Chapter 5

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Chapter 5 Research and Management

Preparing this Programmatic Supplemental Environmental Impact Statement (SEIS) has highlighted areas where scientists and managers need to pursue greater information about the resource, the effects of fishing, and the social and economic impacts of management decisions. Accordingly, this chapter reviews research and practical management components of the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Fishery Management Plans (FMPs) and discusses the research and enforcement needs implicated by the alternatives.

Section 5.1 provides an overview of the existing data gaps and plans to fill those gaps. This section is intended to serve as a further reference for those impact ratings in the Chapter 4 analysis where the conclusion was 'unknown'.

Section 5.2 focuses on management and enforcement issues and examines the effects of each Alternative from the perspective of management complexity.

5.1 Information Gaps and Research Needs

The policy alternatives analyzed in this Programmatic SEIS all require that certain monitoring and research plans continue such that uncertainties associated with management and the environmental effects of the Alaska groundfish fisheries can be addressed. This section reviews current and planned research projects and identifies the information gaps and research needs for the BSAI and GOA marine ecosystem. Section 5.1.1 discusses the major research priorities, funding process and ongoing research. Section 5.1.2 then goes on to describe specific information gaps and research needs by resource category.

5.1.1 Major Research Priorities, Funding Process and Ongoing Research

The following sections outline the major research priorities, and ongoing research activities currently being conducted on groundfish and the marine and human environment of the North Pacific. Scientific research and the necessary funding in support of federal fisheries management in the Exclusive Economic Zone (EEZ) off Alaska, come from various sources in addition to National Marine Fishery Service (NMFS or National Oceanic and Atmospheric Administration [NOAA] Fisheries) own facilities and budget; the Alaska Department of Fish and Game (ADF&G), the North Pacific Research Board (NPRB), various academic institutions, industry groups, grant programs such as SeaGrant and the Saltonstall-Kennedy Program, and other public and private entities. To the extent that current funding continues, NOAA Fisheries will continue to conduct and avail itself of existing research activities. Expanded research to collect new information and fill existing data gaps in dependent on the agency's receiving additional research funding. While additional funds are not certain, NOAA Fisheries intends to pursue the funding necessary to meet future research needs and improve the scientific information available for managing the fisheries.

5.1.1.1 NOAA Fisheries

NOAA Fisheries is responsible for ensuring that management decisions are based on the best available scientific information relevant to the biological, social, and economic status of the fisheries. The agency strives for information that is comprehensive, objective, credible, and effectively communicated. Along these lines, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended by the Sustainable Fisheries Act of 1996, requires the Secretary of Commerce to develop and publish a strategic plan for fisheries research. The MSA mandates strong action to conserve and manage fishery resources that contribute to the food supply, economy, and health of the Nation. Furthermore, MSA provisions require NOAA Fisheries to end overfishing, rebuild all overfished stocks, and conserve essential fish habitat (EFH) through research and consultations on federal and state actions that may adversely affect such habitat. These are among the agency's primary stewardship responsibilities.

To meet these responsibilities, the agency developed and, in December 2001, published the *NMFS Strategic Plan for Fisheries Research* (the Strategic Plan) (http://www.st.nmfs.gov/st2/strategic_plan.html) (NMFS 2001c). This plan, which updates the original *Strategic Plan for Fisheries Research* released in 1998, outlines NOAA Fisheries' proposed research efforts for the subsequent five years. The scope of this plan includes fisheries, habitat, and protected species research that addresses requirements of the MSA. The mission of NOAA Fisheries scientific enterprise is to ensure that the science products produced and disseminated by NOAA Fisheries is of the highest quality. The Strategic Plan outlines the following broad goals and objectives for NOAA Fisheries: 1) to improve scientific capability; 2) to increase science quality

assurance; 3) to improve fishery research capability; 4) to improve data collection; 5) to increase outreach/information dissemination; and 6) to support international fishery science. The following bulleted list details the actions called for in meeting these goals and objectives.

Improve Scientific Capability

- Implement National Research Council (NRC) recommendations (NRC 1998) to ensure state-of-the-art resource assessments through NOAA Fisheries' Stock Assessment Improvement Plan (NMFS 2001d).

- Continue to incorporate economic and social factors into the agency's decision-making. As part of this continuing effort, NOAA Fisheries will periodically publish the report *Our Living Oceans: The Economic Status of United States (U.S.) Fisheries*. The report will measure the economic health of U.S. fisheries relative to current conditions versus desired future conditions of long-term sustainability.

- Increase the agency's ability to predict natural living marine resource variation through improved data collection, improved understanding of how living marine resources respond to environmental variability and climate change, and coordinated bio-socioeconomic modeling, which will result in more accurate assessments and estimations of the uncertainty associated with them.

- Increase NOAA Fisheries' ability to identify, conserve, protect, and restore those habitats essential to managed fishery resources and to estimate the impact of pollution, wetland and estuarine degradation, and fishing gear on the abundance and availability of fish.

Increase Science Quality Assurance

- Implement policies to ensure that the agency's science programs, analyses, and products are sound, credible, and provide an objective basis for management.

- Improve the agency's professional standards for research and scientific advice by establishing national guidelines for technical program and staff performance evaluations, performance award programs, and professional career development opportunities.

- Expand and improve the agency's system for peer review of scientific advice by establishing panels of knowledgeable scientists from both within and outside government.

- Solicit input from external scientists in topical areas when identifying research initiatives for the various NOAA Fisheries' grant programs.

Improve Fishery Research Capability

- Implement NOAA Fisheries' fishery research vessel replacement plan (NMFS 1998a) that integrates government, university, and industry vessel capabilities to provide the state-of the-art facilities necessary for the accomplishment of the agency's varied at-sea research programs.

Improve Data Collection

- Implement NRC recommendations (NRC 2000) to improve the agency's data collection and analysis techniques and fishery data management systems.

- Provide a core fishery statistics program based on strategic and operational needs.

Increase Outreach/Information Dissemination

- Involve constituents in research programs. To the extent practicable, NOAA Fisheries will charter fishing vessels to participate in research projects, invite constituents to participate aboard NOAA Fisheries' research vessels during resource surveys, encourage frequent contact and cooperation between scientists and constituents, and develop methods to incorporate scientifically valid observations by fishers and others into fish stock assessments and other analyses related to living marine resources and their habitat.

- Coordinate with the NOAA Fisheries' Constituent Affairs and Outreach Team to develop an internet web-centralized resource for neutral science-based information to educate the public and user groups and answer questions on various topics on the status of the nation's fisheries, including how NOAA Fisheries research is conducted and how stock assessments are performed.

- Develop a new series of reports and presentations to communicate scientific results in simplified language that is easier to understand than traditional scientific publications.

Support International Fishery Science

- Participate in international scientific initiatives, such as the United Nations Intergovernmental Panel on Climate Change, Program for the Conservation of Arctic Flora and Fauna, Commission for the Conservation of Antarctic Marine Living Resources, Food and Agriculture Organization of the UN, Global Oceans Observing Program, North Pacific Marine Science Organization, International Council for the Exploration of the Seas, International Whaling Commission, United Nations Atlas of the Oceans, and Global Ocean Ecosystems Dynamics.

- Participate in bilateral scientific initiatives with neighboring countries, Canada and Mexico, and in scientific exchange programs with foreign countries that are developing their fishery resources.

Because fisheries are managed on a regional basis, the focus of NOAA Fisheries' research programs varies among the five regional science centers. Science center directors and their division chiefs develop annual research priorities, based upon regional and national needs, through dialogue with their Regional Administrator, regional councils, the program offices in NOAA Fisheries headquarters, and user groups and other interested parties. Teams of researchers at each science center work together to develop research plans.

NOAA Fisheries provide annual stock assessment information and management advice to support the their stewardship mission for the living marine resources in their regions. These cross-disciplinary efforts are undertaken in cooperation with other Federal and state agencies, international organizations, the fishing industry, and academia, and are based on long-standing cooperative research agreements. In addition to these basic responsibilities, each regional science center has unique capabilities to focus on special research needs.

The Alaska Fisheries Science Center (AFSC) is the research branch of NOAA Fisheries responsible for research on living marine resources in the coastal oceans off Alaska. The AFSC has research facilities in Alaska (Auke Bay and Kodiak Island), Washington (Seattle), and Oregon (Newport). Organizationally, the AFSC consists of the Auke Bay Laboratory, the National Marine Mammal Laboratory, the Resource Assessment and Conservation Engineering Division, the Resource Ecology and Fisheries Management Division, and other administrative units. The AFSC has a permanent staff of about 325 employees who conduct fisheries and marine mammal research in the coastal and offshore waters off Alaska. This marine region of nearly three million square miles includes over 50 percent of the U.S. coastline and over 70 percent of the U.S. continental shelf. The region supports some of the most important commercial fisheries in the world, particularly groundfish and Pacific salmon species, and is host to some of the world's largest populations of marine mammals and seabirds.

The 2001 *NMFS Strategic Plan for Fisheries Research* (NMFS 2001c) outlines the AFSC's research priorities for Fiscal Year (FY) 2001-2006. These priorities were developed in collaboration with state and other federal agencies, academic institutions, foreign research institutions, the fishing industry, and resource conservation organizations. Summarized below are the AFSCs research priorities grouped into four major research areas: research to support fishery conservation and management; conservation engineering research; research on the fisheries themselves; and information management research. The following list details the specific research being undertaken to support each of these major research areas.

I. Research to Support Fishery Conservation and Management

A. Biological research concerning the abundance and life history parameters of fish stocks

- Conduct an annual summer bottom trawl survey on groundfish and crabs in the eastern Bering Sea (EBS) shelf with chartered fishing vessels.

- Conduct Midwater trawl-acoustic surveys to assess the off-bottom component of pollock stock in the Bering Sea every two years (2002, 2004, 2006) and the GOA (2003, 2005) with the NOAA Research Vessel (R/V) *Miller Freeman.*

- Conduct an EBS slope survey on groundfish every two years (2002, 2004, 2006) with a chartered fishing vessel.

- Conduct an annual March survey on spawning pollock resources in the Bogoslof Island area by the NOAA Fisheries R/V *Miller Freeman* or with cooperating foreign research vessels.

- Conduct an annual spring survey of pollock resources in the Shelikof area by the NOAA Fisheries R/V *Miller Freeman*.

- Conduct a summer bottom trawl survey on groundfish in the GOA with chartered fishing vessels every two years (2001, 2003, 2005).

- Conduct a summer bottom trawl survey on groundfish in the Aleutian Islands region with chartered fishing vessels every two years (2002, 2004, 2006).

- Conduct an annual summer longline survey on sablefish resources in the GOA by a chartered vessel.

- Conduct a triennial summer bottom trawl survey on shelf groundfish off the Pacific west coast with two chartered vessels in 2001.

- Conduct an autumn bottom trawl survey on slope groundfish off the Pacific west coast with the NOAA Fisheries R/V *Miller Freeman* in 2001.

- Conduct a triennial summer hydroacoustic-bottom trawl survey on Pacific whiting off the Pacific west coast with the NOAA Fisheries R/V *Miller Freeman* in 2001.

- Conduct an annual April Fisheries Oceanography Coordinated Investigation egg-larvae survey in the GOA and a May survey on late-larvae by the NOAA Fisheries R/V *Miller Freeman.*

In addition to the above surveys, the AFSC is also planning to conduct many field operations to study marine mammal-fish interactions, with particular emphasis on sea lion-pollock/cod/Atka mackerel interactions in the GOA and the BSAI areas.

The following observer programs are planned for the groundfish fisheries that occur off Alaska:

- 100 percent observer coverage of fishing and processing vessels longer than 125 feet (ft).

- 100 percent observer coverage of most fish processing plants onshore.

- 30 percent observer coverage of fishing vessels that are 65-125 ft.

- 100 percent observer coverage (with multiple observers) of special category vessels that engage in community development quota (CDQ) and American Fisheries Act (AFA) fishing operations.

The AFSC will assess the status of stocks, estimate their biological production potentials (maximum sustainable yield (MSY), acceptable biological catch [ABC], overfishing levels [OFLs]), bycatch requirements, and other parameters required for their management. The following stocks will be assessed annually and be published in Stock Assessment and Fishery Evaluation (SAFE) reports:

- All BSAI and GOA groundfish stocks, including pollock, cod, sablefish, Atka mackerel, yellowfin sole, rock sole, flathead sole, Greenland turbot, other flatfish, Pacific ocean perch, and other rockfish species.

- King and Tanner crabs in the Bering Sea.

The National Marine Mammal Laboratory will assess the population dynamics, ecosystem interactions, and abundance of marine mammal stocks and their incidental take requirements. Some specific programs and activities that will be pursued are:

- Implement the Steller Sea Lion Recovery Plan.
- Implement the Steller Sea Lion - Fishery Interactions Research Plan.
- Implement the Northern Fur Seal Conservation Plan.
- Implement the Alaska Harbor Seal Research Plan.
- Analyze existing aerial survey data and harvest monitoring data on Alaskan ice seals.
- Analyze data collected during the international Antarctic pack ice seal cruise.
- Implement the Humpback Whale Recovery Plan.
- Implement the Northern Right Whale Recovery Plan as it pertains to the North Pacific.
- Implement an extended 5-year research and monitoring plan for the eastern North Pacific gray whale.
- Analyze data collected during the 1997-1999 small cetacean surveys in Alaska.
- Implement the West Coast Pinniped-salmonid Research Plan.
- Monitor the Makah gray whale harvest.

B. Social and economic factors affecting abundance levels

- Expand sociological and economic research and incorporate results into the fishery management process.
- Conduct research on vessel over-capitalization and impacts of their fishing effort levels on fisheries.

C. Compilation and analysis of data on harvesting and processing sector behavior

D. Interdependence of fisheries or stocks of fish

- Collect biological specimens of spawning pollock throughout its range for genetic marker studies through deoxyribonucleic acid (DNA) and other genetic techniques. Cooperation with foreign scientists is required for sampling non-U.S. waters.
- Analyze survey and observer data to determine spatial distributions of different species clusters that would indicate separation or interdependence of stocks.

- Develop genetic baseline information on salmonids to identify stocks or area of origin.

- Conduct winter surveys to estimate distribution and abundance of pollock (acoustic) and Pacific cod (bottom trawl) in Steller sea lion critical habitat areas in southeast Bering Sea, Shumagin Islands, and Kodiak Island to determine dependence of sea lions on localized food supplies and assess feasibility of annual time series.

E. Identifying, restoring, and mapping of EFH

- Conduct studies on the impacts of logging, urbanization, and mining on coastal salmon resources in southeast Alaska. NOAA Fisheries will work with the Corps of Engineers and local organizations to restore an urban impacted salmon stream.

- Conduct restoration studies related to the *Exxon Valdez* oil spill (EVOS) in Prince William Sound (PWS). The research will build upon the results reported in the accomplishments section, including a study of the effects of oil on the biology, homing, and survival of pink salmon.

