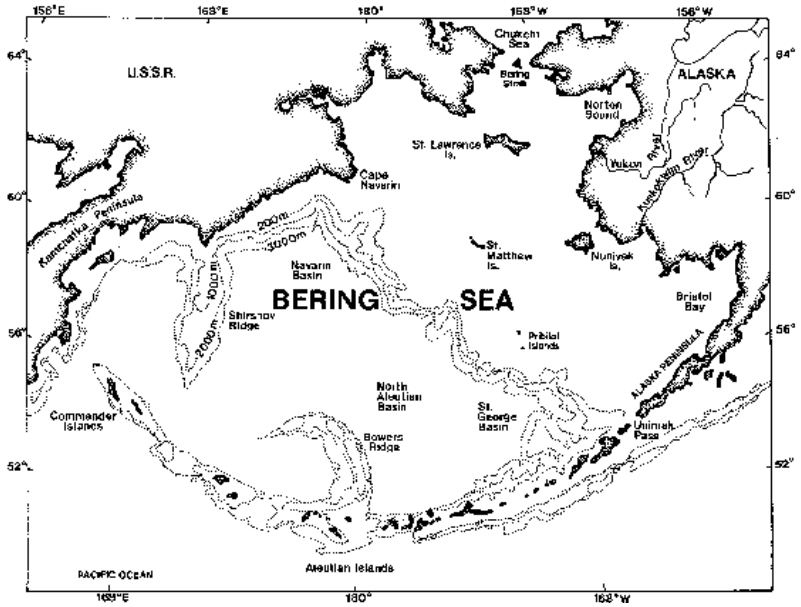
A DISCUSSION PAPER

Fishery Ecosystem Plan for the Aleutian Islands

This paper is organized as follows:

The Aleutian Islands represent the central and eastern portion of the Aleutian-Komandorski (Commander) archipelago that extends from the Alaska Peninsula across the U.S.-Russian boundary to the Kamchatka Peninsula (see Figure 1). Numerous straits and passes through the Aleutian Islands connect the Bering Sea to the North Pacific Ocean. The islands are volcanic, with a narrow shelf descending to a steep dropoff. Rich in marine life, the Aleutian Islands are home to seabirds, marine mammals, sessile invertebrates, and fish stocks. The Aleut peoples have inhabited the islands for over 10,000 years and subsisted on the marine bounty.

Figure 1 Bathymetric map of the Bering Sea, showing the Aleutian-Commander archipelago (Sayles 1979).



In recent years, the Aleutian Islands have been at the forefront of many issues before the North Pacific Fishery Management Council (Council). The Aleutian Islands area has figured in focused measures to protect Steller sea lions and seabirds, conservation of benthic habitats that support coral and other special resources of public interest, and allocation issues related to the Aleutian Islands pollock and Pacific cod fisheries. With national interest on ecosystem-based management of fisheries heightened through recent Ocean Commission reports and other national-level panels, the Aleutian Islands area has been recognized by the Council as meriting consideration as a candidate for an ecosystem-based fishery plan.

1 Purpose and Need

The Council is faced with a growing national momentum to adopt an ecosystem approach to fisheries (EAF). While many of the Council's management actions can arguably be considered to reflect an overall ecosystem approach, there is still progress to be made. There are many ways in which the Council could apply an ecosystem approach in its fishery management; however, much attention has been given to the concept of Fishery Ecosystem Plans (FEPs), or similar ecosystem-based fishery management documents. The Ecosystems Principles Advisory Panel touted FEPs as the way to move forward with ecosystem-based fishery management (EPAP 1999). Various draft legislative documents that have passed through Congress have suggested revisions to the Magnuson-Stevens Act that would require either FEPs or some other type of fishery ecosystem management document. To date, however, there are few examples of such documents, and there is no national template for their implementation, or their relationship to fishery management plans (FMPs).

The Council believes that applying a more explicit ecosystem approach to fisheries may be the appropriate way to move forward in fishery management. With regard to fishery ecosystem planning, the Council has the opportunity to help define the standard for implementing an EAF. As the practicalities of developing a fishery ecosystem planning document have yet to be worked out, the Council feels it is appropriate to designate an ecosystem area as a test case.

In recent years, the Aleutian Islands have been at the forefront of many issues before the Council. By its actions to date, the Council recognizes that the Aleutian Islands contain unique ecological values that the Council wishes to preserve. The Aleutian Islands area has figured in focused measures to protect Steller sea lions and seabirds, conservation of benthic habitats that support coral and other special resources of public interest, and allocation issues related to the Aleutian Islands pollock and Pacific cod fisheries. Recent scientific evidence indicates a clear ecological difference between the eastern Bering Sea shelf ecosystem and the western Aleutian Islands archipelago. Far less is understood about the ecological interactions in this area than in the eastern Bering Sea, yet the two areas are managed conjointly in all of the Federal fishery management plans. The Council may wish to consider fishery interactions within this ecosystem more directly, and applying an ecosystem approach to fisheries may promote this goal. For these reasons, the Aleutian Islands ecosystem area may merit consideration as a candidate for area-specific management, and could be an appropriate test case for the Council to develop a fishery ecosystem planning document.

The Council captured their rationale in a purpose statement, presented below. The SSC has recommended revising the purpose and need statement to explicitly emphasize that the FEP should consider aggregate, cumulative impacts on the Aleutian Islands ecosystem. One of the ways that a FEP might provide added value to the Council, in addition to the many ecosystem-based analyses that are already produced for each Council action, is to focus on the Aleutian Islands and look cumulatively at impacts from all fisheries and non-fishing impacts. The cumulative impact analysis in other documents, such as the Groundfish PSEIS, does look at cumulative fishing and external effects, but from the perspective of the groundfish fisheries

rather than the Aleutian Islands ecosystem. A FEP for the AI would provide an opportunity for fishery management to coordinate actions across fisheries.

The Council might wish to consider a revision to the purpose statement, to reflect the SSC's concerns. The Council's original purpose statement is below, with the bold text representing additional language.

