management concern.

Section 3 Alternative 1: Continue Under the Current Risk-Averse Management Policy

The existing BSAI and GOA FMP policy statements, Alternative 1(a), do not specifically call out the protection of seabirds as a policy goal. Nonetheless, these policies do prioritize the general protection of the marine environment against irreversible or long-term adverse effects, and they recognize stewardship responsibilities. Additionally, these management policies must be consistent with all federal laws that mandate seabird protection.

Policy Alternative 1(b) specifically affirms the current practice of incorporating seabird considerations in fishery management. The seabird-related goals are to continue working with USFWS to protect ESA-listed species and to conserve/restore other seabird species while maintaining sustainable fisheries. Under this management strategy, fishery impacts to seabirds are mitigated as scientific evidence indicates that the fishery is adversely impacting particular species. The management process will be adaptive to new information and reactive to new environmental issues; incorporate and apply ecosystem-based management principles; and consider the impact of fishing on predator-prey, habitat, and other important ecological relationships. This strategy is based on the assumption that fishing produces some adverse impacts on the environment and that as these impacts become known and are determined to be significant, mitigation measures are developed and implemented through FMP amendments.

The Groundfish Plan Teams make recommendations to the NPFMC in an annual report that details progress on ecosystem management efforts, including those pertaining to seabirds. These "Ecosystem Considerations" reports are incorporated into the annual SAFE reports and are available at NOAA Fisheries, Alaska Region website: http://www.fakr.noaa.gov/npfmc/safes/safe.htm. This is also the report that discusses and evaluates the effectiveness of previous seabird protection efforts.

3.1 Overview of Seabird Protection Measures Under FMP 1

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, the NPFMC reviewed these recommendations, made some changes, and requested NOAA Fisheries to implement the necessary regulations. NOAA Fisheries is presently preparing the documents necessary to enact these new measures (Draft Environmental Assessment [EA]/Regulatory Impact Review [RIR]/Initial Regulatory Flexibility Analysis [IRFA], NMFS 2002). The NPFMC's recommendations include the following:

- Vessels over 55 ft LOA in the EEZ would be required to use paired streamer lines of specified performance and materials standards.

- Vessels between 26 ft LOA and 55 ft LOA 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, vessel type, and gear type.

- 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.

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

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

- Vessels less than or equal to 26 ft LOA would continue to be exempt from seabird measures.

The incidental take threshold for short-tailed albatross, as established in the 1999 BiOp, was originally supposed to be reviewed after the 2000 season, but USFWS decided to wait for the results of the Washington Sea Grant study before conducting a new Section 7 consultation. The incidental take threshold of 4 short-tailed albatross per two-year period was extended for the 2001-2002 fishing seasons. No short-tailed albatross incidental takes have been recorded in the Observer Program data or self-reported since 1998. The USFWS is presently conducting a Section 7 consultation with NOAA Fisheries based on the recommended seabird protection measures outlined above. These measures are expected to greatly reduce the chances of the longline fleet reaching the incidental take threshold for short-tailed albatross.

The expected effects of the FMP 1 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

3.2 Effects of FMP 1 Seabird Measures on Seabirds

The Washington Sea Grant study (Melvin *et al.* 2001) found that paired streamer lines of specified performance and material standards successfully reduced seabird incidental take in both years and in all regions and longline fleets by 88 to 100 percent relative to controls with no deterrent. It should be noted that these percent reductions in take are not relative to incidental take rates using the existing avoidance measures. The use of paired streamers will likely reduce incidental take compared to the present situation, but the amount of that reduction will depend on what optional techniques are presently being used and how effective they are relative to no deterrent. The Observer Program has been collecting some of this information since 1999, but inconsistencies in the way deterrence gear is deployed limit the usefulness of the data for comparative purposes.

Single streamer lines of specified performance and material standards were slightly less effective than paired streamer lines, reducing overall seabird incidental take by 96 percent and 71 percent in the sablefish and cod longline fisheries, respectively, compared to controls with no deterrent (see cautionary notes above). However, Laysan albatross were able to attack the groundline five times more frequently with single streamers than paired streamers. This means that the potential for catching albatross on longline gear, including the short-tailed albatross, remains when using single streamer devices.

Single and paired streamers were most effective in reducing incidental take of surface-feeding and shallow-diving seabird species such as northern fulmar, gulls, and albatross. They did not reduce catch rates for species that could dive deeper on baited lines such as shearwaters. The requirements of the proposed regulations depend on the size of the fishing vessel. The overall effectiveness of the regulations in reducing incidental take will thus depend on the distribution of fishing effort between large vessels that must use paired streamers, medium-sized vessels that have a choice of deterrent devices, and small vessels that are not required to use any deterrent devices.

The seabird protection measures currently in place do not address or mitigate incidental take in the trawl or pot sectors of the groundfish fisheries or with another source of incidental take in all sectors, vessel strikes. Although research is being conducted on some of these interactions under FMP 1, the effect of not mitigating these sources of incidental take can be assessed from recent trends.

Estimates of the numbers of birds killed in trawl fishing gear are reported as a range because observers have been inconsistent in recording which of the different types of sampling methods they have used for seabird counts. These inconsistencies are currently being addressed through the observer training program (S. Fitzgerald, Observer Program, personal communication). Surface-feeding seabirds make up the great majority of birds taken in trawls and are apparently captured as the net is deployed or retrieved (NPFMC 2002). Northern fulmars are the most frequently taken species with an estimated average range of 274 to 5,891 birds per year (1997-2001). The number of fulmars taken in trawl gear appears to be increasing. Looking at just the high end of the estimated range, the number of fulmars taken in trawl gear increased from 343 in 1997 to 9,255 in 2001. Substantial numbers of shearwaters, Laysan albatross, unidentified tubenoses, and gulls are also taken in trawls. Although alcids are taken more frequently in trawls than they are on longline gear, the numbers taken in trawls (estimated average range of 178-340 birds per year, 1997-2001) are still very small compared to their overall abundance in the BSAI/GOA. The overall estimated average take in the BSAI/GOA trawl fisheries has increased from 528-2,343 birds per year in 1997 to 741-12,488 birds per year in 2001.

Incidental take in the pot fisheries has remained very low over the years, with an average total take of 48 birds per year in the combined BSAI/GOA from 1993-2001 (NPFMC 2002). Many of these recorded takes may actually be the result of vessel strikes, with the birds falling into the pots while they are on deck, rather than as they are fishing.

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 2002). 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 7 incidents), and sooty shearwater (526 birds in 6 incidents), with almost half of the birds being killed or injured. As the last three 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 be disoriented.

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 2002). 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 is currently pursuing the possibility of using video technology to evaluate this issue and working with trawl fishermen to develop potential mitigation equipment and techniques. NOAA Fisheries and USFWS are presently trying to determine if this impact poses a threat to short-tailed albatross (USFWS 2000b).

3.3 Effects of FMP 1 Seabird Measures on Other Resources

The proposed seabird protection measures will not impact the physical environment or benthic habitats. Marine mammals are rarely caught on longlines and it is unlikely that paired streamers or any other devices used to deter surface-feeding seabirds would alter the frequency of catching diving marine mammals. The experimental fishing trials used to develop the proposed seabird avoidance measures demonstrated that they did not affect catch rates for target or non-target fish species (Melvin *et al.* 2001).