- Impact of anthropogenic factors and environmental changes on fish populations

- Investigate mortality and pathogens of shellfish and groundfish.

- Conduct Fisheries Oceanography Coordinated Investigations: a cooperative research program with the Pacific Marine Environmental Laboratory of NOAA's Oceanic and Atmospheric Research Office to investigate the causes of variation in annual recruitment in fish stocks.

F. Assessment of effects of fishing on EFH and development of ways to minimize adverse impacts

II. Conservation Engineering Research

A. Continue to conduct research to measure direct effects of bottom trawling on seafloor habitat according to a five-year research plan.

B. Conduct fishing gear performance and fish behavioral studies to reduce bycatch and bycatch mortality of prohibited, undersized, or unmarketable species, and to understand performance of survey gear.

C. Work with industry and North Pacific Fishery Management Council (NPFMC) to develop bycatch reduction techniques.

III. Research on the Fisheries

A. Social and economic research

- Continue to build upon the economic data collection program, initiated by AFSC. This program collects cost, earning, and employment data for the Alaska groundfish fishery. AFSC will continue to work with the NPFMC, AFD&G, and the Alaska Fisheries information network to identify the elements of a broader program to collect economic and social data.

- Assess the economic impact of different fishing and conservation strategies that are proposed throughout the year by NOAA Fisheries and NPFMCs.

- Compile the economic status of Alaska's groundfish fisheries as part of the annual groundfish SAFE reports.

- Assess economic performance of the Alaska groundfish and halibut fisheries and research to improve these assessments.

B. Seafood safety research

- No research activities identified.

C. Marine aquaculture

- Study the growth, distribution, behavior, and early marine survival of salmon; conduct research on salmon biology and enhancement technology in Alaska.

IV. Information Management Research

- Continue to build data infrastructure and resources for easy access and data processing. The AFSCs key databases are its survey data bases from the 1950s (or earlier) and the scientific observer database that extends back to the foreign fishing days of the 1960s.

- Continue to provide information products based on experts and technical data that support NOAA Fisheries, the regional office, NPFMC, international scientific commissions, and the overall research and management community.

5.1.1.2 North Pacific Fishery Management Council

NPFMC relies on its Scientific and Statistical Committee (SSC) to assist NPFMC in interpreting biological, sociological, and economic information. The SSC also plays an important role in providing NPFMC with recommendations regarding research direction and priorities based on identified data gaps and research needs. At its March 2003 meeting, the SSC reviewed the list of research priorities as developed by NPFMC's BSAI and GOA groundfish plan teams in November 2002. The SSC used this list to develop the following short list of research topics needing immediate attention in 2003:

I. Critical Assessment Problems

A. For rockfish stocks there is a general need for better assessment data, particularly investigation of stock structure and biological variables.

- Supplement triennial trawl survey biomass estimates with estimates of biomass or indices of biomass obtained from alternative survey designs.

- Obtain age and length samples from the commercial fishery, especially for Pacific ocean perch, northern rockfish, and dusky rockfish.

- Increase capacity for production ageing of rockfish so that age information from surveys and the fishery can be included in stock assessments in a timely manner.

- Further research is needed on model performance in terms of bias and variability. In particular, computer simulations, sensitivity studies, and retrospective analyses are needed. As models become more complex in terms of parameters, error structure, and data sources, there is a greater need to understand how well they perform.

B. There is a need for life history information for groundfish stocks, e.g., growth and maturity data, especially for rockfish.

- There is a need for information about stock structure and movement of all FMP groundfish species, especially temporal and spatial distributions of spawning aggregations.

II. Stock Survey Concerns

- There is a need to explore ways for inaugurating or improving surveys to assess rockfish, including nearshore pelagics.

- There is a need to develop methods to measure fish density in habitats typically inaccessible to NOAA Fisheries survey gear, i.e., untrawlable habitats.

III. Expanded Ecosystem Studies

- Research effort is required to develop methods for incorporating the influence of environmental and climate variability, and their influence on processes such as recruitment and growth into population models, especially for crab stocks.

- Forage fish are an important part of the ecosystem, yet little is known about these stocks. Effort is needed on stock status and distribution for forage fishes such as capelin, eulachon, and sand lance.

- Studies are needed to identify essential habitat for groundfish and forage fish. Mapping of nearshore and shelf habitat should be continued for FMP species.

IV. Social and Economic Research

- Development of time series and cross-sectional databases on fixed and variable costs of fishing and fish processing.
- Pre- and post-implementation economic analyses of crab and GOA groundfish rationalization.
- Identification of data needed to support analyses of community level consequences of management actions.
- Development of integrated multi-species/multi-fishery models for use in analyses of large scale management actions, such as PSEIS and EFH.

V. Bycatch

- Identify sources of variability in actual and estimated bycatch rates.

VI. Monitoring

- Promote advance in video monitoring of otherwise unobserved catch for improved estimation of species composition of total catch and discrimination of retained and discarded catch

VII. Research Priorities Identified by the NRC Steller Sea Lion Committee

The SSC held a brief discussion on the research and monitoring recommendations of the NRC Steller Sea Lion Committee, as presented in the Executive Summary of their report. The SSC noted that their recommendations are consistent with recognized needs, but also that there is considerable ongoing Steller sea lion research. Among the NRCs recommendations, the SSC wishes to particularly identify their recommendation for a spatially-explicit, adaptive management experiment to definitively conclude whether fishing is playing a role in the current lack of Steller sea lion recovery. As noted in the SSCs February 2003 minutes, there are a number of scientific, economic, and Endangered Species Act (ESA) regulatory considerations that must be addressed before such a plan can be seriously considered for implementation. However, the SSC supports further exploration of the merits of this adaptive management approach.

5.1.1.3 North Pacific Research Board

The NPRB was created by Congress in 1997 to recommend research relating to fisheries or marine ecosystems in the North Pacific Ocean, Bering Sea, and Arctic Ocean, with emphasis on cooperative research designed to address pressing fishery management or marine ecosystem information needs. NPRB's long-term goal is to develop a high caliber, comprehensive research program for the regions and fisheries under its purview. The program's foundation rests on science planning, prioritization of pressing fishery management and ecosystem information needs, coordination and cooperation among research programs, competitive selection of research projects, increased information availability, and public involvement. NPRB strives to avoid duplicating other research.

NPRB uses an open, competitive process for gathering research proposals. Criteria for project submission and evaluation are specified in an annual request for proposals that is normally released each fall. NPRB's enabling legislation is quite broad in defining who can receive research grants. Research grants may be made available to federal, state, private or foreign organizations or individuals. NPRB receives advice from various panels and committees, and recommends grants based on the merits of the request and the extent to which the proposed research meets the priorities established by NPRB. Research recommendations of NPRB are reviewed by the Secretary of Commerce, through his designee, the Alaska Regional Administrator for NOAA Fisheries. The Secretary is not free to use the recommended funding amount in some other way; it can only be used to fund some other grant recommended by NPRB.

NPRB's research funds are based on the interest earned by the Environmental Improvement and Restoration Fund, also created by Congress and derived from the Dinkum Sands case. Each year, 20 percent of the interest is made available to the Secretary without further appropriation to carry out marine research activities. NPRB approved about $2.2 million in marine research beginning in 2002, and $7 million in new research in 2003. Of the 156 proposals submitted for research in 2003, thirty proposals were approved by NPRB on March 20, 2003. NPRB's recommendations for 2003, however, still need to be given final approval by the Secretary of Commerce acting through his designee, the Alaska Regional Administrator for NOAA Fisheries. The following 29 proposals were recommended by NPRB for funding in 2003:

- Evaluation of emergent structure in low-relief benthic habitats as criterion for defining the EFH of juvenile North Pacific flatfish.
- A continuous plankton recorder survey of the North Pacific and southern Bering Sea.
- North Pacific Anadromous Fish Commission (NPAFC) Cooperative Research: salmon community structure and response to environmental change in the Bering Sea.
- Deep sea coral distribution and habitat in the Aleutian Archipelago.
- Monitoring and modeling predator-prey relationships.
- Species identity and life history of *Hematodinium*, the causative agent of vitter crab syndrome in Northeast Pacific snow (*opilio*) and Tanner (*bairdi*) crabs.
- Forage fishes in the western GOA: variation in productivity.
- Sperm whale and longline fisheries interactions in the eastern GOA.
- Estuaries as EFH for salmonids: assessing residence time and habitat use of coho and sockeye salmon in Alaska estuaries.
- NPAFC Cooperative research: genetic stock identification of chum salmon in the Bering Sea and adjacent waters.
- Establishing a statewide data warehouse of salmon size, age and growth records.

- Ice seal bio-monitoring in the Bering-Chukchi Sea regions.
- Effects of prey availability and predation risk on the foraging ecology and demography of harbor seals in PWS: development and test of a dynamic state variable model.
- Thermal habitat preferences of Pacific halibut and the potential influence of hydrographic variability on local coastal fishery.
- Continuation of long-term observations on the Bering Sea shelf: biophysical moorings at Sites 2 and 4.
- EFH for blue king crab, Phase I: development of cultivation techniques for blue king crab larvae.
- Pre-season forecast of Bristol Bay sockeye salmon migration timing based on oceanographic and biological variables.
- Pilot project for development of comprehensive baseline commercial fishing community engagement and dependency profiles for the BSAI and western GOA regions.
- Retrospective study of pigmented macrophage aggregates as markers of Pacific herring population health.
- Effects of inter-annual climate change on food availability, diet composition and productivity of planktivorous and piscivorous seabirds.
- Evaluation of alternative hypotheses to explain the collapse of the Kvichak sockeye salmon: a project to catalyze a comprehensive, hypotheses-driven research program.
- Spatial and temporal interactions between endangered short-tailed albatrosses and North Pacific commercial fisheries.
- Assessment of trawl third wires as a threat to seabirds, including the endangered short-tailed albatross.
- NPAFC cooperative research: use of genetic stock identification to determine the distribution, migration, early marine survival, and relative stock abundance of sockeye, chinook, and chum salmon in the Bering Sea.
- Bering Sea wintering grounds of beluga whales.
- Regime forcing and ecosystem response in the Bering Sea: Phase II.
- Video monitoring aboard Bering Sea factory trawlers—a pilot study.

- Enhancing rural high school involvement in North Pacific resource issues through participation in Alaska Regional National Ocean Sciences Bowl.

- Early marine ecology of juvenile chum salmon in Kuskokwim Bay, Alaska.

5.1.2 Specific Information Gaps and Research Needs by Resource Category

This section provides a brief summary of specific information gaps and research needs identified by PSEIS resource category. Most of these data gaps and research needs are fairly consistent across all of the alternatives; however, those data gaps and research needs pertaining to a specific alternative are highlighted and discussed. While the information gaps are many and the research needs important, it is beyond the scope of this section to examine the tradeoffs between the cost of collecting this new information versus the potential value of the new knowledge. As such, no attempts were made at prioritizing these research needs. However, expanded research to collect new information and fill existing data gaps is dependent on the agency's receiving additional research funding. While additional funds are not certain, NOAA Fisheries intends to pursue the funding necessary to meet future research needs and improve the scientific information available for managing the fisheries.

5.1.2.1 Physical Environment

At present, there is a considerable lack of environmental information from which to relate climate to the ecosystem in the North Pacific. NOAA is the primary steward for the living marine and protected resources and is responsible for the provision of long-term ecosystem observations. As such, a system should be developed for sustained measurement of climate and ecosystem variability; discern from those measurements significant changes; comprehend the underlying mechanisms for those changes; and develop and test prognostic ecosystem models. Research associated with the development of this system should focus on the following:

- Establish an observation system for the U.S. North Pacific marine environment for sustained monitoring of climate and ecosystem variability.

- Establish an infrastructure for the dissemination, interpretation and analysis of climate and ecosystem data.

- Conduct process studies to understand the underlying mechanisms relating climate change and ecosystem response.

- Integrate emerging scientific knowledge into prognostic models for resource management decisions.

- Provide annual reports on observed and predicted ecosystem changes.

- Improve understanding of interactions between the environment and society.

5.1.2.2 Target Groundfish Species

The significance of the impacts on target groundfish species were evaluated with respect to five effects: 1) fishing mortality; 2) change in biomass level; 3) spatial/temporal concentration of the catch; 4) prey availability; and 5) habitat suitability. When evaluating the significance of these effects, it was considered whether the impacts of effects could reasonably be expected to jeopardize the sustainability of each target species or species group. Related to this evaluation was the assignment of each species to one of six "Tiers" based on the availability of information about that stock (Appendix F-1). Tier 1 has the most information and Tier 6 has the least.

Species or species complexes that fall within Tiers 1 through 5 have estimates of the current fishing mortality rates and were evaluated with respect to exceeding the overfishing mortality rate (fishing mortality effect). Species or species complexes that fall within Tiers 1, 2, or 3 have reliable estimates of maximum stock size threshold (MSST) and were evaluated for the effects of spatial/temporal concentration of the catch, prey availability, and habitat suitability. The significance of these effects could not be evaluated for species or species complexes that fall within Tiers 4, 5, or 6, as these species do not have reliable estimates of MSST. This inability to evaluate the significance of the effects also occurs for the forage, prohibited and non-specified species. Additional research is needed so that the information base for Tiers 4-6 species will expand to the point where they can be move into Tiers 1-3. What follows are data gaps and research needs highlighted by many of the PSEIS target groundfish species authors.

Research is needed to reduce the uncertainty of survey biomass estimates for many of the target groundfish species. While there are adequate collections of biological data (e.g., lengths, weights, otoliths) for many of the target groundfish species from fishery independent bottom trawl surveys, these surveys may do a poor job of estimating abundance trends and biomass for some of the species. A major problem is that the survey's stratified random design for selecting haul locations may not be adequate for a species with a very patchy distribution. Biomass estimates in some years are greatly influenced by extremely large catches in just one or two hauls, and variance of these biomass estimates is consequently very high. This results in much uncertainty regarding abundance trends. Also, the surveys may not adequately sample rocky habitats where some target species may live, and so survey catchability *(q)* is uncertain.

A survey designed specifically for species with known patchy distributions (e.g., Pacific ocean perch, northern rockfish) would be an improvement. The objective of the present survey is to provide information on distribution and abundance of all groundfish species within the geographic area it covers. Because of the patchy distribution of some species, we need to sample many more locations than are possible given the constraints of the present survey methodology. It appears that a new survey that combines trawling with hydroacoustics may be the best future approach, but additional research is needed to determine how and if hydroacoustics can be used. Instead of the present survey net, a more up-to-date survey net equipped with tire gear on the footrope would also be useful for trawling over rougher bottoms.