> The Council recognizes that an explicit Ecosystem Approach to Fisheries (EAF) is a desirable process for future management of the marine fishery resources in the Alaskan EEZ and therefore is a concept that it wishes to pursue and further implement. A primary component of an EAF is the development of ecosystem-based fishery planning documents, and the Council intends to move forward with such development on a pilot basis. The Council recognizes that the Aleutian Islands ecosystem is a unique environment that supports diverse and abundant marine life, and a human presence that is closely tied to the environment and its resources. The Council believes that in light of these features, EAF could be a useful guide for future fishery management decisions in the Aleutian Islands area. **Area-specific management associated with an EAF should specifically examine the aggregate effects of all fisheries within the Aleutian Islands ecosystem area, cumulatively with non-fishery inputs.** Enhancing our current ecosystem approach to fisheries in the Aleutian Islands could allow the Council to better focus on the unique features of and interactions within the Aleutian Islands ecosystem area.

2 Ecosystem-based Fishery Management

Ecosystem-based fishery management has been variously defined in the last decade. In June of 2000, the Council developed its own definition in conjunction with reviewing the groundfish fishery management program:

Council's current definition

> Ecosystem-based approach to fisheries management is defined as the regulation of human activity towards maintaining long-term system sustainability (within the range of natural variability as we understand it) of the North Pacific covering the Gulf of Alaska, the Eastern and Western Bering Sea and the Aleutian Islands region.

In July 2005, a panel of fishery scientists familiar with the North Pacific and Pacific met to discuss, among other things, issues relating to ecosystem-based fishery management. Their findings were published in a report by the Pacific States Marine Fisheries Commission (PSMFC 2005). The panel reviewed various ecosystem-based fishery management definitions, including those of the NPFMC, the United Nations Food and Agricultural Organization, and other national and international recommendations. Based on this review, the panel proposed a synthesized definition that would help provide direction to the fishery management councils:

PSMFC report definition

> Ecosystem-based fishery management recognizes the physical, biological, economic, and social interactions among the affected components of the ecosystem and attempts to manage fisheries to achieve a stipulated spectrum of societal goals, some of which may be in competition.
>
> Elements of an ecosystem-based fishery management approach:
>
> 1. Employs spatial representation

2. Recognizes the significance of climate/ocean conditions
3. Emphasizes food web interactions
4. Ensures broader societal goals are taken into account (possibly by incorporating broader stakeholder representation)
5. Utilizes an expanded scope of monitoring (total removals, cumulative effects, non-target species, environmental covariates)
6. Acknowledges and responds to higher levels of uncertainty
7. Pursues ecosystem modeling/research
8. Seeks improved habitat information (target and non-target species)

The PSMFC definition will be used as a working definition for the purposes of this analysis.

3 Fishery Ecosystem Plans

What is a Fishery Ecosystem Plan?

The Fishery Ecosystem Plan (FEP) was described in detail in the Ecosystems Principles Advisory Panel (EPAP)'s Report to Congress in 1999. Excerpted material from that report, describing the principles, goals, and policies of ecosystem-based fishery management, and the steps to develop a FEP, is included at the end of this appendix. In brief, the FEP is intended to provide the mechanism to integrate the ecosystem goals, principles, and policies into single species or species complex FMPs.

A FEP describes the interactions of the ecosystem, and the degree to which they are considered in conservation and management measures, including the efforts being made to monitor the effects of fishing. In order to address the goal of maintaining ecosystem health and sustainability, the FEP should develop indices of ecosystem health as targets for management.

The FEP is intended to:

- "provide Council members with a clear description and understanding of the fundamental physical, biological, and human/institutional context of ecosystems within which fisheries are managed;
- direct how that information should be used in the context of FMPs; and
- set policies by which management options would be developed and implemented," (EPAP 1999).

Comparison of guidelines for FEP content

Table 1 Comparison of guidelines for FEP content

Topic	Suggested Tasks for FEPs		
	Ecosystem Principles Advisory Panel Report, 1999	**Marine Fisheries Advisory Committee Task Force Report, 2003**	**Interim Report of the ad hoc Working Group, May 2005**
Ecosystem Boundary	• Delineate geographic extent of ecosystem	• Describe geographic area of coverage	• Define relevant ecosystem boundaries
Understanding of Ecosystem Area	• Characterize biological, chemical, and physical dynamics of ecosystem • Develop conceptual model of food web • Describe habitat needs of different life history stages for 'significant food web' • Assess uncertainty • Consider predator-prey affected by FMP fishing • Consider bycatch in terms of food web/community structure • Assess the ecological, human, and institutional elements of the ecosystem that are outside DOC authority and that most significantly affect fisheries	• Describe current natural resource/ socioeconomic conditions to provide status/ trends • Describe historic ecosystem	• Inventory ecosystem data and information sources, including all relevant federal and non-federal agencies, academic institutions, and others • Assess impacts of fishing and non-fishing activities on non-target species so no gaps in species protection • Define essential fish habitat • Determine effects of variability in marine environmental conditions (e.g. climate, oceanography)
Data gaps		• Identify/ prioritize crucial information needs	• Define gaps and priorities in ecosystem data
Objectives for Ecosystem Area	• Prescribed ecosystem objectives and principles • Zone ecosystem area for alternative uses • Minimize any impacts of fishing on EFH	• Describe Desired State of Natural ecosystem (objectives/ goal statements) • Describe Desired State of Socioeconomic ecosystem (long/ short term)	
Current Management Approach to Ecosystem Area	• Describe how habitat needs are considered in conservation and management measures • Assess buffers against uncertainty that are included in conservation and management measures		• Inventory management practices re ecosystem approach
Future Management Approach to Ecosystem Area	• Develop indices of ecosystem health as targets for management • Describe available long-term monitoring data and how they are used • Include a strategy to address the influences outside DOC authority	• Describe ecosystem management options: pros/cons • Apply indicators of ecosystem 'health' • Process for periodic evaluation	• Account for predator-prey interactions and other feedback effects, including impacts of fishing practices on habitat productivity • Account for variable marine environmental conditions when formulating management plans • Evaluate tradeoffs among fisheries (FMPs?) linked by interactions between species (e.g., bycatch interactions, predator-prey relationships) • Include economic and social factors in evaluating tradeoffs • Develop adaptive approaches to ecosystem management that e.g. take into account changes in knowledge, use of experimental approaches, etc.