From an economic standpoint, paired streamer lines are estimated to cost $100 to $500, depending on materials used (NMFS 2002). A USFWS program has been reimbursing the cost of paired streamer lines to applicants for the past two years although future funding for this program is uncertain. Deploying this gear requires additional crew time and there are some safety and "fishability" concerns. However, these methods were developed in conjunction with the fishing industry to address these concerns and there are regulatory exceptions for not deploying deterrent gear when weather conditions would place the crew in danger. These costs may be at least partially recovered in better fishing success from having more baited hooks reach their intended depth. One potential economic benefit of the seabird protection measures is that they reduce the chance that the fleet will exceed the ESA incidental take threshold for short-tailed albatross and therefore reduce the chance that the USFWS will mandate additional restrictions on the fleet.

Section 4 Alternative 2: Adopt a More Aggressive Management Policy

The seabird-related goal of the Alternative 2 policy is to maintain the current measures to protect ESA-listed species while maximizing the biological and economic yield from the fishery resource. This management strategy is based on the assumption that fishing does not have an adverse impact on the environment except in specific cases when science provides convincing evidence of harm. For this reason, protection for non-ESA-listed species is not considered in this alternative. Both bookends of the Alternative 2 FMP framework, FMP 2.1 and FMP 2.2, include the same seabird protection measures to avoid a "jeopardy" determination for short-tailed albatross under the ESA. The FMP scenarios differ in some other management measures that may affect seabirds indirectly, these effects are discussed in Section 4.6.7 of the Programmatic SEIS.

4.1 Overview of Seabird Protection Measures Under FMP 2.1

Under FMP 2.1, the incidental take threshold of 4 short-tailed albatross taken in a two-year period would remain in effect unless it was changed as part of a new Section 7 consultation and resulting BiOp. The seabird avoidance regulations on longline vessels would remain the same as at present (outlined previously in Section 1.4) and would not include the changes recommended by the NPFMC in December 2001 (Section 3.1). However, USFWS is currently reviewing the results of the Washington Sea Grant study (Melvin *et al.* 2001) and may require changes in the longline regulations to reflect this research as part of a new BiOp. FMP 2.1 would have to conform to any changes in mandated ESA regulations. No other seabird avoidance measures or restrictions on fishing effort would be implemented to protect any other species or groups of seabirds under FMP 2.1.

Overall TAC would likely be increased in FMP 2.1 to maximize economic gain from the fishery. However, in a previous BiOp concerning short-tailed albatross (USFWS 1995), the USFWS stated that any increase in TAC of 10 percent or more from the level considered in that BiOp would constitute a significant change in fishing effort, thereby threatening to increase the incidental take of short-tailed albatross, and would require a new Section 7 consultation. The goal of increasing TAC may thus be tempered by USFWS determinations regarding jeopardy to short-tailed albatross.

This alternative would include changes in data collection and reporting programs that would impact seabird protection measures. The Observer Program would be greatly reduced except as mandated by laws such as the ESA and American Fisheries Act. As part of the most recent BiOp regarding short-tailed albatross, USFWS required NOAA Fisheries to establish independent monitoring of incidental take rather than rely on self-reported takes by fishing vessels (USFWS 1999). The amount of observer coverage in the fleet is an important consideration for determining the incidental take threshold. Since short-tailed albatross are so rarely seen and even more rarely taken incidentally in the fishery, trying to extrapolate the number of birds taken by the whole fleet from only a small percentage of observed vessels is statistically problematic. For this reason, the incidental take threshold is currently triggered only by actual numbers of birds taken rather than extrapolated numbers. If the amount of independent monitoring provided by the Observer Program was substantially reduced, or if seabird identification training for observers was eliminated, another Section 7 consultation would be triggered. USFWS may then require a specific level of observer coverage and other conditions in order for the fishery to remain in compliance with the ESA. NOAA Fisheries would therefore

need to balance the objective of reducing the Observer Program under this alternative with the need to abide by mandated BiOp RPAs.

The expected effects of the FMP 2.1 and 2.2 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

4.2 Effects of FMP 2.1 Seabird Measures on Seabirds

Since FMP 2.1 would retain the seabird avoidance measures that have been in place since 1997, the impacts of this policy can be inferred from recent incidental take data (Tables 8 and 9 from the seabird section of the NPFMC 2002). Comparisons of the average estimated incidental take in the BSAI longline fisheries from 1993-1996 (when no avoidance measures were required although some may have been used voluntarily) and 1997-2001 (when the existing rules were in place), indicate that the numbers of the four major species/groups caught on longlines actually increased since 1997. Northern fulmars, which make up the majority of birds caught, increased from an estimated average of 6,000 birds taken per year (1993-1996) to 10,700 birds per year (1997-2001). In those same time periods, the incidental take of gulls increased from 2,000 to 3,300 birds per year, Laysan albatross increased from 400 to 640 birds per year, and shearwaters increased from 390 to 580 birds per year. The total of all birds taken from the BSAI longline fishery increased from an estimated average of 11,600 birds per year (1993-1996) to 16,600 birds per year (1997-2001).

These average numbers of incidental take in the BSAI longline sector appear to show that the seabird avoidance measures enacted in 1997 did not have their intended effect. However, the number of birds caught per unit effort was almost the same in the different periods, with 0.085 birds caught per 1,000 hooks set in 1993-1996 and 0.090 birds per 1,000 hooks in 1997-2001 (NPFMC 2002). The higher overall incidental take in 1997-2001 is thus partly a result of increased fishing effort in this sector (average of 135 million hooks set per year from 1993-1996 and 186 million hooks set per year from 1997-2001). An examination of the data on a year-to-year basis indicates that there is a great deal of annual variation, with 1998 having a very high take rate (0.14 birds per 1,000 hooks) and 2001 having a very low take rate (0.04 birds per 1,000 hooks). It is not clear why there is such high variability between years but one reason may be related to the nutritional state of birds in general. In 1997 and 1998, oceanographic conditions did not favor species that fed close to the surface of the water and several large scale die-offs were recorded (Hunt *et al.* 1999, Baduini *et al.* 2000). In these same years, fishermen reported that flocks of birds attacked their lines with great intensity and were not deterred despite their best efforts (S. Fitzgerald, Observer Program, personal communication). The large reduction in take rate in 2001 may be due in part to some of the longline fleet's voluntary adoption of paired streamer line avoidance techniques in advance of their regulatory implementation.

In the GOA longline fishery, the overall take of birds is much less than in the BSAI, and the avoidance measures enacted in 1997 had a mixed impact on incidental take (NPFMC 2002). Take of northern fulmars decreased from about 570 birds per year (1993-1996) to 410 birds per year (1997-2001). Take of black-footed albatross decreased from about 230 to 160 birds per year while take of Laysan albatross remained essentially the same at about 130 birds per year and gulls increased from 70 to 150 birds per year. The total of all birds taken from the GOA longline fishery decreased from an estimated average of 1,250 birds per year (1993-1996) to 870 birds per year (1997-2001). Incidental take per unit effort is also much less in the GOA than the BSAI, with an overall take rate of 0.03 birds per 1,000 hooks from 1993-2001 (NPFMC 2002).