Bayesian type analyses may be useful to quantify the effect of estimate uncertainty and improve stock assessments for target groundfish species. Particular attention should be given to estimates of q, and natural mortality (M) which have been shown to have a large influence on stock assessment model output. Also, updated studies on fecundity, size at maturity, age methodologies and validation, selectivity schedules at age, and weight at age information would be helpful in moving those groundfish species in Tiers 4-6 into Tiers 1-3.

Genetic research is needed to assess the risk of localized depletion on the genetic integrity of a given stock. Identification of stock structure is an essential part of examining whether a particular management scheme is providing the level of conservation as intended. Alternative 1 apportions ABC for many of the target groundfish species geographically among management areas in order to spread the effort and reduce the likelihood of localized depletion. However, information on stock structure for many of these species is inadequate, and for some species (e.g. many of the rockfish species), tag-and-release studies are not possible to elucidate stock structure. A number of genetic studies on Pacific ocean perch have been done, but the results have been equivocal. The most recent mitochondrial DNA studies suggest that some stock structure may exist, and additional studies are planned (Gharrett, personal communication 2000).

The development and application of molecular markers to studies of marine fish species have provided insight into the genetic connectivity of marine populations managed as stocks. Recent studies have focused on species supporting commercial fisheries, such as walleye pollock, using microsatellite, allozyme, mitochondrial DNA, and pantophysin markers. However, there is a considerable need to expand this approach to other directly exploited species (e.g., skates, flatfishes), species impacted as bycatch (e.g., sculpins), and ecologically important forage fishes (e.g., eulachon, capelin) in order to identify and assess the autonomy or connections among component stocks and their potential response to environmental or fishery-mediated changes.

Research is needed to assess the utility of rationalizing the fishery in order to reduce the risk of overfishing by eliminating the race for fish. Under Alternative 1, the groundfish trawl fishery is compressed in time and may increase the risk of overfishing. Consequently, the spatial concentration of catch could result in a negative impact on the reproductive success of the stock and subsequently on stock sustainability. However, more research is needed before the impacts can be fully known.

Research is needed to assess the utility of existing and proposed refugia to improve the reproductive success of various groundfish stocks. Under Alternative 1, a portion of the eastern Gulf is closed to trawling and may serve as *de facto* refugium allowing for increased survival of larger and older fish that produce significantly more eggs and larvae to replenish Gulfwide populations. Consequently, the spatial concentration of catch could result in a positive impact on the reproductive success of the stock and subsequently on stock sustainability, but more research is needed before the impacts can be fully known.

Research is needed to assess ecosystem considerations for single species management for many of the target groundfish species. There is currently insufficient information to conclude that existing trophic interactions would undergo significant qualitative change under Alternative 1. Consequently, the impacts of Alternative 1 on prey availability and the subsequent impact on stock sustainability can not be fully known without more research.

More research is needed to identify the habitat requirements of adult and juvenile target groundfish species and to assess impacts from fishing on habitat suitability. The habitat preferences of many of the groundfish species are poorly known. The trawl survey gear is able to sample flat, smooth substrates fairly well, but cannot sample rough, steep substrates. So for those species occupying the rougher substrates, the current trawl surveys may be doing an inadequate job of assessing them and their respective habitats. Juvenile habitat requirements are not known for many of the target groundfish species. For example, very few Pacific ocean perch less than 20 to 25 centimeters fork length are caught in the survey, and it is presumed these young fish live in habitats that cannot be sampled by the survey's nets.

Bottom trawling or other fishing gear in contact with the ocean could negatively impact the habitat of adult and juvenile groundfish species and may reduce survival of juvenile fish. Consequently, the change in habitat suitability could result in a negative impact on rearing success of the various groundfish stocks and subsequently on stock sustainability, but more research is needed before the impacts can be fully known.

5.1.2.3 Prohibited Species

Pacific herring populations in PWS are still recovering from the EVOS. It is unknown how, when, and if these populations will eventually recover and to what extent. Habitat contamination in PWS is also lingering but it has not been determined what the long-term effects of the EVOS will have on herring and its habitat. Additional research could be helpful in identifying physiological changes that may be occurring in those populations (some populations are showing signs of recovery while others are not). It is also unknown how the EVOS and its related lingering contamination have affected prey availability for herring, if at all.

It is known that Pacific herring form dense schools which make them more vulnerable to spatial/temporal effects of fishing. Currently the movement of herring schools throughout Alaskan waters has not been studied to the extent that one could predict their location and timing. Thus, additional research to elucidate the spatial/temporal characteristics of herring populations could prove extremely valuable in the management of this species.

There are data gaps for spawning habitat for all salmon. Since these fish spawn in fresh water, impacts from state subsistence fishing, sport fishing, and land management practices have not been studied to the extent that impacts are known. Degradation of watersheds (mainly from land management practices) used as salmon spawning grounds could impact reproductive success and stock sustainability, but no specific trends over time have been reported to date.

It has been thought that climatic changes are also playing a role in the current poor stock status of salmon runs in western Alaska, but specific effects are unknown. The potential for climate change, degradation of spawning habitat, change in prey availability, and increased mortality (fishing and natural events) to effect all species of salmon is recognized as a fruitful area for future research.

Determining relationships between prey catch and salmon prey availability is also a data gap and an area of potential research. Composition of prey for salmon are unknown. Identifying essential prey items in the diets of salmon could provide information to minimize prey competition between salmon and fisheries.

Focusing research efforts on depressed stocks of salmon in Alaska and chinook salmon originating in the Pacific Northwest that are currently listed species under ESA, may provide additional data that could help manage and protect this species until recovery begins to occur. Research collaboration between ADF&G and NOAA Fisheries could encompass the different phases of salmon's life cycles, thus, maintaining and improving the complex management of all species of salmon throughout Alaskan waters.

5.1.2.4 Other Species

NOAA Fisheries has increasingly been charged to conduct assessments on progressively more species. This is particularly true in the case of stock assessments for non-target species in Alaskan waters. A strong need exists for research in the following areas of concern regarding management of species that are caught as bycatch in other fisheries:

- When species are not identified as a single fisheries management unit, quotas may not adequately protect the reproductive potential of the less abundant members of a complex.

- When stocks are managed in complexes that include species with different life history characteristics, quotas may not adequately protect the reproductive potential of the slower growing, long-lived, less fecund members of a complex.

- Rare species may be vulnerable to overfishing because of their low stock size and patchy distributions.

- Traditional fishery independent assessment surveys are not designed to assess rare species and biomass estimates for these species may be uncertain.

The AFSC has collected specimens of skate species from previous surveys conducted in the BSAI and GOA that are difficult to classify. Some samples exhibit characteristics that may be indicative of a new species. Research funds are needed to allow staff to travel to various museums to compare EBS/GOA skate specimens with museum specimens for verification of species identification. This work will not only improve assessment of skates but will also improve the assessment of new fisheries in the GOA targeting on skates. Research is also needed on the biology and identification of North Pacific cephalopods. The life history and identification of these species are not well understood. Such research will improve the identification of cephalopods taken in commercial fisheries and during resource assessment surveys.

Detailed information on the age composition and fisheries catch are seldom available for bycatch species. This situation leads to increased reliance on survey biomass estimates. A catchability coefficient is needed to scale survey abundance estimates to total abundance. Research is needed to evaluate the catchability of non-target species to the EBS survey trawl used in the annual EBS bottom trawl survey.

5.1.2.5 Forage Species

The abundance of ecologically important forage species is unknown in much of Alaska. This information is critical for understanding the Alaska marine ecosystem and managing the commercially important species within this ecosystem. Research is needed to measure abundance of ecologically important forage species including: eulachon, herring, capelin, and in southeast Alaska: pollock. Assessment of forage species is difficult because of their diffuse, patchy distribution and unknown stock structure. Pre-spawning and overwintering aggregations, however, appear to be more discrete and concentrated, potentially enabling more efficient surveys (e.g., with acoustic and mid-water sampling) and stock-specific assessment data. As such, research should be conducted to determine where these winter aggregations of forage species occur in time and space.

Research should be conducted to measure how reliability of forage location and nutritional value affect susceptibility to predation. Different forage species appear to have different strategies to reduce predation. For example, overwintering herring concentrations occupy predictable depths, but are diffusely distributed. The numerical response of predator species affiliated with these prey can be collected simultaneously with measurement of forage species abundance.

The lack of population level assessments for some of the species in the forage species group means that species level effects on those are unknown. Better understanding of the factors influencing forage species dynamics and spatial/temporal distribution will help us better separate the role of climate and fishing in influencing the dynamics of these species.

5.1.2.6 Non-Specified Species

Non-specified species is a huge and diverse category encompassing everything not listed in the FMP as a target, prohibited, forage, or other species. Unfortunately, basic information is lacking for nearly all of the species in this group. They are caught in small or unknown amounts (due to a lack of reporting requirements in this category) and formal stock assessments are not conducted. Research is needed to gain a better information base (e.g., estimates of total biomass, spawning biomass, age and size structure, sex ratios, temporal and spatial distribution, fishing mortality rates, etc.).

Grenadier species represent the major catch from the non-specified FMP category. They are ecologically important and appear to be one of the most abundant species in the northeastern Pacific, but their true abundance and life history are poorly known. This information is critical for understanding the Alaska marine ecosystem and managing the commercially important species within this ecosystem. Only limited assessment work has been done for the grenadier species. Research should be conducted to examine avenues for preparing quantitative assessments for these species based on data from longline surveys.

5.1.2.7 Essential Fish Habitat

The largest fisheries in the continental U.S. occur in waters off Alaska. The region has five FMPs and encompasses the largest shelf and geologically most complex area of the U.S. coastal zone. There is a wide diversity of habitat types in this region ranging from the extensive soft-bottom areas of the Bering Sea shelf to the complex high-relief habitats of the Aleutian Islands and portions of the GOA. Alaskan fisheries that target groundfish, crab, and scallops all use gear that may adversely impact benthic habitat. This gear includes bottom trawls, longlines, pots, and dredges.

Since 1996, the AFSC has been conducting research on the effects of fishing gear on benthic habitat. This research has led to important findings that increase our understanding of fishing gear effects on benthic habitat. Research has focused on 1) understanding the direct effects of bottom trawling on seafloor habitat; 2) the associations of fish and invertebrate species with habitat features that may be affected by fishing gear; 3) the evaluation of technology to determine gear effects and benthic habitat features; and 4) retrospective analyses of spatial/temporal patterns of bottom trawling. Most of the field-oriented studies (i.e., 1-3 above) have focused on small geographic areas in specific habitat types.

Research efforts over larger geographic areas and a variety of habitat types will provide fisheries managers the information needed to develop measures for minimizing the adverse impacts of fishing gear, as required in the MSA.

During a three-day workshop held in January 2000 in Juneau, Alaska, research projects were identified and a time-table for completion was drafted. This plan has been subsequently revised as research is completed or priorities change. The suite of projects identified takes a comprehensive and scientific approach to the issue of fishing gear effects on habitat. During the initial phase of this research, the focus is on identifying the effects of the various gear types on fish habitat for a range of habitat types, mapping habitat, examining the associations between habitat features and fish utilization, and defining the geological processes that will allow comparison of natural versus gear effects processes. After this initial phase, studies will transition to those that establish the connections between habitat and fish production and population dynamics. This research plan will be implemented through collaborative projects with the ADF&G, the University of Alaska, and others.

Two themes emerged in this research plan: (A) The need to better determine the effects of fisheries on benthic habitat; and (B) The need to study the spatial extent of fishing ten individual projects hve been identified that fall into three major categories: 1) effects of specific gear on specific habitat; 2) linkage of fishing induced disturbance to population dynamics of commercial and non-commercial species; and 3) mitigation related studies. Some of these projects represent continuance and expansion of existing projects and others are new projects.

I. Determine Effects of Fishing on Benthic Habitat

Three experimental approaches are applicable to this general research objective and suitable research sites are generally available in the BSAI and GOA.

(A) *Compare conditions in heavily fished and lightly fished/unfished areas that are in close proximity and otherwise similar.* This approach allows an assessment of long-term (chronic) effects of fishing activity on physical features of the seabed as well as effects on the structure and function of associated benthic invertebrate communities. High quality fishing effort data are required to identify appropriate experimental sites, which may or may not straddle closed area boundaries. Replicated biological sampling with grabs, trawls, and underwater video or submersible observations are needed to characterize relevant population and community-level attributes in the disturbed and undisturbed sites, such as biomass, numbers of individuals, body size, species richness, species diversity, and the physiological states of biostructure, prey, and resident FMP species. Acoustical surveys with multi-beam, side scan, or single beam devices, coupled with grab and video groundtruthing, would be the basis for comparison of physical features such as sediment texture and bedforms.

(B) *Compare conditions before and after fishing to identify effects on the benthos. Unfished controls are necessary to evaluate the effects of fishing where existing closures do not provide a necessary contrast in fishing intensity*. Recovery can be examined in unfished controls with continued sampling. Replication with multiple (paired) sites is required to avoid spurious outcomes. Otherwise, longer-lived individuals or species will be under-represented in the samples thereby biasing results. In addition to sampling methods and gears described in (1) above, effective contrasts of conditions before and after fishing requires highly accurate positioning of fishing and sampling gear within the disturbed (experimentally fished) and undisturbed (control) sites, especially when destructive sampling methods are used.

(C) *Determine rates of disturbance with repetitive fishing of specific grounds. Incremental and cumulative catch rates can be used to measure the rates of depletion of benthic fauna, changes in community structure, and alteration of seabed properties as a function of fishing intensity.* Similar to (2) above, these sites should have limited or preferably no prior fishing disturbance history in order to obtain a full measure of effects. Once again, careful positioning of fishing and sampling gear is required for meaningful results.

II. Specific studies:

A. Effects of specific gear on specific habitat

1. <u>Effects of bottom trawling on soft bottom habitat of the GOA</u>
   Extensive trawling occurs over soft-bottom habitats in the GOA. Immediate and long-term changes in soft substrates and associated animal communities will be evaluated through comparisons of adjacent open and closed fishing areas and through intensive trawling experiments. In areas with soft substrates, sea whip colonies are vulnerable to gear damage. Sea whips can be removed, dislodged, or broken by fishing gear. Previous studies conducted by the AFSC on soft-bottom habitat have shown that areas with sea whips appear to have greater productivity (greater biomass and numbers of megafauna) than adjacent areas devoid of sea whips. Since sea whips are believed to be long-lived, recolonization rates may be very slow. Sea whip biological characteristics and their resistance to levels of trawling will be studied. The study will also provide an opportunity to assess recolonization in future years. The study will

provide information for evaluating measures to minimize fishing effects such as area closures or gear modifications.