Regulatory authority, and interaction with FMPs

FEPs are to be developed for each ecosystem area, and a FEP would likely apply to more than one FMP. In the North Pacific, for example, an Aleutian Islands FEP would apply to the Federal groundfish (BSAI and perhaps GOA, depending on the boundary of the Aleutian Islands ecosystem), king and tanner crab, scallop, and salmon FMPs. There is no explicit discussion in the EPAP report as to the interaction of the FEP with state water fisheries; however, it would be desirable for the Council to coordinate with the State when developing the FEP.

In terms of regulatory authority, the EPAP report generally recommends that specific management measures be included in the FMPs, and that the FEP provide an ecosystem policy and understanding from which management measures could be developed for the individual FMPs as necessary. Yet the report does suggest that those regulations or management measures which extend across individual FMPs be contained in the FEP. The example used is essential fish habitat protection measures, which may apply to all fisheries, and thus including them in the FEP would reduce redundancy.

The intent of the report was for FEPs to eventually become required by law, and to meld with FMPs in the long term. At present, however, there is no authority attached to a FEP, and only the FMP can authorize regulations to implement management measures. Therefore it would not be possible, without a change in statute, for a FEP to authorize regulations. Management measures must be incorporated at the FMP level, not the FEP level.

This means that the influence of the FEP would be to extend an ecosystem policy over the FMPs in the ecosystem area, but not to prescribe management measures. This policy would guide the development of management measures in each FMP. The FEP would also contain an assessment of how to determine whether the goals and objectives of the ecosystem policy are being met.

Examples of Fishery Ecosystem Plans

There are very few examples nationally of Fishery Ecosystem Plans, and they do not provide a clear template of how to do FEPs. The Chesapeake Bay FEP embraces many of the concepts of the Ecosystems Principles Advisory Panel, including developing a strategic plan that accounts for the role of habitat and predator-prey relationships, social and economic considerations, and unpredictable externalities such as climate impacts. The FEP does not specify what measures management agencies should undertake, but instead lays out what is known about the ecosystem, and the kind of research and monitoring needed by fishery managers. It also includes the impacts of non-fishery activities on, for example, fish habitat. The South Atlantic Council has taken a similar approach in developing their FEP. Their FEP expands upon their existing Habitat Plan to include a characterization of the biological and physical dynamics, an assessment of existing agencies and management institutions, development of a food web model, development of indices of ecosystem health, updated habitat requirements for managed species, determination of total removals, specification of research and monitoring needs, and further development of appropriate management measures.

A different concept was adopted by the Western Pacific Council, with their Fishery Management Plan for Coral Reef Ecosystems of the Western Pacific Region. The 2001 plan is the first ever ecosystem-based plan for fisheries developed in the United States. It incorporates many of the principles and policies recommended by the EPAP. The goal of the FMP is to establish a management regime for the entire Western Pacific Region that will maintain sustainable coral reef fisheries while preventing adverse impacts to stocks, habitat, protected species, or the ecosystem. The FMP measures include the designation of zoned Marine Protected Areas (MPAs) for coral, a recommendation of the EPAP report.

In FY04, Congress allocated $1.98 million for NOAA Fisheries to conduct ecosystem pilot projects in four regions: New England, Mid-Atlantic, South Atlantic, and Gulf of Mexico. The plan is to 1) use a public process to determine management objectives, threats and alternatives, 2) hold technical workshops for establishing guidelines in applying ecosystem principles to fisheries management, and 3) develop quantitative methods and software (models and GIS tools) to aid in evaluating management options and consequences. Each of the four Councils (MAFMC, NEFMC, SAFMC, and GOMFMC) received $225,000 from NMFS to develop their pilot programs. The SAFMC is further along in this project, and is already developing an FEP; the other Councils are focusing on the development of ecosystem-based goals and objectives and for implementing the FEP approach.

BSAI and GOA Groundfish FMPs as an example of a FEP?

The Council's revised BSAI and GOA groundfish FMPs contain many elements of a FEP. The revised management policy, adopted by the Council following the PSEIS analysis, is a broad, ecosystem-based policy. It contains goals and objectives for each of the ecosystem components, and a management approach statement that provides a means to balance ecological, social, and economic objectives. Many of the recommendations of the EPAP are incorporated in the groundfish management program, such as buffers against uncertainty, indices for ecosystem health, long-term monitoring data, and the habitat needs of many of the ecosystem's fish species.

One difference between the groundfish FMPs and a FEP as intended by the EPAP is that the groundfish FMPs apply only to a single species complex in each management/ecosystem area, rather than all fisheries in that area. Also, much of the ecosystem information that is used in managing the groundfish fisheries is not contained in the FMP, but rather is available to managers in supplemental documents such as the SAFE reports, including the annual Ecosystem Considerations appendix. Including such information in the FMP could be restrictive as the knowledge base for such information is constantly expanding, and the formal process for amending the FMP may not be sufficiently efficient as to keep it up to date .

Fishery Ecosystem Plan for the Aleutian Islands

A Fishery Ecosystem Plan for the Aleutian Islands would be a stand alone document, developed along the lines of the EPAP. The AI FEP would provide an assessment of the Aleutian Islands ecosystem, and would provide guidance, through goals and objectives, to managers of all fisheries in the Aleutian Islands ecosystem area. The FEP would have no regulatory authority.

The FEP would allow the Council to include a focused consideration of the role of each ecological component of the region (e.g., seabirds, marine mammals, communities, industries) in the sustainability of the whole, when making decisions on Aleutian Islands management actions.

Possible issues that might be addressed under a FEP are briefly listed below.