While overall incidental take has gone down in the GOA since seabird protection measures were implemented in 1997, the take rate has remained the same with an average of 0.028 birds per 1,000 hooks taken in 1993-1996 and 0.027 birds per 1,000 hooks taken in 1997-2001. The average number of hooks set in the GOA declined from 45 million per year in 1993-1996 to 32 million per year in 1997-2001. The GOA data show a similar pattern in annual variation of catch rates as described for the BSAI above. Take rates in 1998 were relatively high at 0.05 birds per 1,000 hooks and relatively low in 2001 at 0.01 birds per 1,000 hooks.

It is not known whether the differences in incidental take rates between the BSAI and GOA longline fisheries is due to differences in avoidance techniques used, sizes of vessels involved, composition of seabird flocks attending vessels, sea or weather conditions, seasonal concentration of the fisheries, or any other variable that might impact the effectiveness of deterrence measures. The problem with using the Observer Program data to analyze the effectiveness of avoidance techniques is that the present regulations do not have specific performance standards. Some deployments may have met the legal requirements for deterrent devices but were poorly executed and hence were rather ineffective in keeping birds away from baited hooks. Although the Observer Program is presently making improvements in their procedures, observers have not had any way to assess deployment performance on their data sheets, so past records will be of limited value in analyzing regional differences in effectiveness.

Statistically analyzing the effectiveness of the present regulations in preventing incidental take of short-tailed albatross on longlines is problematic given the rarity of encounters. The issue would be even more difficult to resolve if observer coverage of fishing effort was decreased as proposed in FMP 2.1. It is clear, however, that the existing regulations did not eliminate the incidental take of short-tailed albatross. Even though no short-tailed albatross have been reported taken since 1998, the fact that two short-tailed albatross were caught in one month in 1998 by vessels using the existing avoidance techniques indicates that the threat remains.

There are presently no regulations that require any mitigation of seabird incidental take in either the trawl or pot sectors of the groundfish fleet. Since no restrictions on these sectors would be implemented under FMP 2.1, the effects on seabird incidental take can be deduced from recent trends. As described previously in Section 3.2, incidental take in trawls appears to be increasing since 1997, especially for northern fulmars. The overall estimated average take in the BSAI/GOA trawl fisheries has increased from 528-2,343 birds per year in 1997 to 741-12,488 birds per year in 2001. With the goal of increasing TAC under FMP 2.1, incidental take of seabirds in trawl gear would be expected to increase in proportion to trawl effort.

Research on seabird-fishery interactions would not be a high priority under FMP 2.1. Present research on trawl third wire collisions and possible mitigation techniques would likely be discontinued or reduced in scope unless mandated by USFWS under Section 7 ESA consultation. Determining if any seabird-fishery interactions led to significant population-level effects would require much more research on seabird population trends and distribution than presently exists. Under FMP 2.1, NOAA Fisheries would not place a high priority on collaborating with USFWS on this type of research.

4.3 Effects of FMP 2.1 Seabird Measures on Other Resources

Maintaining the present seabird protection measures will not impact the physical environment or benthic habitats. Incidental take and entanglement of marine mammals does not appear to be affected by the present seabird deterrent devices. Catch rates of fish species on longlines should not be affected because there would be no new restrictions or requirements on the fleet's operation.

The longline fleet has been operating under the same requirements since 1997 so there should be no additional costs involved under FMP 2.1. One potential economic benefit of the seabird protection measures is that they reduce the chance that the fleet will exceed the ESA incidental take threshold for short-tailed albatross and therefore reduce the chance that the USFWS will mandate additional restrictions on the fleet. Considering the fact that the existing avoidance techniques have not eliminated the take of short-tailed albatross, the possibility of exceeding the incidental take threshold remains.

4.4 Overview of Seabird Protection Measures Under FMP 2.2

FMP 2.2 would be the same as FMP 2.1 with regard to seabird protection measures and would include only those measures currently in place as mandated by the short-tailed albatross BiOp (USFWS 1999). One important difference between FMP 2.1 and FMP 2.2 is that the Observer Program would be the same under FMP 2.2 as it is at present. Monitoring of short-tailed albatross incidental take would thus be the same as at present and would therefore not trigger any new Section 7 consultations with USFWS.

4.5 Effects of FMP 2.2 Seabird Measures on Seabirds

Since FMP 2.2 is the same as FMP 2.1 with regard to seabird protection requirements, the impacts on seabirds are the same as listed previously in Section 4.2.

4.6 Effects of FMP 2.2 Seabird Measures on Other Resources

Since FMP 2.2 is the same as FMP 2.1 with regard to seabird protection requirements, the impacts on other resources are the same as listed previously in Section 4.3.

Section 5 Alternative 3: Adopt a More Precautionary Management Policy

The seabird-related goals of the Alternative 3 policy are to continue working with USFWS to protect ESA-listed species, to initiate non-ESA-mandated efforts to conserve or restore other seabird species, and to increase research on fishery-impacted seabird populations and ecosystem interactions. This management strategy would accelerate the incorporation of precautionary management measures and ecosystem-based management principles in order to provide sound conservation of living marine resources, including seabirds. This policy will strive to maintain a balanced and sustainable fishery and will adopt new conservation measures when scientific evidence indicates that the fishery is negatively impacting the environment.

Alternative 3 places more emphasis on research and management of potential effects of the fishery on a broader range of seabird species than does the present policy. Since seabirds are an important element of the marine ecosystem, both in numbers of animals and in energy flow through the food web, and there is presently a great deal of uncertainty regarding population estimates and ecological interactions, this alternative would initiate an expansion of joint research programs designed to investigate seabird biology and more closely monitor seabird-fishery interactions.

5.1 Overview of Seabird Protection Measures Under FMP 3.1

At one end of the Alternative 3 management framework, represented by FMP 3.1, the incidental take threshold of 4 short-tailed albatross within a two-year period would remain in effect unless it was changed as part of a new BiOp. The seabird avoidance measures would be the same as in FMP 1 and would thus follow the joint recommendations of the Washington Sea Grant Program, NOAA Fisheries, and USFWS as interpreted by the NPFMC and implemented by NOAA Fisheries (see Section 3.1). In addition, under FMP 3.1, NOAA Fisheries would collaborate with USFWS to scientifically develop and assess fishing methods that would reduce the incidental take of all albatross species. This shift to include measures that protect other albatross besides the short-tailed would probably not yield substantial differences in the avoidance regulations, since the species all feed in similar fashion and often occur together. In fact, the effectiveness of the proposed regulations to deter short-tailed albatross is an assumption based on the measured deterrence of the non-endangered albatross (Melvin *et al.* 2001).

Overall fishing effort may be the same as under the status quo but it also may be decreased, depending on some new considerations under this alternative. As part of the goal to accelerate the incorporation of ecosystem considerations into the TAC-setting process, NOAA Fisheries would review the appropriateness of using F_{40} as the target fishing rate (Appendix B). NOAA Fisheries would also develop indices of key ecosystem processes that will be used to track ecosystem health and modify TAC if warranted. Environmental measurements involving particular species of seabirds and their food supplies may well be included in these new ecosystem indices. If fishing effort is reduced in response to ecosystem concerns, incidental take of seabirds could be reduced.

Under FMP 3.1, NOAA Fisheries would establish goals and guidelines for selecting Marine Protected Areas (MPAs) and other no-fishing zones. To the extent that these new conservation areas are established in areas important to seabirds, this program could offer important refuge areas for at least some species.