2. Effects of bottom trawling on soft-bottom habitat of the Bering Sea shelf
   The relatively recent and well-documented development of large-scale commercial fisheries in the EBS presents a rather unique opportunity for studying the potential impacts of trawling on benthic habitats. Areas closed to trawling are adjacent to heavily fished areas allowing for comparison of the effects of fishing activities on seabed habitat utilized by nationally important stocks of groundfish and crab. Physical and chemical characterizations of the seabed, in addition to biological assessments, are needed to evaluate fishing effects on these habitats. Current studies in the Bering Sea have identified possible adverse effects of bottom trawls on soft-bottom benthos, including chronic effects on community diversity and on individual megafauna populations. However, interpretation of these findings and effective use for management purposes requires some understanding of the underlying processes. To address this need, a multi-year study is required to investigate acute effects and recovery from bottom trawling. Project findings will address management issues related to the need for and efficacy of bottom trawl prohibitions, as well as operational considerations related to management of closed areas.

3. Effects of scallop dredging on benthic communities
   A research program is urgently needed to examine the effects of scallop dredging on the scallop's life history, population dynamics, and associated benthic community and habitat. A scallop dredge is a heavy fishing gear with maximum contact with the seafloor. Worldwide, scallop dredges have been implicated in negative, neutral, and positive effects on benthic animals and habitats depending on local environments. Typically, dredges catch only 5 to 35 percent of scallops in their path, so dredge paths are towed repeatedly during intense fishing seasons before vessels move to new fishing areas. In Alaska, the main target species, the weathervane scallop, overlaps in geographic distribution and habitat with a number of other important commercial species, including Tanner crabs whose stocks are depressed and/or overfished throughout Alaska. In Alaska, large areas of the coast are permanently closed to scallop dredging without evaluation of potential effects. We propose a multi-agency program with industry cooperation to study the biological and physical effects of scallop dredging in Alaska. A carefully planned research program was developed by internationally acclaimed scientists during a workshop sponsored by the ADF&G and University of Alaska in Kodiak, during June 10-12, 1999. A set of integrated field and laboratory projects will focus on process-oriented research directed at individual, population and community levels.

4. Effects of longline and pot gear on sensitive habitats
   Considerable attention and some research has been directed at the effects of bottom trawling on benthic habitat. However, large scale fisheries that target crab, sablefish, rockfish, and Pacific cod use longline or pot gear. These gears can have an impact on certain sensitive habitat as evidenced by limited underwater observations. The actual capture of gorgonian and stony corals, as examples, has been verified by commercial fisheries observers and NOAA Fisheries surveys. Damage can be caused to corals, sponges, and some other sessile organisms by hooking, by crushing and plowing by pots and anchors, and from shearing by groundlines upon retrieval. On the other hand, a large proportion of this gear is set on soft substrate where effects are

considered negligible. Estimating cumulative effects for a variety of substrates and the behavior of gear in contact with the bottom are two topics that require study. These studies will involve underwater observation of longline and pot deployment and retrieval with remote and manned submersibles.

5. Effects of fishing on hard-bottom habitat of the Aleutian Islands

   The narrow shelf areas of the Aleutian Islands, characterized by swift currents and very irregular terrain, support a very diverse and lush community of benthic organisms, including commercially important fish and shellfish. The taxonomy, life history and ecology of many of the invertebrate species are poorly known. Initial studies in the Aleutian Islands focused on the Seguam Pass area, where a trawl fishery for Atka mackerel has operated over the past two decades. This research identified six distinct bottom habitats and documented potential impacts from the historical trawl fishery. This study also considered potential recolonization of coral following trawl closures established to protect sea lion foraging areas. Additional work is needed to investigate impacts from other fisheries (e.g. cod, halibut, crab and rockfish) and gears types that occur in other key areas of the Aleutians. Because of limited habitat data, extreme tides and currents, and overall high biodiversity throughout the Aleutian Archipelago, research in the area is challenging. More exploratory studies will be the basis for development of specific research hypotheses that will emerge as more knowledge and experience is gained in the region.

6. Impacts of fishing on crab resources and habitat

   Crab populations that support major commercial fisheries are perceived to be highly vulnerable to bottom trawling, given crab life cycles and behavioral patterns. Over the past 30 years, crab stocks have undergone significant fluctuations in abundance and currently are at very low levels. Juvenile crab, particularly juvenile king crab, are dependent on a variety of epibenthic organisms which are themselves vulnerable to bottom trawls. Also, large pods of juvenile king crab and female Tanner crab form during the mating season in very localized areas, and substantial numbers could be removed or injured if bottom trawling were to occur at these locations. Fishery management regulations for crab and groundfish have been directed at protecting the productivity of the crab resources in order to expedite their recovery. Large areas have been closed to bottom trawling and restrictive bycatch limits for crab have been imposed. However, because of interactions with other fisheries, effective use of these measures requires a clear understanding of factors affecting spatial/temporal patterns of crab distribution. In particular, podding behavior must be thoroughly investigated so that protective time and area closures can be accurately devised not only to reduce unintended mortality but also to minimize consequences for trawl fisheries. Similarly, research is needed to observe and document species associations that are critical to juvenile growth and survival. Furthermore, impacts of lost crab pots on EBS habitats must be investigated. In some years, tens of thousands of crab pots are lost due to rapidly moving ice flows. Derelict crab pots may alter habitat by adding hard structure to an otherwise flat and featureless soft bottom. Traditional dump sites for trawl-caught derelict pots would serve as natural laboratories for documenting effects on the benthos, and controlled laboratory and/or in-situ field studies would subsequently evaluate long-term impacts on productivity.

7. Effects of bottom trawling on shelf break and upper continental slope habitats
   Some of the highest density of bottom trawl effort occurs in the narrow zone that constitutes the upper continental slope and shelf break. This zone is a geologically unique area used by species of high commercial value such as sablefish, shortraker and rougheye rockfish, and Pacific ocean perch. Studies are needed to understand how bottom trawls affect the habitats that constitute this zone. These studies will focus on determining effects of bottom trawling in this zone and identification of habitat types that are sensitive to fishing-induced disturbance.

B. Linkage of fishing induced disturbance to population dynamics

1. Laboratory and field studies
   In instances where fishing gear has measurable effects on the seafloor, follow-up research is required to quantify the biological responses. Overall productivity could change as a result of gear-induced disturbances. Individual rates of growth, survival, settlement and reproduction could also be affected. Except in instances where change is inherently unacceptable, it is paramount to know whether these changes are positive or negative in nature. The ecological relationships in affected areas will be extremely complex. Variation in the responses of different taxa, life history stages and even individuals can be expected. Thus, only the dominant linkages will be understood or practical to investigate, at least initially. Controlled experiments over the range of observed impacts will be required. Specific hypotheses will be designed in laboratory and field settings as dictated by the needs for specific environmental conditions or variability, treatment groups, controls, and statistical replication. Experimental work will be conducted in seawater laboratories or *in-situ* at selected sites in the BSAI or GOA. These sites may require protection from further human disturbances throughout the experimental period.

2. Modeling
   An understanding of the natural processes of seabed disturbance (storms, erosion, deposition, bioturbation, landslides etc.) is required for comparison with the disturbance effects of fishing gear. Once disturbed naturally or with fishing gear, does the habitat return to the original undisturbed state or to some new equilibrium condition? Models of natural seabed sediment dynamics and seafloor geologic and biologic disturbance will be developed and applied to different physical and biological settings to allow comparison with fishing gear disturbance.

   Because potential management decisions are typically evaluated with respect to their effect on the population attributes (stock size, recruitment, etc.) of specific stocks, it is necessary to consider the linkage between fishing-induced disturbances and population dynamics. This process would minimally require information on the critical life history stages where substantial mortality takes place, the habitats associated with those critical life history stages, and how changes in habitat quality affect mortality rates and other vital population parameters. The field projects identified in the other parts of this initiative should provide the basic information to guide modeling efforts.

C. Mitigation related studies

1. Evaluation of mitigation measures and impacts with research closures

The MSA mandates the protection of EFH of the Nation's fishery resources. As the regulatory agency for federally managed fisheries, the NOAA Fisheries is particularly responsible for adverse effects to EFH due to fishing activities. As a result of that responsibility NOAA Fisheries is in the process of determining alternative measures to minimize to the extent practicable the adverse effects to EFH. Due to a considerable lack of available information, there is a great deal of uncertainty about the type and extent of measures that would actually be necessary or effective. The EFH Final Rule instructs that establishment of research closures be considered to evaluate the impacts of fishing activities. This research plan is an attempt to design and utilize research closures as a method to obtain information needed to protect habitat in a practicable manner. We will first provide a design to be implemented under baseline conditions, then attempt to modify the design as needed for the various minimization alternatives being considered.

The long-term goal of this research is to understand effects of fishing on habitat and validate whether adopted minimization measures are necessary and effective. Objectives are to determine whether fishing does or does not reduce or alter benthic habitat and whether such alterations effect the shelter, food, species composition, and ultimately the productivity, or MSY of important FMP species. Specific objectives of the research closures would be to compare, under contrasting (fished versus not fished) levels of fishing, information such as habitat condition, the abundance, composition, and size of habitat forming organisms, and possibly local abundance of fish and prey. These research closures are not expected to be able to demonstrate differences in stock productivity due to fishing impacts on habitat, but are a first step in seeing whether habitat features that provide shelter, prey, and other functions are altered.

2. Reducing fishing gear effects through gear modification

The modification of fishing gear has potential to substantially reduce seafloor effects. Fishing gear research has greatly improved both the effectiveness and the selectivity of fish harvests and similar success is likely if efforts are turned toward reducing seafloor effects. Some promising concepts are already apparent (i.e., fishing trawl doors off-bottom and using lighter groundgear) while others would emerge from focused research and development. Since gear effects are habitat-and community-specific, appropriate gear modifications are likely to vary between fisheries and locations. Failing to develop such options would exclude an entire class of mitigation possibilities.

A survey of fishing gears and the ecosystems where they operate will be examined for situations where modifications could have greatest effect. Development of seafloor-friendly gear will start by identifying which parts of the fishing gear generate adverse effects and what characteristics of those components can be changed to make those effects less severe. From this information, appropriate modifications will be developed and tested. Methods will be developed to quantify component-specific effects to allow measurement of the resulting improvements. Expected is that most improvements will involve some reduction in catch rates. Measuring such losses will

also be a component of testing. To maximize the relevance and acceptance of the resulting gears, this project will be conducted in cooperation with the fishers and fishing gear designers.

II. Spatial Extent of Fishing-Induced Disturbance

A. Habitat evaluation in current FMP fisheries

Of urgent need is the examination of benthic habitat in the vicinity of major FMP bottom trawl fisheries. Currently, NOAA Fisheries is the defendant in a lawsuit that claims NOAA Fisheries violated EFH provisions in the MSA. The lawsuit expresses concern that "in the North Pacific, bottom trawling and other fishing activities harm EFH in various ways" and cite evidence that bottom trawls will damage benthic marine life, such as sponges and sea whips. The suit claims practicable measures to minimize adverse impacts were not adopted and proposes that NOAA Fisheries prepare assessments of measures that could be taken to protect EFH from fishing effects. As very little is actually known about the bottom habitat where major FMP bottom trawl fisheries currently occur, particularly in the GOA there is little information to assess the necessity and effectiveness of any measures that may be proposed. While a variety of measures, such as further area closures, can be proposed without any information, ideally measures should be chosen that have a high likelihood of being effective while retaining benefits of the fishery.

Observations of the Alaska seafloor have been made with manned submersible and Remote Observation Vehicles; however, these observations have covered only limited areas. Because the costs and logistic limitations of manned submersible observations necessary to survey the fishery area are prohibitive, the AFSC has been developing remote camera devices to lower costs and reduce the limitations. The initial phase of this study would sample current heavily-fished grounds to see where and to what extent different habitat types occur. Habitat types that are physically vulnerable to fishing may be of particular concern. Subsequent phases of the study would provide groundtruth information on habitat type to complement NOAA/U.S. Geological Survey (USGS) mapping efforts (see item 3, below). Later phases of the study would be to survey fishing grounds to evaluate any measures that may have been adopted to protect EFH.

B. Mapping of habitat features of major fishing grounds

Little of the continental shelf and slope of the Alaska EEZ has been adequately characterized. This project proposes to target limited areas of the Alaska EEZ for geomorphic/geologic mapping using state-of-the-art technology. These areas would correspond with areas most at risk to FMP fishing activities. NOAA Fisheries will determine the essential benthic ecological characteristics from ground truth surveys to allow useful habitat characterization and classification. Geological aspects will include assessing sediment dynamics to allow comparison of natural processes versus gear impact processes. High-resolution multi-beam systems that include coregistered calibrated backscatter are capable of mapping the continental shelf at spatial resolutions of less than 4 meters (m). The deeper water depths of the upper continental slope can now be mapped at spatial resolutions of ~8 m. Together, accurate, high-resolution bathymetry and backscatter provide quantitative insights into the geology and distribution of the surficial sediments and rock outcrops of benthic habitats. The bathymetry and calibrated backscatter can be combined with accurately

georeferenced groundtruth sediment, biota and rock samples to predict the sediment types and habitats in zones where no groundtruth exists.

C. Retrospective analysis of seafloor geologic and biologic character

An analysis of existing data sets can improve current management practices and guide future field studies. These analyses consist of identification of the spatial/temporal occurrence of target fisheries (defined by species composition), and identification of species assemblages using cluster analysis. The data available for this analysis include those collected from NOAA Fisheries observer program and the NOAA Fisheries surveys. The identification of target fisheries builds upon the previous analyses of bottom trawl effort in Alaska and would be extended to include other gear types. This study will also provide large regional perspective and retrospective of the character of the shelf and upper slope sediments and outcrops based on existing geological and biological data collected by the USGS and others. The identification of fish/invertebrate assemblages provides key information that, when combined with geological characteristics, reveals which habitats have particular biological significance. In cooperation with the USGS maps and data bases summarizing the present adequate and inadequate state of knowledge of the seafloor off Alaska will be produced and maintained. These products would form the basis for extrapolating site specific (postage stamp) studies and for targeting priority areas for high resolution habitat mapping and groundtruthing.

D. Quantify abundance of habitat types over large geographic areas

Essential for both fisheries managers and researchers are estimates of the amount of specific habitats by management area. Interagency consultations and evaluation of management alternatives require this information in order to evaluate habitat effects of permitted actions. However, given the immense shelf and upper slope areas of the GOA and the Aleutian archipelago a long-term, multi-year study is required. High-resolution multi-beam systems can cover relatively large areas of the continental shelf (>20 kilometers^2 per hour), collecting georeferenced bathymetry and backscatter. The initial effort for this task will be to design an approach to improve the ability to quantify habitat abundance over large areas. High-resolution habitat studies over large geographic regions are currently difficult with today's technological and likely funding limitations. The project will involve extensive acoustic and video transects that can map depth, substrate type, and benthic organisms. Currently available mapping databases will be used where practicable. The project will also tie into projects that intensively map small areas of high priority, such as intensively fished grounds and dense coral and sponge habitats. From this project will come area estimates by habitat type, improved description of fish and shellfish habitats, and a general overlay of habitats throughout the GOA and Aleutian Island areas.