- For management decisions that result in harvest of non-target species, to what extent are these non-target species important as prey for other fish, seabirds, or marine mammals?
- For management decisions that might result in incidental take of seabirds or marine mammals, what is the current population status of these seabirds and marine mammals? Are the trends up or down? Would the possible incidental take of seabirds or marine mammals, or removals of their prey items, have any measurable effect on their populations?
- For management decisions that result in harvest of target species, what are the population dynamics of those target species and to what extent would harvest change those dynamics? What other species of fish, seabirds, or marine mammals rely on these target species? How might

current harvests affect future geographic distribution of target species, spawning locations and success, juvenile production, and recruitment (to both a fishery and to the reproductive segment of the population)? How might fisheries affect the behavior of predators that rely on this target species biomass?

- The Council might consider ecosystem response to biomass (energy) removals by fishing, in time and space, as well as ecosystem response to biomass (nutrient) inputs from offal and discards at sea and point source nutrient input along the Coast (processor waste). In part, this is a redistribution of energy in the ecosystem – how is this affecting the marine system?
- The Council might consider the phenology of both target species and non-target species and how harvest might alter the timing of key events in the life cycle of these species. For example, could spawning be shifted in time because of harvest removals of spawning fish during a particular time period?
- The Council would consider uncertainty in the scientific knowledge of natural mortality for target fish and non-target species, and develop management policies to address uncertainty.
- What process might the Council employ to adaptively learn about ecosystem impacts of fishery management decisions and employ this new knowledge in future decision making? How might the Council adapt management measures to compensate for environmental change or regime shifts?

Spatial boundary and application

The definition of an ecosystem often includes a geographic component, but conspicuous boundaries in marine systems are rarely evident. Because the FEP does not authorize management measures, a specifically delineated boundary that can be charted in regulations is not necessary. Instead, the ecosystem boundary may be specified in other terms.

Recent publications have suggested that the size of an ecosystem might be considered to be the geographic extent of the foraging distances for a top consumer species in that area. Ciannelli et al. (2004) define the aerial extent of the Pribilof Islands ecosystem as that oceanic area that accommodates the energetic demands of the principal predatory species, the northern fur seal – that is, encloses the area of highest energy balance and lowest biomass import (which in this case is approximately a 100 nm radius around the islands). Certainly that boundary is not a precise 100 nm, but rather a less-well-defined boundary based on foraging, which may shift from season to season and year to year. Concepts such as central place foraging may be helpful perspectives in defining an approximate ecosystem boundary for management decisions. Section 4 discusses recent research on ecological divisions in the Aleutian Islands.

The AI FEP would apply to all fisheries within the Aleutian Islands ecosystem area, not just the BSAI Groundfish FMP. The FEP would consider the interactions of fisheries with each other, as well as with other components of the ecosystem.

Effect on existing FMP measures

The development of the FEP itself would not be disruptive to federal fishery management. Barring a change in statute, a FEP cannot authorize management measures, and such authority would remain vested in the FMPs. The associated paradigm shift that could increase the Council's awareness of the ecological impacts of management actions, however, may result in amendments to the FMPs governing the Aleutian Islands fisheries.

The scope of the FEP is broader than either of the two previously considered options, as it would consider all components of the ecosystem, and provide goals and objectives for managing fishery impacts from all Federal fisheries. As such, fisheries other than the BSAI groundfish fishery may be affected.

The FMPs in the Aleutian Islands area would likely be amended to acknowledge the use of the FEP as a reference for ecosystem considerations, and the guidance of the FEP's ecosystem objectives.

Implementation

The FEP would describe the AI ecosystem, including spatial boundaries, predator-prey interactions, habitat needs of the significant food web components, and current and historic states of the ecosystem. Indices of ecosystem health, such as are included annually in the Ecosystem Considerations chapter of the groundfish SAFE report, would be used to assess all impacts, natural and anthropogenic, on the ecosystem. An excerpt from the EPAP's 1999 Report to Congress (Appendix A) describes the components of a FEP. Goals and objectives for the ecosystem would be developed by the Council.

The development of the FEP would require a cooperative effort among many agencies, as the AI FEP would need to consider impacts from other activities in the Aleutian Islands area relative to fishery impacts. Expert authorities from the State of Alaska, USFWS, and the Aleutian Islands communities would likely all be involved in developing the FEP. A mechanism for periodic re-evaluation of the FEP would also need to be devised.

Utility in conserving the Aleutian Islands

The FEP would give the Council an opportunity to examine and incorporate the impacts from all sources on the Aleutian Islands ecosystem, and take action to balance adverse impacts accordingly.

4 Defining a Boundary for the Aleutian Islands

This section discusses the management implications of an ecosystem boundary for the Aleutian Islands, and the evidence for where such a boundary would lie. Also, the section considers the Aleutian Islands as part of a Large Marine Ecosystem.

Management Implications of the Aleutian Islands Boundary

In considering area-specific management, an important element is to define a boundary for the Aleutian Islands management area. If the purpose is to consider a cohesive Aleutian Islands ecosystem separate from dissimilar habitat and oceanographic processes of the Bering Sea, the need to appropriately define the extent of the Aleutian Islands ecosystem seems critical. Although it is difficult to define unequivocal lines for an ecosystem, for the purposes of management the Aleutian Islands must have a distinct spatial boundary.

Geographically, the Aleutian Islands archipelago ranges from Attu Island to Unimak Island, approximately from 170º E. to 165º W. longitude (Figure 6, on page 19). The boundary defined for the Aleutian Islands in each of the Federal FMPs, however, is different (for further information, see discussion in Section 7.2.3). For groundfish, the BSAI FMP defines the Aleutian Islands subarea as that area of the EEZ that is west of 170º W. longitude and south of 55º N. latitude (Figure 11). This definition means that the Fox Islands, which include Dutch Harbor and Akutan, are not included in the AI subarea.

The subareas and regulatory areas of the BSAI and GOA Groundfish FMPs are based on statistical areas defined by the International North Pacific Fishery Commission (INPFC) in the 1950s. The INPFC Shumagin area (now statistical area 610, see Figure 2) includes waters south of the eastern Aleutian Islands and the Alaska Peninsula, between 170º W. and 159º W. longitude. This area is included in the GOA Groundfish FMP management area.