Another goal of the Alternative 3 policy will be to increase the rationalization of the fisheries. If such programs lead to changes in the size of fishing vessels, they could impact the overall effectiveness of seabird avoidance measures that vary according to vessel length. This could also affect data collection on seabird-fishery interactions, since coverage of the Observer Program is also dependent on the size of the vessel. In both cases, when vessel size increases above a certain threshold, seabird protection measures and observer coverage are both improved as far as seabirds are concerned.

Under FMP 3.1, the Observer Program would likely be strengthened to improve the scientific collection of data. This may include more extensive training for observers in seabird identification, especially from hard body parts (feet and bills), which may allow an improvement in the amount of species-specific information collected and the reduction of the "unidentified seabird" category. Improvements in sampling design and record-keeping may also help narrow the confidence intervals around estimates, especially in the trawl data, and thereby improve the usefulness of the data for impact assessment purposes. The Observer Program may also be used to expand research on the effectiveness of seabird avoidance techniques under different conditions.

The expected effects of the FMP 3.1 and 3.2 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

5.2 Effects of FMP 3.1 Seabird Measures on Seabirds

Since the seabird protection measures under FMP 3.1 would likely be the same as under FMP 1, the impacts on seabirds would be the same as listed in Section 3.2. The increased emphasis on developing and testing the effectiveness of new avoidance techniques may lead to future changes that would reduce incidental take even further. Any progress in reducing incidental take on longlines, especially for surface-feeding species, will reduce the likelihood of exceeding the incidental take threshold for short-tailed albatross. At this end of the Alternative 3 management framework, investigations into the extent of trawl third wire collisions would be continued and mitigation measures would be implemented for the trawl sector as they are proven effective or as required by future ESA Section 7 consultations with USFWS. The initial effects of the trawl and pot fisheries on incidental take of seabirds under FMP 3.1 would be similar to that described in Section 3.2.

5.3 Effects of FMP 3.1 Seabird Measures on Other Resources

Seabird protection measures under FMP 3.1 would be unlikely to impact the physical environment or benthic habitats. For the same reasons as stated in FMP 1, no marine mammals, target fish, or non-target fish are likely to be affected by seabird avoidance requirements on the longline fleet. The increased emphasis on seabird research under this policy, among other research topics, would certainly be expected to contribute to our understanding of predator-prey relationships and other ecosystem functions, just as research into marine mammal biology and fish biology would be expected to improve our understanding of seabirds.

From an economic standpoint, the cost to the longline fleet in new gear and vessel modifications is minimal. The USFWS has recently had a program to reimburse vessel owners for these costs but future funding for this program is uncertain. It is possible that additional deterrent devices or modifications will be instituted under FMP 3.1 as research demonstrates the effectiveness of new techniques. Any new techniques would be developed in conjunction with the longline fleet in order to address safety and fishability concerns. The cost of adding new gear and deploying it will be offset, at least in part, by the more successful delivery of baited hooks to their intended target. One potential economic benefit of these seabird protection measures is that they reduce the chance that the longline fishery will exceed the incidental take threshold of short-tailed albatross and therefore reduce the chance that the USFWS will mandate additional restrictions on the fleet.

5.4 Overview of Seabird Protection Measures Under FMP 3.2

At the end of the range of the Alternative 3 management framework represented by FMP 3.2, research into seabird protection measures is extended to all seabird species. Under FMP 3.2, seabird protection measures would be continually improved through scientific research on the effectiveness of new techniques. Protection of ESA-listed species would continue to have a high priority, but NOAA Fisheries would also initiate research and implement regulations to minimize the incidental take of all seabird species. Since different species are more likely to be taken in trawl gear than longlines, this sector would likely be subject to new gear modifications and/or fishing technique regulations. Pot fishing is by far the cleanest method of fishing in regard to incidental take of seabirds, so it may not receive high priority in mitigation research. The research necessary to develop these new seabird deterrent techniques and gear modifications would require a great deal of cooperation and coordination with USFWS, the fishing industry, and academic institutions.

Under FMP 3.2, allocations of TAC in space and time would be based on protecting living marine resources, including seabirds. Such changes in the distribution of fishing effort may have substantial impacts on the incidental take of seabirds, especially if they are correlated with areas of high seabird concentration. At this end of the Alternative 3 spectrum, up to 15 percent of the BSAI/GOA would be included in MPAs and 5 percent in no-take marine reserves. To the extent that these protected areas overlap with important seabird habitat, they could provide an experimental opportunity to study the dynamics of seabird-fishery interactions, including the impacts of fishing on colony-level survival and reproductive success. The results of such research would provide scientific justification for future fishery management decisions.

Rationalization of all fisheries would be a priority under FMP 3.2. If the economics of rationalization leads to significant changes in the sizes of vessels used (one way or the other), and seabird avoidance measures continue to be based on the size of fishing vessel, rationalization could affect the extent to which particular avoidance measures are used and therefore either increase or decrease the overall effectiveness of these mitigation measures.

The Observer Program would be expanded under FMP 3.2 so that vessels > 60 ft LOA would be required to have 100 percent coverage (up from 30 percent at present). If observers continue to collect data on seabird avoidance or deterrence techniques, this increase in quantity of data would certainly improve our understanding of seabird-fishery interactions. A substantial improvement in observer coverage would also be factored into Section 7 consultations and may affect the establishment of future incidental take thresholds for short-tailed albatross.

5.5 Effects of FMP 3.2 Seabird Measures on Seabirds

Reaching the goal of reducing incidental take for all seabirds will depend on the successful development of efficient new avoidance or deterrence techniques. Assuming that these efforts lead to significant decreases in seabird take for the longline and trawl fleets, several species may realize measurable population-level benefits. Northern fulmars are the species taken most frequently by all three gear sectors. Because their overall population levels are very difficult to census accurately, the beneficial impact of reducing incidental take may only be measurable on a colony level, especially on the Pribilof Islands. Laysan and black-footed albatross have both experienced recent population-level declines (see Section 3.7 species accounts in the Programmatic SEIS) so any reduction in take rates would help overall conservation efforts for these species. Any improvements in fishing gear or avoidance techniques that reduce the take of surface-feeders will reduce the likelihood of exceeding the incidental take threshold for short-tailed albatross.

Under FMP 3.2, NOAA Fisheries would advocate and cooperate as much as possible with USFWS to expand research into seabird population dynamics and foraging ecology. NOAA Fisheries' emphasis on collecting seabird-fishery interaction data will likely complement the work of other agencies and academic institutions, leading to an improved understanding of how seabirds respond to their environment.

5.6 Effects of FMP 3.2 Seabird Measures on Other Resources

New seabird avoidance measures would be required to address the FMP 3.2 goal of reducing incidental take of all species. It is not apparent what this might mean for gear restrictions but it would seem likely that trawl gear would be affected as well as longline gear. Since pot gear takes so few seabirds of any species (estimated average of less than 50 birds per year in the combined BSAI/GOA pot fisheries, NPFMC 2002), it is unlikely that gear modifications would be pursued in this sector. Gear modifications on bottom trawls could change the way these gear types physically modify the ocean bottom. However, given other goals of FMP 3.2 to protect benthic habitats, it is unlikely that any gear modifications designed to minimize seabird take would be approved if they had an adverse impact on benthic habitat. Similarly, reduction of incidental take of marine mammals is also a goal of FMP 3.2, so it is unlikely that changes in seabird protection measures would be approved if they had adverse impacts on marine mammals. Area/gear-type closures aimed at minimizing seabird incidental take may also benefit marine mammals, non-target fish species, and invertebrates where they occur together.