E. Characterization of benthic habitat in habitat areas of particular concern

Recently adopted amendments to FMPs in Alaska address areas of the marine environment that provide habitat necessary for completion of part or all of a managed species' life history cycle. EFH that is especially sensitive to human-induced impacts (such as fishing) may be further classified as a habitat area of particular concern (HAPC). HAPCs that have been identified, or are currently being proposed, in Alaska include living substrates in shallow or deep waters, seamounts or pinnacles, and the continental shelf break. All three habitat types are characterized by a high degree of biological productivity, and living substrates also provide areas of high microhabitat diversity. Deep-water corals have been classified as an HAPC. NOAA Fisheries trawl surveys have identified several sites in Alaska that may harbor colonies of deep-water gorgonian coral. Gorgonians such as red-tree coral (*Primnoa* sp.) colonies provide complex benthic habitat, and may be ancient and extremely slow growing. That, coupled with their arborescent nature, makes them highly susceptible to damage by commercial fishing activities. The goal of this study is to use geomorphic and geologic mapping tools along with a research submersible or towed video imaging system to survey particular locations that are being considered for protection as HAPCs by NPFMC. Investigators will initially assess abundance and distribution of red-tree and other gorgonian coral, identify fish and invertebrate species associated with the colonies, document evidence of damage (if any) to the colonies from human and non-human influences, and ascertain substrate morphology and composition in areas of coral abundance. Research in outlying years will focus on characterizing and linking physical and biological aspects of the seabed on seamounts/pinnacles, and along the continental shelf break.

5.1.2.8 Seabirds

The Draft Programmatic SEIS (NMFS 2001a, pp 4.3-1 and 4.3-50) and the Ecosystem Considerations for 2003 report (NPFMC 2002) have 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 U.S. Fish and Wildlife Service (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 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 years (public comments on Draft Programmatic SEIS, CAR 2001). 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 in this PSEIS 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 has been 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 *et al.* 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 North Pacific Groundfish Observer Program, observers actually watch the groundline as it is retrieved and do tally birds that fall off before being retrieved on board. This accounts for some of the "unidentified seabird" data. 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.

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.

Many questions 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 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' "red list" ranking system for species, defined but for regions 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 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, 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 USGS/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). This report contains several maps that are good examples of how graphic information system technology can be used to facilitate understanding and analysis of seabird/fishery interactions. However, the basic abundance and distribution data for all seabird species needs to be updated for these efforts to be most useful.

5.1.2.9 Marine Mammals

To unequivocally assess the effects of groundfish fisheries on marine mammal populations, definitions of marine mammal population parameters are needed to measure the intensity and direction of the effects. Population parameters and metrics needed include: current population size (n), population trajectory, definition of carrying capacity (K) and/or optimal population size for each species/stock.

To assess the effects of groundfish fishery harvests on the marine mammal prey field the following information is needed: marine mammal energetic requirements; contribution of each prey species to energetic requirements (proportion in diet); adequacy of existing standing biomass of prey (current K for each marine mammal population); standing biomass of prey before and after fishery; and point at which vital rates/K are affected due to food limitation. Currently, this level of information is not available. Some of these issues are under investigation through various research programs; the answers to some of these questions may never be known.

Research is needed to examine methods for quantifying fishery linked (i.e., human) disturbance on marine mammal populations. Specific examples include: rate at which various gear types are lost or discarded which present risk of entanglement; effects of disturbance on baleen whales caused by vessel traffic, fishing operations, or sound production.

Identification of Species Specific Research Needs :

Spotted Seals: Importance of EBS & Aleutian Islands pollock in the diet of spotted seals (diet information in Bristol Bay, Pribilof Islands, and eastern Aleutian Islands).

Elephant Seals: Research is needed into the diet of elephant seals in the GOA.

Killer Whales: Research is warranted to examine the consumption of groundfish by killer whales in the GOA and BSAI.

Steller Sea Lions: NOAA Fisheries has identified the following potential causes of the decline of Steller sea lions: nutritional stress related to competition with fisheries for prey or climate-related changes in prey distribution, abundance or quality; predation by killer whales; disease; contaminants; and other human-related direct mortality (e.g., illegal shooting, incidental takes in fisheries, subsistence hunting).

The largest information gaps in understanding what has caused the decline of Steller sea lions or preventing their recovery are in the area of nutritional stress. In particular, they involve the following issues: measuring nutritional stress in a random sample of the population; determining prey and prey field requirements to sustain healthy individual sea lions; understanding sea lion use of habitat and how this changes with age and season; discerning natural from fishery-induced changes in the prey field.

Research programs have been developed by NOAA Fisheries and our research collaborators in the North Pacific to address these gaps and others related to the remaining potential causes of the decline. This research, however, will not obtain answers quickly, and some questions, particularly regarding causes of the decline observed decades ago, may never be answered. The priorities for NOAA Fisheries AFSCs FY03 Steller sea lion research program are:

- Steller sea lion foraging and marine habitat use (particularly by older juveniles).
- Steller sea lion vital rate determination (survival, fecundity).
- Steller sea lion enumeration (pup counts).
- Steller sea lion diet studies.
- fishery effects on prey populations.
- killer whale assessment and trophic ecology.
- the role of climate change and oceanographic processes in prey distributions.
- development of forage fish assessment techniques.
- assessment of the effects of contaminants and disease.

While little evidence currently exists to suggest that contaminants and disease are contributing to the lack of recovery, there are research programs whose objective is to continue investigating their potential impact on the population. With regard to illegal shooting, however, there are virtually no data on which to base any estimate of mortality, and no programs currently in place to obtain them.

5.1.2.10 Socioeconomic

- Compile information on catch by area and catch per unit effort by area in order to more fully ascertain the effects of closing areas on the temporal and spatial distribution of the groundfish fisheries. This data would be most accurately and efficiently collected from catcher vessels and processors using electronic log books.

- Conduct historical analyses and develop models to explain and predict fishermen's responses to temporal and spatial closures.

- Collect and analyze information to provide a more accurate account of local and regional employment patterns in the harvesting and processing sectors of the groundfish fisheries.

- Perform post-implementation studies of management actions, such as closures. Collect and analyze economic and socio-cultural data to determine whether changes in the human environment were a result of management actions or caused by external factors.

- Conduct additional research to determine the non-market value of Bering Sea and GOA marine ecosystems using appropriate economic methodologies.

- Extend mandatory economic data reporting requirements to the groundfish fisheries, including reporting of fixed and variable cost data, as well as vessel and processors ownership information. Such mandatory economic data will be collected in accordance with confidentiality standards.

- Regularly update the sector and regional profiles, to examine changes over time, including post-action effects of different management regimes.

5.1.2.11 Ecosystem

The probability of introduction of non-native species through ballast water exchange from fishing vessels coming from areas where invasions have already occurred has been identified as a serious threat in the State of Alaska's Aquatic Nuisance Species Management Plan. This plan identifies the need for Alaska to develop mandatory ballast-water exchange laws.

Measures of diversity are subject to bias and we do not know how much change in diversity is acceptable (Murawski 2000). More research is needed to derive meaningful ecosystem indicators of change, including those related to diversity. Particularly, it is important to understand the natural range of variability in diversity measures and determine whether there are diversity thresholds that are important determinants of ecosystem function. It is important to conduct species-level work such as determining life history parameters and abundance of target and non-target species to ensure that species level diversity is being protected. Since we are unable to study every organism in sufficient detail, a system of prioritizing research on species should be devised that takes bycatch amounts in fisheries and sensitive life history characteristics into account in the research prioritization.

The lack of population level assessments for some of the species in the forage species group means that species level effects on those species are unknown. Better understanding of the factors influencing forage species dynamics and spatial/temporal distribution will help us better separate the role of climate and fishing in influencing the dynamics of these species.

More research is required to evaluate whether the amounts of pollock removed are having a population-level effect on the fur seals. Ongoing research is needed to quantify predator needs of mammals, birds, and other predators in space and time would improve our ability to evaluate the effects of fishing removals of prey.

Understanding the role of climate variability in species and ecosystem level production changes is needed. See NOAA Climate and Productivity Initiative for FY2005 and the ongoing NOAA Fisheries *Fisheries and the Environment* research plan for some details on this.

The effect of shark bycatch on shark populations reaching MSST is unknown at present and research directed at better assessment of population levels of these sensitive (late maturing, low fecundity, low natural mortality) species is needed to determine the potential for groundfish fisheries to impact these populations.

Further examination of the potential for fishery removals to induce changes in system level characteristics should be examined using ecosystem models of the BSAI and GOA. These system level characteristics are very difficult to assess outside of a modeling framework but more field research on predator/prey interactions and predator functional responses would improve the predictions of ecosystem and multi-species models. Evaluations of system maturity from these models rely heavily on our assumptions about primary productivity and benthic infauna biomass, two aspects of marine production that are not well studied in the BSAI and GOA baseline.

Some of the species in this forage group are not well studied (such as stichaeids and gunnels) and life history parameter determinations should be a priority in the future to better assess the risk of falling below acceptable population thresholds of abundance.

Many years of survey data and life history parameter determinations for skates, sharks and grenadier species may better define population trends and whether further protection might be warranted.

Members of the HAPC biota guild serve important functional roles in providing fish and invertebrates structural habitat and refuge from predation that are not well studied. The abundance of these structural species necessary to provide protection is not well known and it may be important to retain populations of these organisms that are well-distributed spatially in order to fulfill their functional role. Better understanding of the life history characteristics, distribution, and functional roles of these organisms is needed to better protect their role in the ecosystem.

Genetic diversity has not been well assessed in the baseline, more genetic work on target species that may have more localized spawning concentrations would be important.

Relative to Alternative 2: If a target fishery were to develop on forage species such as capelin, there is potential for the combined effects of fishing on many forage species to affect predators. However, the amounts of forage needed by predators is uncertain. More research is needed to determine predator forage needs and level of forage biomass necessary for successful foraging.

The amount of seabird mortality induced by trawl third wires is not well-known and requires further study.

Relative to Alternative 3: More research on developing ecosystem indicators; enhancing collection of data on climate, ecosystem production, and predator/prey interactions; defining predators needs; and defining the role of climate variability in population fluctuations are needed in order to adopt and use ecosystem-indicators in a total allowable catch (TAC)-setting, and for using ecosystem considerations in setting biological reference points. See the NOAA FY2003 Climate and Productivity Initiative and the Stock Assessment Improvement Plan for details on some of the research that might be required.

Relative to Alternative 4: A substantial research program would need to be initiated to determine foraging needs of dependent species; life history parameters, genetics and abundance and distribution of species proposed for target fisheries. Fishery bycatch of nontarget species and gear effects on habitat would also be evaluated before a fishery could be opened. Natural levels of ecosystem variability and the influence of climate on ecosystem production would also need to be determined.

5.2 Management and Enforcement

This section begins with a discussion of management and enforcement considerations in the groundfish fisheries (see Section 5.2.1), and the factors influencing management complexity (see Section 5.2.2). Section 5.2.3 provides the basis for comparing the alternatives under discussion in this Programmatic SEIS. The effects of the alternatives, including the preferred alternative, on management and enforcement are analyzed for each alternative in Sections 5.2.4-5.2.8. The comparative effects of the alternatives are summarized in Section 5.2.9.

5.2.1 Management and Enforcement Considerations

This section provides information about the effects of the alternatives on management and enforcement for the groundfish fisheries off Alaska. For this discussion, management and enforcement responsibilities include the following:

- Data collection, research, and analysis to prepare annual stock assessments.
- The annual groundfish specifications process through which TAC limits and prohibited species catch (PSC) limits are established.
- The ongoing process of amending the FMPs and regulations to implement fishery management measures recommended by NPFMC or NOAA Fisheries.
- Monitoring of commercial fishing activities to estimate the total catch of each species and to ensure compliance with fishery laws and regulations.
- Actions to close commercial fisheries once catch limits have been reached.
- Actions taken by NOAA Fisheries Enforcement, the U.S. Coast Guard (USCG), and NOAA General Counsel to identify, educate, and, in some cases, penalize people who violate the laws and regulations governing the groundfish fisheries.

Management of the groundfish fisheries in the BSAI and GOA and enforcement of management measures governing those fisheries comprise a complex system for overseeing fisheries that range geographically over an extensive area of the North Pacific Ocean and Bering Sea. Management of these fisheries is more fully described in Appendix B.

NOAA Fisheries manages the fisheries off Alaska based on TAC amounts for target species and PSC amounts for species that may not be retained. The TAC and PSC amounts are further subdivided by gear type, area, and season. As the complexity of the management regime has grown, the number of TAC and PSC subdivisions has grown as well. For example, in 1995 for the BSAI there were 40 TAC allocations, 38 PSC allocations and two CDQ allocations. In 2003 for the BSAI, there were 152 TAC allocations, 78 PSC allocations, and 34 CDQ allocations. Each allocation represents a possible need for NOAA Fisheries to take management actions, such as closing fisheries, reallocating incidental catch amounts, or investigating overages. When a directed fishery in one area is closed, the boats that participated in the fishery often move

to another area or change to another target. This, in turn, often leads to the need for additional management actions.

Though the number of allocations has increased, the quantity of fish available for these allocations has not, and NOAA Fisheries is required to manage increasingly smaller blocks of fish. To do this adequately requires the use of increasingly sophisticated catch-monitoring tools, such as observer coverage, electronic reporting, vessel monitoring systems (VMS), and the use of at-sea scales. Though these tools increase the quantity, quality, and timeliness of the data available to NOAA Fisheries management, they also increase the demands on staff to effectively make use of a larger and more complex data system.

Current fishery management recognizes that a meaningful enforcement program must accompany management measures for them to be effective. As management becomes more complex, the difficulty of adequately enforcing the regulations grows. As the size and complexity of the regulatory environment increases, the burden on enforcement personnel to fully understand the nuances and implications of regulations increases as well. NOAA Fisheries/Alaska Region enforcement maintains approximately 36 agents and officers stationed in nine Alaskan ports for monitoring groundfish landings: Juneau, Anchorage, Dutch Harbor, Homer, Ketchikan, Kodiak, Petersburg, Seward, and Sitka. In addition, enforcement personnel regularly travel to other Alaskan ports to monitor landings and conduct investigations. Enforcement personnel associated with NOAA Fisheries, Northwest Region assist in the monitoring of Alaska Region groundfish harvest, primarily individual fishing quota (IFQ) sablefish, landed at ports in the Northwest Region. Also, USCG personnel conduct enforcement activities, monitor vessel activity, conduct at-sea boardings and aircraft overflights, and assist NOAA Fisheries enforcement personnel in monitoring dockside landings.