The BSAI Groundfish FMP originally defined four subareas, all based on INPFC statistical areas (Figure 3). Areas 1 and 4, now the southern portion of the Bering Sea subarea and the Aleutian Islands subarea, respectively, abut the Aleutian Islands. The four areas are still evident in the statistical areas used by NMFS to monitor groundfish catch in the management area (Figure 4).

Figure 2 Statistical areas for the groundfish fisheries in the GOA

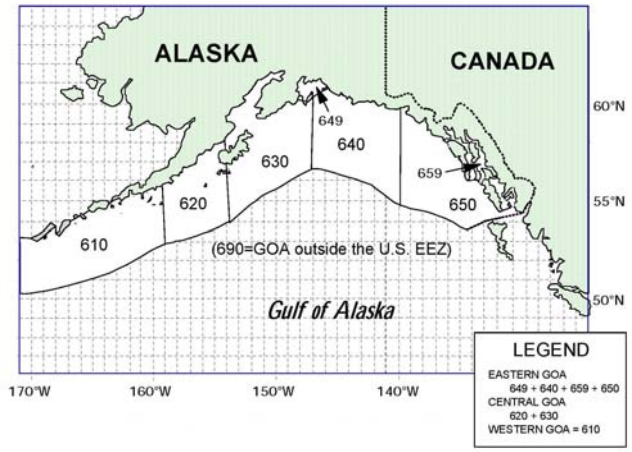


Figure 3 Fishing areas in original BSAI FMP, 1981

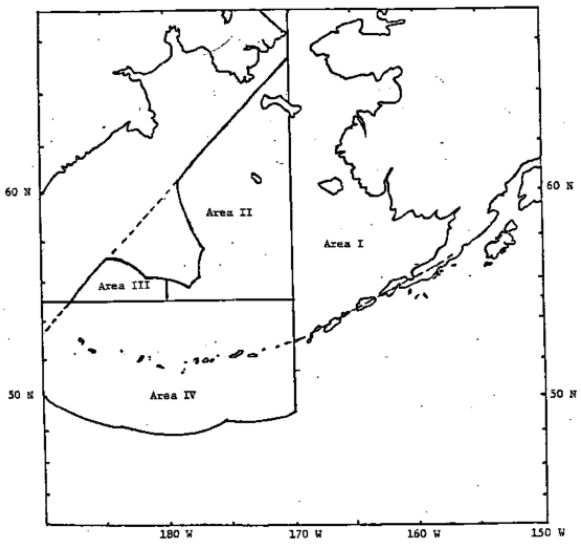
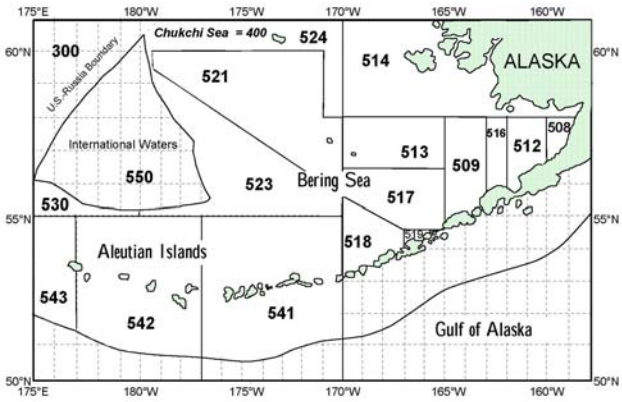


Figure 4 Statistical areas for the groundfish fisheries in the BSAI



None of the existing statistical area boundaries correspond exactly with a geographically-defined Aleutian Islands area. In the BSAI FMP, in addition to the Aleutian Islands subarea, statistical areas 517, 518, 519, and 509 all border the eastern Aleutian Islands to the north (Figure 4). In the GOA management area, the western half of statistical area 610 borders this area to the south (Figure 2).

In considering area-specific management for the Aleutian Islands, the question of an appropriate boundary for the area is a critical one. This is discussed in further detail under each of the management options below. However, it is worth noting some overarching considerations. First, any extension of the Aleutian Islands boundary beyond that of the AI subarea, for management purposes, will create a disconnect between data describing the Aleutian Islands before and after the change. The disconnect would be seriously compounded should the Council draw a boundary that does not correspond to one of the existing statistical areas. Inseason data are collected at many spatial levels, including Federal statistical areas, State of Alaska statistical areas and precise GPS haul locations for some directed

fisheries; however, drawing new Federal statistical areas would make historical comparison of data for this area difficult.

The difficulty with managing data should not necessarily prevent the Council from defining an appropriate Aleutian Islands boundary, although it is an important consideration. For some of the management options discussed in this paper, the defined boundary of the Aleutian Islands may be allowed to differ between the area-specific plan and the management measures in the FMP. While such a solution is not ideal, as it increases the probability of confusion, it may provide the Council necessary flexibility.

Evidence of Aleutian Islands Ecosystem Boundaries

A recent volume of Fisheries Oceanography is devoted to the marine ecology of the Aleutian Islands, and is based on a series of research cruises along the archipelago. Results from the research indicate that there is evidence of an ecological division at Samalga Pass, which is at 169º W. longitude (Hunt and Stabeno 2005; Figure 5).

Figure 5 Eastern end of the Aleutian Archipelago, showing Semalga Pass

East of the Pass, waters from the Alaska Coastal Current predominate, and west of there waters from the Alaska Stream are the prevalent source. Weather east of 170º W. longitude is closely associated with the Aleutian Low Pressure, and to the west weather is more influenced by Asian circulation. Marine ecosystems of the Aleutian Archipelago show a strong discontinuity at Samalga Pass. Deep-water corals, zooplankton, fish, marine mammals, and seabirds show a step change in species composition there. Diets of groundfish, sea lions, and seabirds change there also. Fish growth and tissue composition studies suggest productivity declines westward along the Archipelago. Based on these findings, the authors suggest that marine waters of the Aleutian Archipelago are divided into at least two different ecological regions, with a break at Samalga Pass (Hunt and Stabeno 2005).

The authors also note that there are abrupt changes in the composition of fish communities at several of the major passes, and that Samalga Pass may represent only one of several ecological divisions in the Aleutian waters (Hunt and Stabeno 2005).