The costs of making gear modifications in the trawl fleet may be substantial, depending on the complexity of those modifications. Development of such modifications would have to be done in conjunction with the fishing fleet so that fishability and safety concerns would be addressed for any proposed solution. Maintaining reasonable catch rates of target fish would be one of the criteria used in developing successful mitigation measures, so the impact of new seabird protection measures on target fish should be minimized. However, gear modifications and area restrictions may decrease catch per unit effort and therefore have substantial economic repercussions for the trawl fleet.

Seabird avoidance measures that are currently in use or proposed for the longline fleet are less effective in protecting species that can dive on baited hooks, such as shearwaters, than they are for surface-feeding species. New gear modifications may be required for the longline fleet to protect these diving species, and perhaps the surface-feeding species too, as research demonstrates the effectiveness of new techniques and gear such as weighted groundlines. The cost of adding new gear and deploying it will be offset, at least in

part, by improved success in delivering baited hooks to their intended target. Improved seabird protection measures will reduce the chance that the fishery will exceed the incidental take threshold of short-tailed albatross.

Section 6 Alternative 4: Adopt a Highly Precautionary Management Policy

The seabird-related goals of the Alternative 4 management policy are incorporated into a sweeping change in the way managers approach scientific uncertainty. This management policy is based on the assumption that, until proven otherwise, fishing produces adverse impacts on the environment but, due to incomplete data and scientific uncertainty, we know little about these impacts. Alternative 4 would adopt a highly precautionary approach in which the burden of proof is shifted to the user of the resource to demonstrate that the intended use would not have a detrimental effect on the environment. For seabirds, this means that protective measures would be implemented immediately for all species. Research would be initiated to evaluate current population estimates for all seabird species that interact with the groundfish fisheries. The goal of research on seabird avoidance techniques would be to develop, in cooperation with the fishing industry, measures that reduce incidental takes to levels approaching zero for all threatened or endangered species and for USFWS's list of species of management concern (including red-legged kittiwake, marbled murrelet, and Kittlitz's murrelet). The strategy for instituting seabird protection measures would follow the general management strategy of this alternative, which would be to substantially curtail the groundfish fisheries until more information is known about the frequency and intensity of fishery impacts upon the environment. Once more is known about fishery effects on the ecosystem, scientific information would be used to modify and relax the precautionary measures initially adopted.

6.1 Overview of Seabird Protection Measures under FMP 4.1

In contrast to the other alternatives, the goal of FMP 4.1 in regard to seabirds would be to provide even stricter protection measures than are presently required or proposed by the USFWS for protection of short-tailed albatross. By adding the other two albatross species plus red-legged kittiwake to the list of species for incidental take "approaching zero," seabird protection measures at least as effective as paired streamer lines, perhaps coupled with weighted groundlines or underwater setting designs, would likely be implemented for the entire longline fleet, not just the largest vessels. In addition, the goal of reducing incidental take of marbled and Kittlitz's murrelets to levels approaching zero poses some difficulties for the trawl fleet. Observers presently have identity codes for these two species but they are difficult to distinguish from other small alcids, especially after being brought up in a trawl. Given the hundreds of "unidentified" alcids and seabirds taken in trawls every year, there is uncertainty about how many of these murrelets are presently caught in groundfish trawls. Under FMP 4.1, this uncertainty will have to be addressed before and after any mitigation measures on the trawl fleet are implemented.

While it may be desirable to develop perfect technological solutions, reducing incidental take of all albatrosses and other species of concern to levels approaching zero may also require extensive training programs to demonstrate how to deploy gear correctly, plus performance reviews or incentives to maintain the highest standards. NOAA Fisheries is currently trying to identify the longline vessels with the worst incidental take records in order to provide customized evaluations and assistance for those crews and captains (S. Fitzgerald, Observer Program, personal communication). Given the wide variety in vessel and gear configurations in use, this vessel-specific approach to training may prove very effective in reducing overall incidental take. Incentive programs may also be useful management tools. These could range from an annual prestigious award (the "bragging rights approach") to an increased allocation of TAC to the cleanest

fishermen (the "market approach"). Captains and their crews would then have incentive to monitor the birds more closely and develop their own avoidance behavior procedures. This would probably work best in conjunction with the Observer Program for independent verification of incidental take levels.

FMP 4.1 would be similar to FMP 3.2 in that NOAA Fisheries would establish seabird protection measures for all species of seabirds. Since different species are more likely to be taken in trawl gear than longlines (i.e., alcids and shearwaters), this sector would likely be subject to new gear modifications and/or fishing technique regulations. Pot fishing could also be subject to new seabird avoidance regulations even though this is currently the cleanest method of fishing. The research necessary to develop these new seabird deterrent techniques and gear modifications would require a great deal of cooperation and coordination with USFWS, the fishing industry, and academic institutions. It is hard to predict whether seabird protection measures would be based on vessel length, but if all fisheries are required to reduce incidental take for all species, potential changes in the structure of the fishery should have minimal impact on total seabird incidental take.

The TAC-setting policies of FMP 4.1 would greatly reduce fishing effort from current levels and would thus reduce seabird incidental take. In addition, MPAs would be established in 20 to 50 percent of the BSAI/GOA. To the extent that these new conservation areas overlapped with areas important to seabirds, this program could offer important refuge areas for at least some species.

The expected effects of the FMP 4.1 and 4.2 seabird protection measures for seabirds and other biological and socioeconomic resources are described below and summarized in the table that is presented at the end of this paper.

6.2 Effects of FMP 4.1 Seabird Measures on Seabirds

The species that are taken most frequently in the groundfish fisheries and that stand to benefit the most from improved avoidance or deterrence techniques include the northern fulmar, Laysan albatross, and black-footed albatross. Several species groups, including gulls, shearwaters, and alcids, are also taken in substantial numbers but the impact on particular species within these groups is not known. Continued improvements in seabird identification protocols (especially from feet and bills) and an increased priority on seabird data collection efforts in the Observer Program could reduce the proportion of unidentified birds in the data set and narrow the confidence intervals around incidental take estimates. For vessels that do not have observers, fishermen could be required to retain all seabirds for identification in port. The expansion of directed research on seabird population trends could potentially allow the direct effects of the fisheries to be monitored on the population or colony level. However, if the take reduction programs are successful, these effects should be negligible.

The large number of significant changes to the fishery contemplated in this alternative would undoubtedly trigger new Section 7 consultations with USFWS regarding incidental take thresholds for short-tailed albatross. The outcome of those complex deliberations can not be predicted at this time. However, more research and emphasis would be given to seabird-fishery interactions and mitigation efforts in this alternative than any of the others. Improved seabird avoidance or deterrence measures should greatly reduce the chance of exceeding any incidental take threshold for short-tailed albatross.

6.3 Effects of FMP 4.1 Seabird Measures on Other Resources

The broad seabird protection goals of FMP 4.1 would likely require substantial changes in at least the groundfish trawl and longline gear types and may include area/season closings to avoid seabird concentrations. Acceptable gear modifications under this alternative could not have adverse impacts on benthic habitat, marine mammals, non-target fish, or any other part of the environment. The much greater emphasis on seabird research, both in population censussing and foraging ecology, would certainly contribute to an improved understanding of other ecosystem components and dynamics.