A key component of management and enforcement is education and outreach. Complex management programs are accompanied by a regulatory structure that can be difficult for the fishing industry to understand and comply with. This is exacerbated when regulations change rapidly. When fishermen believe that regulations are unduly burdensome or unnecessary, they are less likely to comply voluntarily. Thus, successful implementation of the regulations is dependent on outreach programs that explain the goal of regulations and why they are necessary. NOAA Fisheries Management, NOAA Fisheries Enforcement, and the USCG all conduct extensive outreach and education programs that seek not only to explain the regulations, but to help the fishing industry understand the rationale for those regulations.

5.2.2 Factors Influencing Management Complexity

Complexity of Quota Management

Annual groundfish TAC amounts and PSC limits are either established in regulations or through the annual groundfish specification process (described in further detail in the TAC-setting Process paper, in Appendix F-1). These area-specific TACs may be further apportioned by harvesting or processing sector, season, gear, or vessel size class.

NOAA Fisheries initially estimates how much of each groundfish species will be caught as incidental catch in other directed groundfish fisheries throughout the year. The amount available as a directed fishing allowance is determined by subtracting the estimated incidental catch needs from the total amount available

for the species or species group. For some species, such as rockfish, NOAA Fisheries usually determines that the entire TAC will be needed as incidental catch and no directed fishery will be allowed. These species are closed to directed fishing at the beginning of the year through a notice in the Federal Register (FR). For other species, sufficient TAC exists to authorize directed fisheries in most management areas.

NOAA Fisheries must conduct real-time monitoring of the catch of groundfish to predict when a catch limit will be reached and close the directed fishery before the directed fishing allowance is exceeded. Closure notices must be published in the FR, which requires NOAA Fisheries to decide on a closure date from one to five days before the closure must be effective. The office of the FR is closed on weekends and Federal holidays. The requirement to publish closures in the FR is an important reason why NOAA Fisheries is limited in how quickly it can assess catch data and close a fishery. In-season closure notices are not required for individual quota programs such as the halibut and sablefish IFQ Program or the CDQ fisheries, because individual quota holders are responsible for maintaining catch within assigned quota limits.

In general three types of closures are triggered by in-season actions. The first is a target species quota closure issued when a TAC, or apportionment of a TAC, is harvested. The second is a prohibited species closure in which vessels participating in a fishery approach a prohibited species bycatch allowance before harvesting all of the groundfish species available to them. The third is closure of a target species fishery when the catch of an incidentally caught species approaches its overfishing limit.

Under the current in-season management system, a species is either open, or on bycatch or prohibited status at any given point in time. When a species is open, vessels are allowed to target and retain it with no restrictions on the amount harvested. Once a particular species TAC or prohibited species bycatch allowance specified for a fishery has been reached, NOAA Fisheries closes the directed fishery for that species. Vessel operators are then limited in the amount of the species closed to directed fishing that they may retain. If the harvest of a given species goes beyond the TAC and approaches the ABC, NOAA Fisheries will prohibit retention of that species for the remainder of the year.

NOAA Fisheries uses information from a variety of sources to determine how much groundfish and prohibited species are caught in the groundfish fisheries. This information is used to determine when to close a directed fishery so that the groundfish or PSC limit will not be exceeded. In general, data submitted by both observers and by at-sea and shoreside processors are used to accrue catch against a quota. The non-CDQ fisheries generally are managed through the blend, which combines information from observers on vessels and information submitted by processors in a weekly production report to determine the best estimate of catch for each processor and week. In some cases, NOAA Fisheries requires more timely submission of catch data. For example, AFA shoreside processors are required to submit pollock landings data daily through the electronic shoreside logbook. For fisheries with small quotas or those rapidly approaching a catch limit, in-season managers also rely on daily catch data and anecdotal information from the industry to decide when closures should occur.

Any increase in the number of quota categories that must be monitored and closed on time increases the complexity of the fisheries management system. The difficulty of accurately determining when a quota will be reached and when to close a fishery increases as the number of quota categories increases and the amount of quota available in each category decreases.

Complexity of Area Boundaries

Enforcement of regulations that close specific areas to vessel activity is the responsibility of the USCG and NOAA Fisheries Enforcement. Enforcement of closed area regulations is more difficult and time consuming as the complexity of the area boundaries increase. Large, rectangular areas, such as NOAA Fisheries 3-digit reporting areas in the BSAI and GOA (e.g., 518, 541, 620, see Figures 1.2-2 and 1.2-3) are less complex to monitor from aircraft, vessels, or through VMS (see NMFS 2001b [Steller sea lion SEIS Section 4.11.3] for a more detailed description of a VMS) than are concentric circles around a point, particularly if these circular closures overlap each other. Complex area closures are more difficult to monitor and enforce than simple area closures for a number of reasons. It is more difficult to accurately communicate complex area boundaries to those being regulated and to agency personnel, as is apparent from the numerous revisions that have been made to tables, maps, and regulations as the complexity of the Steller sea lion area closures has increased in recent years. In addition, although computer and satellite technology is sophisticated enough to accurately determine the location of a vessel relative to almost any area boundary, the sheer number of closed areas and the complex, irregular boundaries require enforcement personnel to check vessel positions and activities relative to closed area boundaries more frequently, which could reduce the number of vessels or areas that can be monitored during a flight or vessel cruise.

Increasing Number and Complexity of Directed Fishing Closures

Increasing the number of directed fishing closures and the complexity of the boundaries of the closed areas complicates enforcement. The catch accounting system developed by NOAA Fisheries, and described in detail in Appendix B, was designed to collect the best available data to estimate total catch (retained and discarded) from all vessels fishing for groundfish. The catch accounting system was not designed to determine which directed fishery a vessel is participating in for areas smaller than a federal reporting area, or whether the vessel was complying with maximum retainable amounts in that smaller area.

When an area is closed to directed fishing by vessels using a particular gear type, fishing can continue in the area by vessels using other gear types or by vessels directed fishing for species other than the closed species. To determine whether a vessel is fishing legally in an area, the composition of retained catch *from that area at any time during a fishing trip* must be assessed to determine whether any applicable maximum retainable amounts have been exceeded. Making this determination while a vessel is at sea is difficult for catcher processors and nearly impossible for catcher vessels.

For catcher processors, the report of processed product in the daily catch and production logbook is assessed to check compliance with maximum retainable amounts. However, to accurately check compliance with maximum retainable amounts, catch from areas with different directed fishing status must be recorded separately in the logbook. For example, assume that directed fishing is closed in a sub-area of a larger NOAA Fisheries management area, but is open elsewhere in the management area. This means that catch of the closed species up to the maximum retainable amount could be retained inside the closed area, but all catch of the species could be retained outside the closed area. If a vessel caught fish both inside and outside the closed area in a particular day, it is not possible to assess whether they complied with maximum retainable bycatch amounts inside the closed area unless they kept records of catch made inside the closed area separate from catch made outside the closed area. Current logbook formats require catcher processors to report catch by a variety of factors that relate to different directed fishing closures and maximum retainable amounts (day,

gear, management program), reporting area (3-digit area codes), and two special areas for managing crab bycatch. However, catcher processors are not required to report catch separately in their logbooks, for example, inside and outside Steller sea lion critical habitat or specific Steller sea lion management areas where different directed fishing closures could occur for pollock, Pacific cod, Atka mackerel. The format of the catcher processor and mothership logbooks need to be revised to keep up with area-specific directed fishing closures.

It is nearly impossible to check compliance with maximum retainable amounts for catcher vessels at-sea. The weight of each species onboard a catcher vessel cannot be reliably determined until the catch is removed from the vessel, sorted by species, and weighed. If a catcher vessel delivers catch from areas with different directed fishing closures, it is impossible to verify at the time of delivery how much catch came from each area that the vessel fished. If accurate accounting of the location of catch and compliance with maximum retainable amounts by unobserved catcher vessels is required, the following options should be considered: 1) require offload of catch from specific areas before continuing to fish in areas with different directed fishing closures (different maximum retainable amounts); 2) apply the most restrictive maximum retainable amounts to the entire catch at the time of delivery (even though the vessel may have caught some fish in areas with less restrictive maximum retainable amounts); 3) use a VMS to determine if the vessel fished inside special management areas at any time during the trip and, if so, apply the most restrictive maximum retainable amounts to the entire delivery, or 4) require observers to monitor catch for vessels fishing in areas with different directed fishing closures. VMS on unobserved vessels is of limited value in determining what directed fishery a vessel was in, what proportion of the catch came from closed areas, or whether the vessel complied with maximum retainable amounts. VMS provides location data, but it does not provide data about total catch or catch composition.

5.2.3 Basis for Comparing the Effects of the Alternative

The alternatives provide policy goals and objectives for fishery management that will be implemented by measures that fall within the range provided in the analytical framework (see Section 4.2). Most of these management measures are already used in some form under the current regime, including catch limits to control the amount of a species harvested in the commercial fisheries; prohibition of commercial fisheries in certain areas or during certain times of the year; regulations that limit or define the type of fishing gear that may be used or the manner in which the fishing gear may be used; and rights-based fishing systems. Table 5.2-1 summarizes how the specific management measures change over the alternatives.

Six categories of management measures will be used to assess the significance of the alternatives in their effect on management and enforcement complexity (relative to the baseline condition described in Section 4.4). The six management measure categories are as follows:

- Managing harvest within specified catch limits (TAC & PSC).
- Monitoring and enforcing compliance with area closures (including seasonal, gear, directed fishery).
- Monitoring and enforcing compliance with bycatch (discard) reduction standards.
- Managing and enforcing gear modifications requirements and gear restrictions.

- Management complexity due to rights-based management programs.

- Managing observer programs and data collection.

5.2.4 Alternative 1

Alternative 1 continues the management of the groundfish fisheries based upon the present risk-averse policy. The guideline for implementing this policy is the current (2002) BSAI and GOA FMPs as amended, and the 2002 regulatory environment. Management measures that were approved by NPFMC through the June 2002 meeting are also assumed to be incorporated in this implementing guideline.

The Alternative 1 management measures differ from the baseline only with respect to those measures that were only approved but not yet fully implemented at the 2002 cut-off date. These include full retention for demersal shelf rockfish (DSR) in southeast Outside for the hook-and-line and jig fisheries, and the seabird avoidance measures approved by NPFMC in December 2001 but not yet implemented.

Monitoring and Enforcing Compliance with Bycatch (Discard) Reduction Standards

The DSR retention management measures applies only to fixed gear fisheries in the southeast Outside District of the eastern GOA. The implementation of the retention standard will be managed by the State of Alaska, and is thus unlikely to cause a significant increase in management complexity to NOAA Fisheries managers.

Managing and Enforcing Gear Modifications Requirements and Gear Restrictions

The seabird avoidance measures approved by NPFMC in 2001 require staff time for writing regulations and preparing training material to educate fishers as to the nature of the additional measures. The additional seabird avoidance measures were initiated at the request of the longline industry, to reduce the risk of a premature closure of the fishery due to short-tailed albatross interaction. Proven incentives for industry to adopt the avoidance measures should allow enforcement within existing enforcement activities.

Summary

As compared to the baseline suite of management and enforcement measures, Alternative 1 may result in some additional time to monitor and enforce DSR retention and the use of seabird avoidance methods. However, because of their localized effects, it seems unlikely that these efforts will result in an overall increase in the complexity of management and enforcement.

5.2.5 Alternative 2

Alternative 2 represents a more aggressive harvest strategy that would be implemented based upon the assumption that the present policy is overly conservative and that higher harvests can be taken without overfishing the target groundfish stocks. Alternative 2 would be implemented through management measures that fall within the range of two example FMP bookends (see Section 4.2). Both bookends 1) increase the BSAI harvest by redefining the cap on optimum yield; 2) repeal bycatch and incidental catch restrictions,

with the exception of PSC limits; and 3) repeal the 2001 gear modifications for hook-and-line gear intended to decrease interactions with seabirds.

FMP 2.1 also contains additional changes to existing management measures, including eliminating PSC limits, repealing all closure areas and gear restrictions save those required to avoid jeopardy or adverse modification under the ESA, repealing the Improved Retention/Improved Utilization (IR/IU) standard, eliminating all non-AFA rights-based management, repealing the Observer Program, and rescinding monitoring through VMS devices.

Managing Harvest Within Specified Catch Limits (TAC & PSC)

Although both Alternative 2 bookends would result in an increase in the BSAI groundfish quota, they differ in the way they redefine the optimum yield cap. FMP 2.1 defines the optimum yield cap as the sum the OFLs of the managed species or species complexes, and sets the ABC level equal to OFL. This removes the buffer between ABC and OFL that exists under the current system. FMP 2.2 sets the optimum yield cap equal to the sum of ABCs, which still would result in a substantial decrease in the buffer between ABC and OFL in the BSAI. (For background information about TAC, ABC, OFL and optimum yield, see the TAC-setting Process paper in Appendix F-1.)

The current management system provides a buffer between TAC/ABC and OFL for many species, as NOAA Fisheries is required to take management action to prevent further catch of that species if the catch of any species reaches its OFL. This may mean closing other directed fisheries in which that species might be taken as incidental catch. Fishery managers try to limit the catch of a particular species in directed fisheries and as incidental catch to less than the TAC. However, if TAC is exceeded by small amounts, the OFL generally is not reached due to the buffer. Under Alternative 2, the consequences of reaching the catch limit may be the same as the consequences of reaching OFL. Therefore, NOAA Fisheries managers would need to be more conservative in their management of the directed fisheries and incidental catch to ensure that a TAC was not exceeded. Alternative 2 likely would lead to earlier fishery closures to protect certain species from reaching OFL. It is also likely that more directed fisheries would be curtailed because an incidentally-caught species had reached OFL than occurs under the existing management system.

Repealing the Observer Program except for AFA monitoring requirements, and lifting bycatch and incidental catch restrictions under FMP 2.1, would increase the need to manage conservatively. The data used to monitor catch limits would be less reliable, and directed species quotas would need to take into account the level of incidental catch that would likely be taken in other fisheries. As above, this would potentially result in earlier fishery closures. FMP 2.1 also eliminates all PSC limits, however, which would decrease management complexity by removing an entire category of catch limits that currently need to be monitored by NOAA Fisheries.

Monitoring and Enforcing Compliance with Area Closures (Including Seasonal, Gear, Directed Fishery)

Although FMP 2.2 does not change the existing area closures, FMP 2.1 eliminates all closure areas except those that are required to avoid jeopardy or adverse modification to Steller sea lions. The repeal of bycatch restrictions, including PSC limits, under this bookend also means that those areas that are triggered closures after a certain catch limit is reached will also no longer be implemented. As a result, FMP 2.1 would result in a substantial relaxation of management and enforcement complexity.

On the other hand, the elimination of VMS in the directed pollock, Pacific cod and Atka mackerel fisheries under FMP 2.1 would create difficulties for the effective enforcement of the Steller sea lion closure required under ESA. Traditional methods to monitor compliance with Steller sea lion area closures, including periodic USCG overflights and USCG cutter operations, do not fully meet the NOAA Fisheries' need to monitor fishing activities in and around Steller sea lion rookeries, haulouts, and areas designated as critical habitat because of their complexity and their irregular boundaries. Reverting to these methods would require a substantial increase in effort.