The Aleutian Islands Region and Large Marine Ecosystems

NOAA has adopted the Large Marine Ecosystem, or LME, concept for approaching regional marine ecosystem management. The agency has identified ten LMEs across the nation, three of which are in Alaska. The three geographic areas in Alaska are the Arctic, the Bering Sea, and the Gulf of Alaska. The Council actively manages fisheries in the GOA and the Bering Sea. No known commercially exploitable fish populations inhabit the Beaufort and Chukchi Seas (comprising the Arctic LME).

The Aleutian Islands do not fit neatly into the proposed LME categorizations. The region lies on the border of the Bering Sea and the GOA LMEs. However, although NOAA's discussions on the practical applicability of the LME concept to ecosystem management have not progressed into actual guidelines, it has been acknowledged that in some instances, subregions may be appropriate to deal with unique areas.

The Council's management of the North Pacific groundfish and shellfish resources of commercial value is centered in three regions, the Gulf of Alaska, the eastern Bering Sea, and the Aleutian Islands. Species complexes, environmental forcing mechanisms, productivity, ocean floor relief, and overall productivity and target species biomass levels are quite different in each of these three areas. Thus current fishery management basically focuses on three ecosystems in the North Pacific, not two. In a practical fishery-management context, the Aleutian Islands region west of about 165º W. longitude extends into an open oceanic environment much of which is distant from the actively fished eastern Bering Sea. The Aleutian Islands have different environmental characteristics than the eastern Bering Sea and the GOA, different target species fisheries, and unique marine mammal and seabird issues that fishery management must consider.

For these reasons, considering the Aleutian Islands as an LME subregion is likely to be compatible with the LME concept.

Options for an Aleutian Islands FEP Boundary

Based on the discussions above, there are several options available to the Council to identify a boundary for the FEP.

Option 1: Geographic extent of Aleutian Island archipelago

This definition would be based on the geography of the archipelago, and would include the Federal waters surrounding all of the Aleutian Islands from Unimak Island to the west. This option would perhaps cause the least public confusion. It would encompass groundfish fisheries occurring in the Bering Sea and Aleutian Islands subareas, and the western GOA. It would match up to crab and scallop management areas for the Aleutian Islands, and Areas 4A and 4B for halibut management.

Option 2: Aleutian Islands west of Samalga Pass (169° W. longitude)

Using this definition would most closely accord with the recent evidence of ecological boundaries in the Aleutian Islands. Hunt and Stabeno (2005) found a distinct ecological division occurring at Samalga Pass. There may be other ecological divisions, however, along that part of the Aleutian archipelago that would be included in this definition. This division would approximate the AI subarea of the BSAI groundfish fishery, but would divide the AI management area for scallop, crab, and halibut.

Option 3: Geographic extent of Aleutian Islands pollock stock (west of 174° W. longitude)

Defining the AI FEP according to a particular stock means that the ecological boundary fits for pollock, but does not necessarily accord with any other species or ecosystem components. This option does not accord with any existing management boundaries.

Option 4: No set boundary; for each species or ecosystem component, the FEP considers the appropriate ecological range of the species

Another approach to defining a boundary for the FEP is to define the boundary individually for each ecosystem component. This approach is possible because there are no regulations directly resulting from

the FEP, but rather it is to be used as a guidance document for fishery management measures that will be put into effect through the FMP process. Therefore, the FEP will identify the appropriate ecological extent of each stock or stock unit that uses the Aleutian Islands.

5 Planning Process for developing a FEP

The development of an AI FEP, should the Council choose to proceed with such, would need to be a multi-stage process involving scientific support from the Alaska Fisheries Science Center (AFSC), and stakeholder input. Section 5.1 provides a discussion of the planning of the FEP.

The FEP is envisioned as a living document, which would be developed to guide the Council's fishery management actions in the Aleutian Islands area, and which would need to be kept updated in order to achieve its purpose. A process to accomplish this currency might be to use a Council advisory team. Such an approach is described in Section 5.2 below.

Additionally, the development of an AI FEP would be in part a test case of whether FEPs are a useful management tool for the NPFMC. Consequently, once an initial FEP is developed, a review should be conducted as to whether the FEP provides utility above and beyond current ecosystem considerations.

5.1 Approach to Developing the FEP

The PSFMC panel discussed practical ways for the NPFMC and the Pacific Fishery Management Council to incorporate ecosystem-based management practices in their fishery management programs. The panel (PSFMC 2005) discussed the evolutionary process as moving from:

Single species focus	- focus on target species, its predators, and prey
↓	
Implicit treatment of ecosystem effects	- determination of the status of target species recognizes ecosystem interactions - management measures address bycatch, incidental mortality, some direct effects on habitat
↓	
Explicit treatment of ecosystem effects	- the environment, target stock, predators, and prey are integrated into the assessment before the management procedure is used - food web dynamics, predator requirements, regime shifts are directly addressed

Source: PSMFC 2005.

The NPFMC is moving toward the third stage of the continuum. Management measures to implicitly treat ecosystem effects are already in place, and the Council is exploring mechanisms to address stage three. For example, the Alaska Fisheries Science Center is developing ways to inform the NPFMC of the importance and relevance of climatic and oceanographic conditions to fishery management decisions.

In order to guide the Councils' progress, the panel recommended practical actions to continue the evolution towards explicit treatment of ecosystem effects. Using as a basis the list of eight recommendations for developing a FEP provided by the Ecosystem Principles Advisory Panel (see also Appendix A), the panel provided a list of actions for fishery managers and scientists. This list is reproduced in Table 2.

Table 2 Actions for achieving an ecosystem-based fishery management approach, as recommended by a panel of fishery scientists of the North Pacific and Pacific[1].