The economic impact of seabird protection measures would include research development costs for new fishing techniques, the costs of making gear and ship modifications throughout the fleet, any change in catch per unit effort for target species, and costs associated with a more dispersed fishing effort due to closures. These economic costs would undoubtedly be very substantial.

6.4 Overview of Seabird Protection Measures Under FMP 4.2

At this end of the Alternative 4 management framework, as represented by FMP 4.2, all commercial groundfish fishing would be halted while research on environmental parameters continued. Experimental fishing permits could be granted so that the industry could work in cooperation with various agency personnel and academic institutions to conduct research. The intent of FMP 4.2 would be to close the fisheries only until specific fisheries were certified or demonstrated to have minimal effects on the environment, at which point they would be opened under a new ecosystem-based management system. Under FMP 4.2, biological monitoring of seabirds would be conducted at a much higher level than at present as part of the ongoing effort to track ecosystem health.

6.5 Effects of FMP 4.2 Seabird Measures on Seabirds

Cessation of fishing would certainly eliminate the incidental take of seabirds and benefit certain species. Whether such benefits could be measured on a population level would probably depend on the intensity of population monitoring for those species both before and after fishing was stopped. Some seabirds, notably fulmars and gull species, may derive substantial benefits from fishing activity in the form of scavenged offal and waste. Although their attraction to fishing vessels puts them in danger of incidental take, this supplemental food source would be eliminated if all the fisheries were closed, with potentially adverse effects on their survival and reproductive success rates. The cumulative net benefit or detriment of fishing activity on scavenging species has not been examined in Alaska. This would be an appropriate and likely topic of seabird research under this alternative.

6.6 Effects of FMP 4.2 Seabird Measures on Other Resources

Although many other elements of FMP 4.2 would lead to the same conclusion, the seabird protection goal of eliminating incidental take of all seabirds completely would lead to a closure of the entire groundfish fishery. The impact on all physical and biological resources in the BSAI/GOA could be considered beneficial in the sense that human influence on them would be greatly reduced. However, some species would undoubtedly suffer losses in population and distribution, even as other species gain, as the ecosystem moves to a new dynamic state.

The economic cost to the groundfish industry and the communities that rely on such fishing would be disastrous. Only those involved in supporting environmental research and perhaps ecotourism could be seen to benefit economically from this situation.

Section 7 Data Gaps and Information Needs

7.1 Information Required to Monitor and Quantify Impacts

The 2001 Draft Programmatic SEIS (NMFS 2001, pp 4.3-1 and 4.3-50) and the Ecosystem Considerations for 2003 report (NPFMC 2002, pp 192-195) has identified the major gaps in our knowledge of seabird ecology with respect to the groundfish fisheries and recommend the following:

- Compile existing data on diet, distribution, and abundance of seabirds into a common, accessible database.
- Initiate new research on seabird diets and foraging ecology, especially during the non-breeding seasons.
- Update population estimates for all seabird species.
- Improve knowledge about the distribution, abundance, and ecology of forage fish, especially with regard to management of predatory groundfish and climate change.
- Initiate studies to examine potential fishery impacts at the breeding-colony level.
- Analyze Observer Program data to identify particular areas and time periods with the most adverse seabird-fishery interactions.
- Continue to improve collection of species-specific incidental take data through the Observer Program and collaborative efforts to develop and test effective take reduction measures in the longline and trawl fleets.
- Quantitative modeling of fishery impacts on selected seabird species at the population level.
- Examine role of fishery discards and offal in seabird reproduction and survival as a function of the spatial/temporal distribution of fishing efforts.
- Employ new research techniques (i.e., satellite telemetry) to examine at-sea distributions of sensitive species like short-tailed albatross.

Many of these efforts are underway but will require long-term commitments of resources and patience on the part of administrators and the public before scientists can reach meaningful conclusions.

For the purposes of analyzing regional population trends, adequate data exists for only a few species of seabirds that breed in Alaska, notably black-legged kittiwakes, red-legged kittiwakes, common murres, and thick-billed murres. More limited population and reproductive data is available for several other species (Dragoo *et al.* 2001). Unless USFWS receives substantial increases in their future research budgets, the murres and kittiwakes will most likely continue to be the most useful species for fishery impact assessments. Population trends for the three albatross species can also be monitored fairly accurately because of their

limited number of tropical breeding colonies, although assumptions must be made regarding the number of non-breeders that do not return to the colonies every year. The albatross species in the BSAI/GOA traverse huge distances and are impacted by many different kinds of human activities across international boundaries. Their frequent interactions with the groundfish fisheries and the important management implications of the ESA necessitate ongoing cooperation with other regional and international conservation agencies and institutions.

In addition to basic reproduction and population trend data, fishery impact assessment also requires an explanation of the mechanism(s) of action. For species that are thought to be impacted primarily through direct fishery-related mortality, such as the albatross species, population modeling can be combined with measurements of incidental take in the fisheries to calculate the degree of population impact (Cousins and Cooper 2000). The accuracy and completeness of incidental take levels should continue to be monitored by independent observers and tracked over time as new seabird avoidance techniques are introduced. Several other factors that influence seabird incidental take, such as overall nutritional state of the birds and seasonal distribution of fishing effort, should be monitored as well so that the effectiveness of the new avoidance techniques can be assessed with less uncertainty. For species thought to be affected primarily through fishery-induced changes in food availability, quantitative changes in prey availability (which includes elements of prey abundance, schooling behavior, and the "patchiness" of distribution) are much more difficult to measure. The complexity of the issue may be best addressed by trying to measure and compare the physiological state of birds in areas that are fished versus areas that are not fished. While traditional studies of this nature require the collection of birds for stomach and tissue samples, newer serological methods only require live capture and drawing blood samples (Piatt *et al.* 1998, Suryan *et al.* 1998a, Suryan *et al.* 1998b, Suryan *et al.* 2000).

The key to this kind of comparative analysis is finding suitable study areas for comparison. The establishment of no-fishing reserves around selected breeding colonies would greatly facilitate such studies. Comparative studies of this nature could be conducted for both fish-eating and plankton-eating seabird species. Ideally, nutritional studies would be conducted in conjunction with reproductive and population trend studies in order to link the impact mechanism with the potential effect. While it would not eliminate all uncertainty about potential impacts, a system of research reserves offers some hope of scientifically deciphering the ecosystem complexities of marine life. It is important to note that no-fishing reserves that were within 3 nautical miles (nm) of shore would have to be established in conjunction with the State of Alaska. The effect of a federal reserve would obviously be nullified if state-managed fisheries were allowed to continue inside a no-take reserve boundary. This would be especially important if the no-fishing reserve encompassed a seabird breeding colony.