Monitoring and Enforcing Compliance with Bycatch (Discard) Reduction Standards

FMP 2.1 repeals the current IR/IU requirements for pollock and Pacific cod and does not implement the DSR retention program. This would reduce operational regulations on the fishing industry, reduce recordkeeping and reporting requirements, and reduce the staff resources needed to monitor compliance.

Managing and Enforcing Gear Modifications Requirements and Gear Restrictions

The 2001 seabird avoidance measures that are repealed under this alternative are not currently implemented in the 2002 baseline, therefore there is no change to management or enforcement complexity.

Management Complexity Due to Rights-Based Management Programs

Alternative 2 maintains the statutorily mandated rights-based management programs authorized under AFA, for the BSAI pollock fishery and the CDQ program. The absence of any objectives to eliminate excess capacity and the race-for-fish leads to the repeal of all other rationalization programs under FMP 2.1, and the cessation of work on further rationalization of the groundfish fisheries. This would eliminate the IFQ program for sablefish, and associated community quota purchase programs, and the License Limitation Program (LLP). The elimination of the LLP is likely to increase management complexity to some degree, due to the likely increase in the number of vessels participating in the fishery. The repeal of the IFQ program, on the other hand, would likely result in a decrease in management complexity, as its implementation since 1995 has had the opposite effect.

Managing Observer Programs and Data Collection

Repealing the Observer Program, except for AFA monitoring requirements, under FMP 2.1 would result in foregone data about the amount and location of catch, and species composition of the haul. Non-AFA pollock monitoring accounts for approximately 80 percent of groundfish observer days annually (Appendix F-10). Observers also record information on interactions with marine mammals and ESA-listed seabirds. The observer data is used to groundtruth industry reporting, and the lack of such data would require NOAA Fisheries to assume a certain degree of under-reporting and consequently manage the fisheries more conservatively to avoid overfishing. The agency currently contributes about $3,000 per year to manage the Observer Program, with the remainder of the costs paid by industry, and some of these costs would be saved by repealing the non-AFA portion of the program (Appendix F-10).

FMP 2.1 also repeals the use of at-sea scales, which would result in less accurate data and consequently would decrease the ability of fishery managers to accurately manage TAC in order not to exceed OFLs.

Summary

Alternative 2 will require more conservative management, particularly in the BSAI, due to the redefinition of optimum yield that reduces the buffer between TAC and OFL and the repeal of bycatch restrictions. The repeal of bycatch restrictions would allow some budget and staff to be redirected to other management and enforcement priorities, resulting in a conditionally significant beneficial rating. The FMP 2.1 end of the range, however, repeals several existing management measures that would significantly alleviate management complexity, particularly the IFQ program, the Observer Program, PSC limits, IR/IU, and closure areas. An FMP 2.1 illustration of Alternative 2 would be significantly beneficial in terms of reducing management complexity. Basing the assessment of Alternative 2 as a whole on the assumption that the alternative would be implemented somewhere in the middle of the range, and that should any one of the FMP 2.1 measures be implemented it would represent a substantial reduction in management complexity.

5.2.6 Alternative 3

Alternative 3 would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles and, where appropriate and practicable, increased habitat protection and additional bycatch constraints. This policy recognizes the need to balance many competing uses of marine resources and different social and economic goals for fishery management. Alternative 3 would be implemented through management measures that fall within the range of two FMP bookends (see Section 4.2). Both bookends 1) initiate new research and re-examine existing management practices; 2) implement rationalization for the groundfish fisheries; 3) break out new species for TAC setting; and 4) improve monitoring data.

The bookends do differ in their implementation, however. FMP 3.1 eliminates the existing vessel incentive program. FMP 3.2 incorporates additional quota specification adjustments, and develops an expanded system of closure areas. Bycatch incentive programs are instituted, the Observer Program coverage is increased, and mandatory VMS is extended to vessels greater than 125 ft length overall (LOA).

Managing Harvest Within Specified Catch Limits (TAC & PSC)

Alternative 3 would increase the number of individual TAC limits managed by NOAA Fisheries by breaking out species from species complexes for TAC setting. Additionally, PSC limits are established in the GOA for salmon, herring and crab. Increasing the number of individual catch limits increases the need for accurate, complete, and timely catch data from fishermen in order to manage the commercial fisheries within catch limits. NOAA Fisheries is responsible for monitoring commercial fishing activity by all vessel types, to estimate the amount of each species caught, and to know the date and location of the catch. NOAA Fisheries uses this information to limit or prohibit commercial fishing so that the catch limits are not exceeded. Obtaining the data necessary to manage current catch limits, as well as additional catch limits recommended under this alternative is particularly difficult for unobserved vessels or for vessels that do not have the capability to transmit observer data to NOAA Fisheries. Reassessment of agency priorities or additional staff resources may be necessary for data collection, research, and analysis to establish catch limits based on new criteria.

FMP 3.2 implements further adjustments to the TAC-setting process by incorporating uncertainty corrections into the quota assessments. This measure would increase the buffer between TAC and OFL to allow for uncertainty, and would thus provide more leeway for fishery managers for in-season actions.

The development of the uncertainty correction in FMP 3.2, and the establishment of new PSC limits in the GOA and the reduction of existing limits in the BSAI and GOA under Alternative 3, also necessitate allocation of staff resources to prepare the analysis to support the revised quotas.

Monitoring and Enforcing Compliance with Area Closures (Including Seasonal, Gear, Directed Fishery)

Alternative 3 prioritizes the development of an marine protected area (MPA) system, that may or may not encompass existing closure areas. This effort is likely to require staff analytical support as well as additional research efforts to situate the closure areas. Although FMP 3.1 makes no actual changes to the closure system currently in place in the BSAI and GOA, FMP 3.2 designs series of comprehensive closures.

In FMP 3.2, the existing Steller sea lion protection measures are left intact. Additionally, two other kinds of closures are implemented, namely no-take marine reserves and no bottom contact MPAs. Depending on the complexity of the areas, the closure of areas or times all fishing can be effectively enforced using aerial or at-sea surveillance by the USCG, a VMS tracking system, or information supplied by observers on the vessels. No bottom contact MPAs, however, present more of an enforcement challenge. Effective monitoring and enforcement requires the ability to assess whether the gear is coming into contact with the bottom, which would require technology not currently used on the groundfish boats.

The no-take marine reserve and no bottom contact MPA closures do, however, supplant the existing mix of closure areas that are often specific to certain directed fisheries. Such closures require assessment of the catch onboard the vessel to determine whether the vessel is complying with catch composition requirements associated with particular directed fisheries, and are consequently complex to monitor and enforce.

Additional agency resources would also be needed under Alternative 3 for data collection, research, and analysis to identify critical or essential habitat areas to be protected by the closures.

Monitoring and Enforcing Compliance with Bycatch (Discard) Reduction Standards

FMP 3.1 eliminates the vessel incentive program, which would, in a minor way, reduce operational regulations on the fishing industry, reduce recordkeeping and reporting requirements, and reduce the staff resources needed to analyze and revise regulations and to monitor compliance.

Under FMP 3.2, the reductions in bycatch limits would be achieved by industry as a result of increased flexibility inherent in the rationalization of the fisheries (see Section 4.7.9). NOAA Fisheries management and enforcement experience with rationalization and rights-based management programs, including bycatch management under these programs, has been that they result in increased complexity. The impacts on complexity of rights-based management programs is discussed further in that section below.

Managing and Enforcing Gear Modifications Requirements and Gear Restrictions

As discussed under Alternative 1, the seabird avoidance measures approved by NPFMC in 2001 and implemented under Alternative 3 require staff time for writing and regulations, and preparing training material to educate fishers as to the nature of the additional measures. Additional seabird protection measures would also be researched under this alternative, in cooperation with USFWS.

The gear restrictions implemented under FMP 3.2 would be designed to allow vessel compliance with the no bottom contact MPA requirements discussed in the time and area closure subsection above.

Management Complexity Due to Rights-Based Management Programs

Rationalization is one of the distinguishing features of Alternative 3. Both bookends develop a rationalization program, although FMP 3.1 takes a more gradual fishery-by-fishery approach and FMP 3.2 proceeds with comprehensive rationalization. Both bookends incorporate community protection concerns in their implementation of rationalization programs.

NOAA Fisheries (NMFS 2001a, Section 4.1.5.2) contains a lengthy discussion about many of the management issues related to the rights-based fishing systems currently in existence in the Alaska Region, including the IFQ and CDQ programs and fishing cooperatives established under the AFA. Each program was implemented together with existing traditional management measures, such as overall catch limits, limits on seasons or areas, gear restrictions, and Observer Programs. However, they also required implementation of additional administrative and catch monitoring regulations to manage and enforce programs based on the assignment of fishing rights to individuals or groups. In some cases, such as the IFQ and CDQ programs, NOAA Fisheries no longer manages the catch limits through closures of directed fishing by a group of vessels once a catch limit is reached. Instead, catch limits are assigned to individuals or groups, who are required to provide accurate and timely reports of catch and to stop fishing once a catch limit is reached.

Rights-based systems present some potential difficulties and some advantages for fisheries managers. Because they are likely to change the practices of harvesters (e.g., less emphasis on maximizing catch rates) they are likely to lead to discontinuities in fishery-dependent data. Commercial catch per unit effort is likely to change independent of stock sizes, and the relative catch rates of different species or cohorts may also change. Any stock assessment models that rely on fishery-dependent data may require recalibration. However, rights-based systems also have the potential to provide new useful information to managers. The

prices of quota shares or use rights, if transferable, should indicate the net value of the fishery and changes in prices can be useful indicators of the economic impact of regulatory changes. Prices of transferable individual quotas on catch and bycatch (including prohibited species) also provide information on the relative value of allocations to different fisheries and sectors.

Experience with the IFQ and CDQ programs and pollock cooperatives suggests that expansion of rights-based systems to other fisheries is likely to result in substantial increases in the costs of monitoring, enforcement, and administration. Cost recovery fees will at least partly offset management costs that would otherwise be publicly funded. To implement rights-based fishing systems, additional agency resources would be required to develop the process through which fishing rights are assigned; to adjudicate appeals about the assignment of fishing rights to individuals or groups; to administer the annual assignment of catch amounts and transfers of fishing rights; to monitor catch of individual or group quotas; and to penalize people violating regulations.

Managing Observer Programs and Data Collection

Alternative 3 introduces a variety of research and analytical objectives that impact management primarily through the need for additional resources for data collection, research and analysis. Increasing data collection requirements for observers requires assessment of the priority of these data relative to other demands on the observers' time.

The objective to improve data quality applies to both observer and industry data. Changes to the data collected by the Observer Program require assessment of the impact of adding more duties for the observer. Increasing the breadth and precision of industry logbook data would require management and enforcement staff resources for program development and maintenance.

The expansion of observer coverage to 100 percent on all vessels over 60 ft LOA may be difficult to implement in the first year or two due to the changes that the requirement creates in the numbers of observers required and the timing of when observers are required, either competing with existing fisheries that need observers or requiring observers at a time of year when they had not been required before. An increase in observer deployments could require additional resources in the Observer Program, NOAA Fisheries Enforcement, and NOAA General Counsel to ensure their ability to manage and support a larger program, depending on the scope of the increase.

Finally, recommendations to expand the use of VMS to all groundfish vessels over 125 ft LOA, together with observer data or vessel logbook data, to increase the precision of catch location data would require management and enforcement staff resources for program development and maintenance.

Summary

Alternative 3 contains a number of changes for management and enforcement. Rationalization of the fisheries, and the increased emphasis on improving data and research efforts, as well as the potential for redesigning the existing closure system, would tend to create a considerably more complex management and enforcement scenario than exists in the baseline case, resulting in additional need for staff and budget resources.

5.2.7 Alternative 4

Alternative 4 represents an extremely precautionary approach to managing fisheries under scientific uncertainty. It shifts the burden of proof to the users of the resource and NPFMC/NOAA Fisheries to demonstrate that the intended use would not have a detrimental effect on the environment. This policy assumes that fishing does produce adverse impacts on the environment, but due to a lack of information and uncertainty, we know little about these impacts. The initial restrictive and precautionary conservation and management measures would be modified (strengthened or relaxed) when additional, reliable scientific information becomes available. Alternative 4 would be implemented through management measures that fall within the range of two FMP bookends (see Section 4.2). Both bookends require more data collection, research and monitoring due to shifting the burden of proof.

The bookends differ substantially in their method of implementation. FMP 4.1 adapts the existing fishery management environment to comply with the Alternative 4 policy, by imposing harvest, bycatch and other conservation constraints on the groundfish fisheries. The implementing management measures include adjustment of the quota specification process, establishment of closure areas and gear restrictions, establishment of additional PSC limits and bycatch limits for non-target species, protection measures for seabirds, effort-based regulations, expanded observer coverage and mandatory VMS and motion-compensated scales. FMP 4.2 implements a more extreme management regime, by suspending all fishing in federal waters off Alaska until such time as individual directed fisheries can be shown to have no adverse impact on the environment.

Managing Harvest Within Specified Catch Limits (TAC & PSC)

The adjustments to the TAC-setting process specified under FMP 4.1 generate a variety of management impacts. Managing TAC on smaller spatial scales, and breaking out species from their species complexes where possible, increases the number of individual catch limits to monitor and enforce. The level of attention required by inseason management staff would increase substantially not simply by expansion of the number of inseason actions but also by increased attention to management of data and monitoring and interacting with the fleet. This requires accurate and timely catch data from industry, and analytical agency support to manage the quantity of data. Additionally, reducing the TACs under this bookend would also require staff resources to prepare the analysis to support revised quotas.

Additionally, PSC limits are established in the GOA, and catch limits will be developed for non-target species. Again, this would increase management and enforcement complexity by increasing the number of catch limits that would have to be monitored and managed. Placing a priority on catch limits for non-target species likely would result in closure of directed fisheries for target species due to bycatch of non-target species before the target species catch limit was fully harvested. In addition, because most non-target species currently are discarded at sea, this alternative would rely more heavily on data collected by observers for estimating catch and would increase the need to extrapolate data from observed vessels to estimate at-sea discards by unobserved vessels. Additional agency resources also may be needed for stock assessment (data collection, research, and analysis) to establish catch limits for species that currently are not assessed and do not have catch limits.

The accuracy of the data available to assess and monitor catch limits would be improved, however, through the expansion of the Observer Program and the requirement for motion-compensated scales to weigh all catches at-sea or at shore-based processing plants.