Eight Recommendations from the EPAP report[2], *as modified by the Panel*	**Panel's Recommended Actions**
1. and 8. Delineate and characterize *the* ecosystem *including* the ecological, human, and institutional elements of the ecosystem which most significantly affect fisheries.	• Define the management goals to reflect the societal objectives
2. Develop a conceptual model of the food web	• Develop a conceptual model of the influence of oceanographic and climatic factors
3. Describe habitat needs of different life history stages of significant food web plants and animals and how they are considered in conservation and management measures	• Expand/modify the conceptual model of the ecosystem to include life history characteristics and spatial variation
4. Calculate total removals, including incidental mortality and show how they relate to standing biomass, production, optimum yields, natural mortality, and trophic structure	• Develop a numerical representation combining the food web model (which would include dynamic models of managed species), the oceanographic model, and explicit representation of management measures and quantities that have been identified as metrics of attainment of the management goals.
5. Assess how uncertainty is characterized and what kind of buffers against uncertainty are included in conservation and management actions	• Identify alternative management procedures. A management procedure would include specifications for the data required as well as how those data are analyzed to determine management actions: e.g., how uncertainty is quantified statistically and how the extent of uncertainty is used in the decision rules (control rules).
6. Develop indices of ecosystem health as targets for management	• Use models to identify indices that are relevant to the stated goals. Identify which indices can be used as the basis for decision making. 'Traffic light' approaches may be useful.
7. Describe available long-term monitoring data and how they are used *to estimate parameters for the model and to quantify the reliability of the model*	• Use the model to identify critical data gaps, and put plans in place to address them. • Conduct evaluations of management procedures (Management Strategy Evaluations): Use the model to evaluate the costs and benefits of management procedures in terms of their probability of achieving as many of the management goals as possible, calculated over a realistic range of uncertainty. • The Fishery Management Council would select from among these management procedures in light of their calculated performance. • Implement the management procedures accordingly. • Monitor to verify success of the management procedure and validity of the model. • Revise the model and the management procedure wherever the monitoring data indicates that the initial approach was mistaken.

[1] The panel met in July 2005 to examine practical ways that the Pacific and North Pacific Fishery Management Councils could move towards an ecosystem-based approach to fisheries management (PSMFC 2005).
[2] NMFS 1999

The first step, using this Sapproach, would be for the Council and AI stakeholders to articulate societal objectives for the AI ecosystem. Management goals for the area should then be examined to see whether

they reflect the stated objectives. This task has already been started through the recent programmatic review of the groundfish fisheries, in which the Council identified a suite of ecosystem-based objectives for the BSAI and GOA groundfish fisheries as a whole. The groundfish objectives are reproduced in Appendix B. To adapt this process for the Aleutian Islands ecosystem area, the Council and stakeholders would need to reconsider the groundfish fishery objectives in light of societal goals for the Aleutian Islands area, and expand or revise them as necessary. The purpose of developing management goals or objectives is to allow the scientific content of the FEP to provide a measure, through the development of indicators, how those objectives or goals are being achieved.

The next step involves developing various oceanographic and food web models of the ecosystem area. Such models are currently in various stages of development by AFSC scientists. These models would be used to identify indicators and metrics of attainment of management goals, and management strategy evaluations of differing management procedures to achieve management goals.

PSMFC (2005) provides a number of suggested metrics that could be used to indicate levels of concern regarding ecosystem status. These metrics are:

- biomasses of one or more important species assemblages or components fall below minimum biologically acceptable limits;
- diversity of communities or populations declines significantly as a result of factors associated with harvest rates or species selection;
- changes in species composition or population demographics, resulting from fishing, significantly decrease resilience or resistance of the ecosystem to perturbations arising from non-biological factors;
- the pattern of harvest rates among interacting species results in lower cumulative net economic or social benefits than would result from a less intense overall fishing pattern;
- harvests of prey species or direct mortalities resulting from fishing operations impair the long-term viability of ecologically important, non-resource species (e.g., marine mammals, turtles, seabirds).

Finally, the results of such evaluations would be made available to the NPFMC to incorporate into its decisionmaking, and management procedures would be implemented and monitored, and revisions and changes made to the models and evaluations as appropriate.

5.2 Council Advisory Team

The Council may choose to develop an advisory group that would become responsible for the AI FEP, would keep its information updated, and provide advice to the Council on actions relating to the Aleutian Islands in accordance with the outlined goals of the FEP. This advisory group could either be created as a new group, or the existing fishery management plan teams for groundfish, crab, and scallop, could be asked to serve this function in addition to their other duties.

Should an AI Ecosystem team be created, its initial charge, with the assistance of staff, would be to assist in the preparation of the Fishery Ecosystem Plan, and to periodically assist in updating it. Additionally, the team would provide advice on Aleutian Islands fishery management decisions facing the Council. The Aleutian Islands FEP and its goals would be used to evaluate future management actions affecting the AI SMA.

Option 1: Create an AI Ecosystem Team

The Council may choose to create a scientific 'team', under the oversight of the SSC and the Council, as an effective way to monitor its goals for AI fishery management. The AI Ecosystem Team could be similar to a Plan team, and would either meet on a regular, periodic basis, or ad hoc at the Council's request.

The Council would decide whether the team should be drawn from fishery management agencies, such as those that already participate on the Plan teams, or from a broader range of agencies with interest in the Aleutian Islands. If the Council chooses to broaden the participation, the Ecosystem Team could serve a broader ecosystem approach to ocean management function in addition to the specific role of guiding the Council regarding its Fishery Ecosystem Plan. Representatives on the team could come from several groups based on their activities in the region, special expertise in ecosystem values or functions that should be part of fishery management decision making, or special interests in the outcomes of management decisions. These might include representatives from the U.S. Fish & Wildlife Service, a CDQ group, a consortium of villages and communities, the Aleut Corporation, the University of Alaska Fairbanks, the Environmental Protection Agency or Alaska Department of Environmental Conservation or other entity involved in Amchitka Island research and remediation, the Alaska Fisheries Science Center, and NOAA-NOS.

An advantage of a new team would be that the membership can be specifically selected among those scientists working on the Aleutian Islands area. Additionally, representatives from each of the major fisheries, as well as other managers and researchers of resources that interact with the fisheries, can all meet together to provide advice to the Council.