Several concerns have been raised about the Observer Program incidental take data, including the large number of birds that are reported under "unidentified" or group categories rather than individual species and the large variability in take estimates within and between reported years (public comments on NFMS 2001, Appendix G). As described in Section 3.2, the Observer Program is addressing some of these issues with improvements in field identification methods based on feet and bills, improvements in sampling design and data collection protocols, and improvements in observer seabird training programs. However, there will always be unidentifiable bird remains and there is some value in combining rarely taken species into groups for reporting and analysis purposes. The quality and quantity of seabird data coming out of the Observer Program is largely a function of how much emphasis is placed on collecting seabird data versus other kinds of fishery data. Some of the alternatives give the collection of seabird data a higher priority than others. For

some types of seabird-fishery interaction data, it may be necessary to have dedicated seabird observers on a subset of vessels that already have fishery observers. These seabird observers would not have fish sampling duties and could collect other types of data not normally collected in the Observer Program. The development of video monitoring techniques may also be useful in this effort, especially on smaller boats that did not carry observers. Of course, the potential value of this data will need to be balanced by the cost of acquiring it.

One concern is that observers were not accounting 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 1998) indicated that 30 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 Observer Program, observers actually watch the groundline as it is retrieved and tally birds that fall off before being retrieved on board. This accounts for some of the "unidentified seabird" data. The question of how many birds are hooked as a line is deployed but fall off while the groundline is underwater is an issue that could perhaps be addressed by a series of experiments. These experiments could use birds already taken in the fishery or taken for other scientific purposes. The known numbers of seabirds placed on the line would then be compared to the number retrieved after the line soaked under normal fishing conditions. Such experiments may improve estimates of how many birds are actually taken in the fisheries. An alternative might be to use underwater video cameras to observe the longlines as they are being deployed. This technology is currently being developed to study the impacts of pelagic trawls (Kim Rivera, NOAA Fisheries seabird coordinator, personal communication) but it would probably require substantial research and development for longline applications. Again, the cost of developing this technology may be disproportionate to the value of the data, especially if new avoidance measures dramatically reduce incidental take on longlines.

7.2 New Modeling Needs

Concerns for fishery impacts range from population-level effects to local breeding-colony effects. As a practical matter, population modeling efforts have been limited to those species most frequently taken incidentally in the longline fisheries (northern fulmars) and to species of special concern (the three albatross species). Even though most other species are not monitored closely enough to determine if impacts are occurring on a population level, recent survey trends have raised interest in trying to model possible colony-level impacts on species that breed near intensive fishing efforts. Considering the proximity of major trawl and longline fishing efforts around the seabird colonies of the Pribilof Islands, it seems that this would be an appropriate region to model potential impacts on diving species such as the murres and on surface-feeding species such as the kittiwakes. While the murres are taken incidentally in trawls, a potentially larger impact may take place through fishery-induced changes in predator-prey relationships and other food web interactions with forage fish and important invertebrate prey. This localized impact model would thus be part of and integrated with a larger ecosystem modeling effort called for in some alternatives.

There are many questions that would need to be addressed regarding how seabirds would factor into an ecosystem model. Recent work by Hunt *et al.* (2000) has attempted to quantify some of the prey consumption parameters for seabirds and marine mammals in the North Pacific. While such "broad brush" analyses are valuable for overall energy and mass flow estimates, more localized measurements and assumptions about seabird numbers, seasonal distribution, and diet will be needed for a mathematical model to reflect the dynamics that are important to seabird survival and reproduction. The impact of seabird foraging on prey species, especially around breeding colonies, would also be an important element in any modeling effort.

The ecosystem model would have practical applications in the Alternative 4 policy, which requires the fishery management system to incorporate indices of "ecosystem health" in allocation decisions. The question of what these indices might be for seabirds deserves careful consideration. One candidate for a measurable index is the population densities of selected "indicator" species. There are two challenges with this approach. First, state-of-the-art seabird censussing techniques are still not very precise so there will always be a substantial amount of scientific uncertainty regarding population levels, especially over large areas. Second, populations of animals are never static, even in the absence of humans, so a certain amount of fluctuation should be seen as acceptable or even desirable in a "healthy ecosystem."

Decisions will have to be made about how much change in an index is acceptable and at what point management should respond. One option is to develop different "levels of concern" based on the direction and amount of change over time, similar to the International Union for Conservation of Nature and Natural Resources's "red list" ranking system for species, but for regions defined as biologically important to the fishery rather than global population. In any case, even if a set of ecosystem "warning signs" can be developed, the underlying mechanisms of change must be determined before appropriate mitigation can be taken. It must be acknowledged that there may be issues that the NPFMC or NOAA Fisheries may not be able to address with changes to the fishery management system. For example, if the population of a seabird indicator species begins to decline because of persistent pesticide pollution from agricultural runoff in Asia, the NPFMC will not be able to correct the situation by changing groundfish allocations.

Every impact analysis depends to some degree on knowledge about the distribution and abundance of seabird species in the BSAI/GOA, especially in areas away from breeding colonies and during the non-breeding season when most direct interactions with the fisheries occur. While a great deal of data has been collected over the years, much of it was collected in the 1970s and 1980s (Outer Continental Shelf Environmental Assessment Program) and is not readily accessible because it is stored in various places and formats. The U.S. Geological Survey/Biological Resource Division, in cooperation with NOAA Fisheries, USFWS, and the Minerals Management Service, has recently begun compiling this information into a standardized database format that will eventually be available to the public. Preliminary results from this North Pacific Pelagic Seabird Database have been used to analyze the degree of distributional overlap between selected species and different groundfish fisheries in the Ecosystem Considerations for 2003 report (NPFMC 2002). The Ecosystem Considerations for 2003 report contains several maps (Figures 5 to 12) that are good examples of how GIS technology can be used to facilitate understanding and analysis of seabird-fishery interactions. However, the basic abundance and distribution data for all seabird species need to be updated for these efforts to be most useful.

Section 8 Comparative Analysis of the Policy Alternatives

The four policy alternatives considered in this document cover a wide range of possibilities as far as seabird protection measures are concerned. Although these measures deal mostly with the direct impacts of incidental take, many other FMP components influence the indirect impacts of the fishery on seabirds. The following comparison will focus on how the different alternatives would approach the incidental take of seabirds in fishing gear.

Under the Alternative 2 policy, incidental take of seabirds would not be considered a serious enough issue to warrant any regulations or restrictions on the fishing fleet unless there was clear scientific evidence of adverse population-level impacts. Alternative 2 would do the minimum amount necessary to comply with the ESA concerning the endangered short-tailed albatross or any other listed species. The use of the Observer Program to gather seabird-fishery interaction data is also integral to this issue because this is the data presently used by USFWS to monitor the incidental take threshold on short-tailed albatross. Under the Alternative 2 policy, the Observer Program could range from having no seabird monitoring function (at the FMP 2.1 end of the management framework) to having the same coverage and seabird monitoring function as at present (under FMP 2.2). NOAA Fisheries would need to find a compromise within the range of Alternative 2 that satisfies USFWS during Section 7 consultations.

Under the Alternative 1 management policy, compliance with the short-tailed albatross BiOp (USFWS 1999) led to the scientific development of new seabird deterrent techniques and the joint recommendations of NOAA Fisheries, USFWS, and Washington Sea Grant Program for improving seabird avoidance regulations on longliners. It is expected that these measures will greatly reduce the numbers of incidental takes for several species of concern, including the three albatross species and northern fulmars. The Observer Program would be used to monitor the effectiveness of these regulations in reducing take and that information would be used to make improvements in the regulations. In contrast, the Alternative 3 management policy would place more emphasis on reducing incidental take for all species of seabirds. Scientific research would be used to develop improvements in seabird deterrent devices and avoidance techniques not only for the longline fleet but for trawl and possibly pot gear as well. The Observer Program would be expanded to improve the quantity and quality of seabird data collected and would continue to be a key component of research on seabird-fishery interactions. Under the Alternative 4 management policy, the goal would be to reduce incidental take of all seabird species to levels approaching zero. This may require strong incentive programs for fishermen as well as gear modifications in the longline and trawl fleets. The great reduction in fishing effort proposed under Alternative 4 would also result in substantial reductions in seabird take.