Monitoring and Enforcing Compliance with Area Closures (Including Seasonal, Gear, Directed Fishery)

The implementation of closure areas under this FMP should reduce management complexity by reducing the variation in the types of closures. All closure areas under this bookend are either no-take reserves (closed to all commercial fishing) or no-trawl MPAs. Also, all fishing effort, and trawl effort in particular, is substantially reduced under Alternative 4. Staff resources would be required to prepare the analysis to support the design of closure areas. However, closures to all fishing, or to vessels using fishing gear that can be easily identified, can be effectively enforced using aerial or at-sea surveillance by the USCG, or information supplied by observers on the vessels.

Additionally, monitoring and enforcement would also be assisted by the requirement that all groundfish vessels carry VMS. Management measures such as comprehensive closure areas require VMS for effective monitoring and management. While VMS alone is not sufficient to effectively implement the closure areas, VMS is an essential component of monitoring and management. The benefits of a VMS system are significantly increased by extending the VMS requirement to all groundfish vessels. The baseline case of having vessels turning the units on and off because they are required to operate them only in particular areas or while targeting a particular species of groundfish reduces the effectiveness of the system and increases agency operational costs and complexity. Removing this complexity under this alternative would be beneficial.

Monitoring and Enforcing Compliance with Bycatch (Discard) Reduction Standards

FMP 4.1 expands the IR/IU program to apply to all target species. Other elements of Alternative 4 would significantly decrease the size of the fleet due to a reduction in catch limits and extensive closure areas. The monitoring and enforcement of this program expansion would increase management complexity, but the impact would not be substantial due to the reduction in the fleet.

Managing and Enforcing Gear Modifications Requirements and Gear Restrictions

The introduction of effort-based regulations such as trip limits, vessel size or horsepower limits, gear size limits, or area registration, increases management and enforcement complexity.

Trip limits are a maximum amount of fish that can be caught on a fishing trip or the maximum amount that can be onboard a vessel at any time while fishing in an area. They currently exist in two Alaska fisheries managed by NOAA Fisheries: the 6,000 pound trip limit in the area 4E halibut CDQ fishery and the 300,000 lb trip limit for pollock in the GOA. Trip limits for catcher vessels do not present any new or difficult in-season management or enforcement issues. A specific trip limit would be established for a fishery and catcher vessel deliveries would be monitored to determine whether participating vessels had exceeded the trip limit. However, determining the appropriate amount of the trip limit to accomplish specific objectives of slowing the pace of fisheries is complicated, particularly in fisheries without quota allocations among different gear types and vessel categories, all of whom fish at the same time during some parts of the year. In addition, it

is not clear how trip limits would be adapted for catcher processors, because catcher processors fish for a much longer time in a trip. Sometimes a "trip" can be an entire season.

Imposing additional limits, whether trip, vessel, horsepower or gear size, increase the need for data collection, research and analysis to identify and evaluate appropriate actions, and require additional resources to monitor and enforce.

Area registration would require a vessel owner to register with NOAA Fisheries each season before they participate in directed fisheries. They may be restrictions on the number of areas or species that may be registered per season. NOAA Fisheries would be required to establish registration forms, accept registration forms from fishermen, acknowledge receipt of registration (something fishermen have onboard vessel to show compliance with registration requirements), and provide a database of registration information to fishermen and enforcement officers (which might link up with VMS).

The primary management and enforcement issues associated with seabird protection measures are providing the staff resources necessary to conduct the research to identify and evaluate appropriate gear modifications and the difficulty of enforcing restrictions on gear and fishing operations on unobserved vessels. In addition, the recommendation to develop protection measures (which could include elements such as bycatch limits or a bycatch monitoring program) would require possible changes in observer duties, and increases in management and observer program staff involvement in the seabird protection program.

Managing Observer Programs and Data Collection

FMP 4.1 expands observer coverage to 100 percent on all vessels over 60 ft LOA. The bookend also proposes to require 30 percent observer coverage on groundfish vessels less than 60 ft LOA. An observer onboard a vessel can help NOAA Fisheries improve estimates of the amount and location of catch, and the target species. However, observers on catcher vessels are limited in the information they can collect about total catch weight and species composition due to the fishing operations (sorted or unsorted catch) and tools available for weighing and sampling catch. To date, Council and NOAA Fisheries have not required observers on vessels less than 60 ft LOA due to concerns about safety, cost, and accommodations for the observers. However, the 60 ft LOA cut-off between observed and unobserved vessels is an arbitrary length established because of the decision to base observer coverage requirements on vessel categories by length. Observer data from vessels less than 60 ft LOA would contribute greatly to information about catch and at-sea discards by this vessel class.

Substantial increases in observer coverage requirements may be difficult to implement in the first year or two due to the changes that the requirement creates in the numbers of observers required and the timing of when observers are required—either competing with existing fisheries that need observers or requiring observers at a time of year when they hadn't been required before. An increase in observer deployments could require additional resources in the Observer Program, NOAA Fisheries Enforcement, and NOAA General Counsel to ensure their ability to manage and support a larger program, depending on the scope of the increase. For instance, timely debriefing of returning observers directly affects observer availability.

The requirement for motion-compensated scales and mandatory VMS on all vessels would require additional resources for equipment certification, and also would require additional staff effort to monitor and analyze the VMS data. The cost of the VMS units has to date been reimbursed by NOAA Fisheries, for up to $2,000. Should the Agency continue with this policy, additional funding would be required to support the extension of VMS to all vessels.

FMP bookend 4.2 would also require a considerable staff and budget commitment in order to develop the criteria and the standards of proof to assess each of the directed fisheries. While the suspension of the commercial fisheries would free up staff, the complexity of designing a new commercial fishing regulatory environment that can be proven to have no adverse effect on the environment would be immense and would presumably require many specialists. Additional data collection and research would likely be required to bolster the fishery assessments, assuming that a higher standard of proof would be necessary to authorize the resumption of fishing. However, all data collection and research would need to be conducted with experimental permits as there would be no data collected in conjunction with commercial fishing, and the data would be obtained at considerably greater additional expense to the agency. The suspension of fishing would likely take a minimum of two years, to develop the criteria and assess directed fisheries. Currently, those fisheries that are under rights-based management, such as BSAI pollock and the sablefish IFQ program, contribute to their management costs through a cost-recovery program. Although a comparable staff load would likely be required to craft the restructured management regime, no management costs would be recovered during the suspension of fishing.

Summary

The management and enforcement complexity under Alternative 4, as represented within the bookend range of FMP 4.1 and FMP 4.2, would be significantly greater than the baseline. The shifting of the burden of proof would implement new types of management measures and expand on the use of existing budget, staff and analytical needs beyond the capability of the existing management and enforcement structure.

5.2.8 The Preferred Alternative

The Preferred Alternative (PA) represents a combination management approach, incorporating forward looking conservation measures that address differing levels of uncertainty. The alternative would be implemented through management measures that fall within the range of two FMP bookends (see Section 4.2 for more detail). Both bookends 1) initiate new research and re-examine existing management practices; 2) implement rationalization for the groundfish fisheries; 3) establish PSC limits for all prohibited species in the GOA; 4) evaluate seabird avoidance measures for the trawl and longline fisheries; and 5) improve monitoring data.

Additional management measures are specific to PA.2. The bookend, however, also implements additional changes to groundfish management. PA.2 adjusts quota specification, develops an expanded system of closure areas, and institutes other bycatch incentive programs while eliminating the existing Vessel Incentive Program (VIP).

Managing Harvest Within Specified Catch Limits (Total Allowable Catch and Prohibited Species Catch)

The PA would increase the number of individual limits managed by NOAA Fisheries by establishing PSC limits in the GOA for salmon, herring and crab. Additionally, in PA.2, species are broken out for TAC-setting. Increasing the number of individual catch limits increases the need for accurate, complete, and timely catch data from fishermen in order to manage the commercial fisheries within catch limits. NOAA Fisheries is responsible for monitoring commercial fishing activity by all vessel types, to estimate the amount of each species caught, and to know the date and location of the catch. NOAA Fisheries uses this information to limit or prohibit commercial fishing so that the catch limits are not exceeded. Obtaining the data necessary to manage current catch limits, as well as additional catch limits recommended under this alternative is particularly difficult for unobserved vessels or for vessels that do not have the capability to transmit observer data to NOAA Fisheries. Reassessment of agency priorities or additional staff resources may be necessary for data collection, research, and analysis to establish catch limits based on new criteria.

PA.2 implements further adjustments to the TAC-setting process by incorporating uncertainty corrections into the quota assessments. This measure would increase the buffer between TAC and OFL to allow for uncertainty, and would thus provide more leeway for fishery managers for inseason actions.

The development of the uncertainty correction in PA.2, and the establishment of new PSC limits in the GOA and the reduction of existing limits in the BSAI and GOA under the PA, also necessitate allocation of staff resources to prepare the analysis to support the revised quotas.

Monitoring and Enforcing Compliance with Area Closures (Including Seasonal, Gear, Directed Fishery)

The PA prioritizes the development of an MPA system, that may or may not encompass existing closure areas. This effort is likely to require staff analytical support as well as additional research efforts to review the efficacy of existing area restrictions as well as to situate new closure areas. Although PA.1 makes no actual changes to the closure system currently in place in the BSAI and GOA, PA.2 designs a series of comprehensive closures.

In PA.2, the existing Steller sea lion protection measures are left intact. Additionally, two other kinds of closures are implemented, namely no-take marine reserves and no bottom contact MPAs. Depending on the complexity of the areas, the closure of areas or times to all fishing can be effectively enforced using aerial or at-sea surveillance by the USCG, a VMS tracking system, or information supplied by observers on the vessels. No bottom contact MPAs, however, present more of an enforcement challenge. Effective monitoring and enforcement requires the ability to assess whether the gear is coming into contact with the bottom, which would require technology not currently used on the groundfish boats.

The no-take marine reserve and no bottom contact MPA closures do, however, supplant the existing mix of closure areas that are often specific to certain directed fisheries. Such closures require assessment of the catch onboard the vessel to determine whether the vessel is complying with catch composition requirements associated with particular directed fisheries, and are consequently complex to monitor and enforce.

Additional agency resources would also be needed under the PA for data collection, research, and analysis to identify critical or essential habitat areas to be protected by the closures.

Monitoring and Enforcing Compliance with Bycatch (Discard) Reduction Standards

PA.1 eliminates the vessel incentive program which, while reducing operational regulations on the fishing industry, recordkeeping and reporting requirements, and the staff resources needed to analyze and revise regulations and to monitor compliance, would not ultimately impact the ability of the agency to monitor/enforce compliance with bycatch reduction standards.

Under PA.2, the reductions in bycatch would be achieved by the industry as a result of increased flexibility inherent in the rationalization of the fisheries (see Section 4.9.9 for further detail). NOAA Fisheries' management and enforcement experience with rationalization and rights-based management programs, including bycatch management under these programs, has increased management complexity. The impacts of the increase in complexity of monitoring and enforcement inherent in rights-based management programs is discussed further in that section below.

Managing and Enforcing Gear Modifications Requirements and Gear Restrictions

The seabird avoidance measures implemented for trawl fisheries under PA.2 would require staff time for writing and regulations, and preparing training material to educate fishers as to the nature of the additional measures.

Gear restrictions may also need to be implemented under PA.2, that would be designed to allow vessel compliance with the no bottom contact MPA requirements discussed in the time and area closure subsection above.

Management Complexity Due to Rights-based Management Programs

As with Alternative 3, rationalization is one of the distinguishing features of the PA. Both bookends develop a rationalization program, although PA.1 takes a more gradual fishery-by-fishery approach and PA.2 proceeds with comprehensive rationalization. Both bookends incorporate community protection concerns in their implementation of rationalization programs.

The Overcapacity qualitative analysis paper (Appendix F-8) contains a lengthy discussion about many of the management issues related to the rights-based fishing systems currently in existence in the Alaska region, including the IFQ and CDQ programs and fishing cooperatives established under the AFA. Each program was implemented together with existing traditional management measures, such as overall catch limits, limits on seasons or areas, gear restrictions, and observer programs. However, they also required implementation of additional administrative and catch monitoring regulations to manage and enforce programs based on the assignment of fishing rights to individuals or groups. In some cases, such as the IFQ and CDQ programs, NOAA Fisheries no longer manages the catch limits through closures of directed fishing by a group of vessels once a catch limit is reached. Instead, catch limits are assigned to individuals or groups, who are required to provide accurate and timely reports of catch and to stop fishing once a catch limit is reached.

Rights-based systems present some potential difficulties and some advantages for fisheries managers. As rights-based management systems are likely to change the practices of harvesters (e.g., less emphasis on maximizing catch rates), they are likely to lead to discontinuities in fishery-dependent data. Commercial catch per unit effort is likely to change independent of stock sizes, and the relative catch rates of different species or cohorts may also change. Any stock assessment models that rely on fishery-dependent data may require recalibration. However, rights-based systems also have the potential to provide new useful information to managers. The prices of quota shares or use rights, if transferable, should indicate the net value of the fishery and changes in prices can be useful indicators of the economic impact of regulatory changes. Prices of transferable individual quotas on catch and bycatch (including prohibited species) also provide information on the relative value of allocations to different fisheries and sectors.

Experience with the IFQ and CDQ programs and pollock cooperatives suggests that expansion of rights-based systems to other fisheries is likely to result in substantial increases in the costs of monitoring, enforcement, and administration. Cost recovery fees will at least partly offset management costs that would otherwise be publicly funded. To implement rights-based fishing systems, additional agency resources would be required to develop the process through which fishing rights are assigned; to adjudicate appeals about the assignment of fishing rights to individuals or groups; to administer the annual assignment of catch amounts and transfers of fishing rights; to monitor catch of individual or group quotas; and to penalize people violating regulations.

Managing Observer Programs and Data Collection

The PA introduces a variety of research and analytical objectives that impact management primarily through the need for additional resources for data collection, research and analysis. Increasing data collection requirements for observers requires assessment of the priority of these data relative to other demands on the observers' time.

The objective to improve data quality applies to both observer and industry data. Changes to the data collected by the observer program require assessment of the impact of adding more duties for the observer. Increasing the breadth and precision of industry logbook data would require management and enforcement staff resources for program development and maintenance. An increase in observer deployments could require additional resources in the Observer Program, NOAA Fisheries Enforcement, and NOAA General Counsel to ensure their ability to manage and support a larger program, depending on the scope of the increase. For instance, timely debriefing of returning observers directly affects observer availability.

Finally, recommended changes to observer data or vessel logbook data, to increase the precision of catch location data, would require management and enforcement staff resources for program development and maintenance.

Summary

The PA contains a number of changes for management and enforcement. Rationalization of the fisheries, and the increased emphasis on improving data and research efforts, as well as the potential for redesigning the existing closure system, would tend to create a considerably more complex management and enforcement scenario than exists in the baseline case, resulting in additional need for staff and budget resources.

5.2.9 Comparison of the Alternatives

The significance of each alternative is determined relative to the baseline, in terms of the alternative's effect on the complexity of management and enforcement in terms of budget, staff, data, and analysis needs. The ratings are included in Table 5.2-2.