While the numbers of birds taken incidentally in the fisheries can be sampled and estimated quantitatively, the impact of specific take levels for the population of a particular species is subject to a substantial amount of uncertainty. The imprecise nature of most seabird population estimates, plus natural fluctuations in population levels, makes it very difficult to say for sure whether a given level of anthropogenic mortality is causing the population to decline. The different alternatives vary in how they would deal with such uncertainty in management decisions. The Alternative 1 policy acknowledges that the fishery has an impact on various parts of the environment but prioritizes management actions based on the scientific evidence of

significant impact. Mitigation efforts may be expanded beyond what is absolutely necessary in order to account for some uncertainty in the scope of a perceived problem. Research is directed toward the most pressing concerns and is oriented toward direct fishery interactions.

The Alternative 2 policy sees the fishery as one of many factors affecting ocean resources but assumes that the fishery does not do any real harm to the environment. Any restrictions on the fleet would only be enacted if there was clear scientific evidence of adverse impact, and mitigation efforts would be as limited in time and space as possible. Research into fishery interactions with the environment would not have a high priority. Alternative 3 assumes that the fishery has a greater impact on a number of environmental factors than we presently realize but that not all of it is bad. Mitigation efforts would still be prioritized by scientific evidence of adverse impact, but more uncertainty would be acceptable for a "significance" finding. The Alternative 3 policy would thus be more "precautionary" in dealing with uncertainty than the Alternative 1 policy, and mitigation efforts would be extended to more seabird species than required under the ESA. More emphasis would be placed on researching indirect fishery interactions with the ocean ecosystem. The Alternative 4 policy approach is to assume that the fisheries are having many adverse impacts on the ocean environment, including on many seabird species, but we do not know enough about fishery interactions to know what they are at present. The fishery would be greatly restricted until scientific evidence could be accumulated to make certain that there was no direct or indirect adverse impacts on a given resource. Environmental research would receive a much higher priority than in any other scenario. In the first three alternatives, various degrees of uncertainty about an impact would be used to prevent restrictions on the industry. In the Alternative 4 policy, the burden of proof is reversed and uncertainty about an impact would be used to prevent fishing.

Table 1. Summary of seabird protection measure effects.

Resource	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Seabirds	• New seabird protection measures based on Washington Sea Grant Program (WSGP) research expected to greatly reduce take of surface-feeding species on longlines and reduce chance of reaching Endangered Species Act (ESA) take threshold for short-tailed albatross. Many vessels have already adopted these measures voluntarily. • Research into trawl third wire collisions and possible mitigation. No other trawl or pot gear modifications under consideration. • Observer Program continues to improve data collection training and protocols and is integral in research efforts. • Fishing rates and allocation between gear types as at present.	• Old seabird protection measures would apply unless mandated by United States Fish and Wildlife Service (USFWS) under ESA. Present measures have no performance standards so effectiveness differs between vessels. Average overall take has not declined with existing measures. Some voluntary use of new techniques likely. • No restrictions or gear modifications on trawl or pot sectors would be considered. • Research on seabird-fishery interactions and Observer Program receive lower priority. • Fishing effort increases impact on total take.	• Old seabird protection measures would apply unless mandated by USFWS under ESA. Average overall take has not declined with existing measures except that voluntary adoption of new techniques has decreased take rate since 2001. • No restrictions or gear modifications on trawl or pot sectors would be considered unless required by ESA consultation. • Observer Program emphasis on seabird data remains stable. • Fishing effort stable so overall impact same as present.	• New seabird protection measures based on WSGP research expected to greatly reduce take of surface-feeding species on longlines and reduce chance of reaching ESA take threshold for short-tailed albatross. • Research into trawl third wire and other impacts receives greater attention. New mitigation considered as needed. • Observer Program continues to improve data collection training and protocols. • Overall take decreases with effective protection measures and stable fishing effort.	• Same protection measures as FMP 3.1 plus emphasis on further reduction. More emphasis on monitoring and mitigating species of mgmt concern, including murrelets and red-legged kittiwake. • Increased emphasis on mitigating take from trawls. New measures implemented as proven effective. • Increased cooperative research into seabird population- and colony-level effects of fishery. Expanded role of Observer Program data. • Decreased fishing effort and new mitigation greatly reduces overall take of seabirds.	• Continual development and adoption of more effective protection measures for longline and trawl fleet with goal of eliminating take of all species. Chance of exceeding ESA take threshold for short-tailed albatross greatly reduced. • Cooperative research into seabird population dynamics and foraging ecology to examine all potential fishery impacts. • Observer Program continues to expand and improve data collection. • Greatly decreased fishing effort and new mitigation essentially eliminates take of seabirds.	• Initial closure of groundfish fishery eliminates incidental take of seabirds. Specific proposed fisheries must have minimal impact on environment, including near-zero take of seabirds. • Research into seabird-fishery interactions and basic ecology increases in conjunction with experimental fisheries and directed studies.

Table 1 (cont.). Summary of seabird protection measure effects.

Resource	Alternative 1	Alternative 2		Alternative 3		Alternative 4	
	Fishery Management Plan (FMP) 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Other biological resources	New seabird protection measures for longlines will not likely affect catch rates of any fish species or incidental take of marine mammals.	Existing seabird protection measures do not affect catch rates of any fish species or incidental take of marine mammals.	Same as FMP 2.1.	Same as FMP 1.	• Same as FMP 1 for longlines. Potential gear modifications for trawls may affect incidental take of other species but prevention of adverse impacts will be criteria for successful mitigation. • Increased research on seabirds improves overall understanding of marine ecology.	• Prevention of adverse effects on other animals will be key criteria of new seabird protection measures. • Increased research on seabirds improves overall understanding of marine ecology.	• No initial fishery or effects. Certified fisheries will not have adverse effects on other fish or mammals.
Physical resources	New seabird protection measures will not affect physical environment.	Old seabird protection measures do not affect physical environment.	Same as FMP 2.1.	Same as FMP 1.	Potential gear modifications for trawls may affect physical environment but prevention of adverse impacts will be criteria for successful mitigation.	Potential gear modifications for trawls may affect physical environment but prevention of adverse impacts will be criteria for successful mitigation.	No initial fishery or effects. Certified fisheries will not have adverse effects on physical environment.
Social and economic resources	• Cost of new seabird protection measures minimal and partially offset by improved deliverance of baited hooks. • Reduced chance of exceeding ESA take threshold for short-tailed albatross reduces chances of new requirements.	• No new costs for longline fleet. • Chance of exceeding ESA take threshold for short-tailed albatross remains and may lead to additional measures.	Same as FMP 2.1.	Same as FMP 1.	• Cost of potential modifications for trawls and longlines may be substantial. • Greatly reduced chance of ESA driven restrictions.	Same as FMP 3.2.	Initial shutdown of fishery will have severe consequences for industry and communities. Gear restrictions on subsequently opened fisheries may be costly.

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