Option 2: Use the existing FMP Teams as advisory teams on the AI FEP

The Plan Teams already represent a broad cross-section of fishery, mammal, and seabird biologists, ecologists, and economists. Membership in these groups has been chosen to represent the greatest expertise on these fisheries. As a result, the Plan Teams may be ideally suited to provide the Council with advice on AI management actions, using the FEP goals and assessments as a guide.

One disadvantage of using the Plan Teams as advisory bodies is that they rarely meet together, and doing so is logistically difficult. Therefore each team would be providing the Council advice independently without the benefit of interaction. This will place more responsibility on the SSC to sift and collate such advice.

Option 2.1: An adaptation of this approach could be for each Plan Team to appoint a representative to the Aleutian Islands Ecosystem Team. In this way, each of the Plan Teams would be represented on the AI Ecosystem Team, and would be able to provide FMP-specific advice regarding the Aleutian Islands. The Council would receive the benefits of Option 1 by having a dedicated group specifically focusing on the needs generated by the AI FEP, while at the same time drawing on the existing expertise already captured within the Plan Teams.

Although the USFWS and the State of Alaska are represented on the Council's groundfish Plan Teams, the Council may choose to invite a dedicated representative of these agencies to the AI Ecosystem Team, as created under this option.

6 Table of Contents for FEP

This preliminary table of contents for the FEP has been developed using the various guidelines for FEP content that are presented in Table 1, page 5, as well as the recommendations of the PSMFC panel (PSMFC 2005) in Table 2, on page 14. Based on these guidelines, a preliminary table of contents for the FEP is suggested as follows:

1 Purpose and need

- 1.1 What is the FEP
- 1.2 Council's purpose statement

2 Understanding the ecosystem area – what do we know about oceanographic and climate features of the AI ecosystem area, about species present in the ecosystem and their interactions, and about human activities influencing the ecosystem. This section should integrate existing models, and be a summary or inventory of other sources, rather than an encyclopedic listing.

- 2.1 Description of AI boundary
- 2.2 Oceanographic, climatic factors (oceanographic and climatic models)
- 2.3 Biological factors (food web model, with life history characteristics and spatial variation)
- 2.4 Fisheries and other human development activities

3 Management Goals – based on our understanding of the ecosystem area, what are our management goals? These should reflect societal objectives.

4 Ecosystem assessment – using the identified management goals, how can we define appropriate ecological indicators to assess the state of the ecosystem by integrating models and indicators. This section would be similar to the AFSC work in the PSEIS and the Ecosystem SAFE chapter.

- 4.1 For each management goal, identify indicators and assess status of ecosystem relative to management goal

5 Implications for fishery management – identify areas of uncertainty, conduct management strategy evaluations to assess management measures calculated over a realistic range of uncertainty

- 5.1 Assess areas of uncertainty
- 5.2 Consider tradeoffs and reconcile conflicting goals

6 Priorities – based on the above, what are priorities for future research or management

- 6.1 General
- 6.2 FMP-specific (groundfish, crab, scallop, state-water fisheries)

7 Strawman Information for FEP

Based on the preliminary Table of Contents identified in Section 6, this section provides some initial information such as will be found in the FEP, should it be developed. **NOTE: the following sections are incomplete, and will be substantially revised should the Council choose to initiate a FEP.**

7.1 Purpose and Need

The purpose and need for the FEP are identified in Section 1 above.

7.2 Understanding the Aleutian Islands Ecosystem Area

The Aleutian Islands region is a unique and, to many, a mystifying place. The Aleutian Islands form an archipelago that extends 1000 miles across the North Pacific and lies along the great circle routes used by vessels and aircraft transiting from the U.S. west coast to eastern Russia, Korea, and Japan. This island

chain possesses special characteristics that set it apart from other areas in the North Pacific. It experiences some of the worst weather on the planet, it harbors abundant and diverse bird and mammal populations, and has an historic and cultural heritage that dates back to the last ice age when the region was likely colonized by peoples that crossed the Bering Land Bridge.

The Aleutian Islands themselves provide habitat for many species of nesting seabirds, rookery and haulout habitat for several species of marine mammals, and a migratory path for great whales, other marine mammals, and seabirds that occupy this region seasonally for feeding, nesting and fledging chicks. The region has a rich cultural heritage, and is poised to change as military, shipping, fishery, and community development proceeds in the coming decade.

7.2.1 Oceanography and Climate

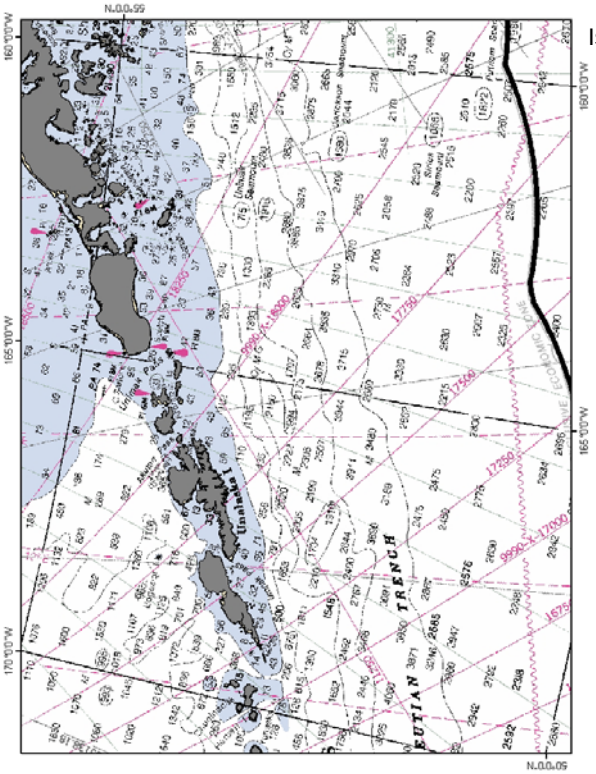
Physical and Biological Characteristics

The Aleutian Islands area or "ecosystem" possesses unique abiotic and biotic environmental features and an interdependent web of energy flow from terrestrial and marine primary production through top level consumer organisms in an island-dominated geographic region. The island chain forms a boundary between the open North Pacific Ocean and its Bering Sea, although the boundary is highly permeable with many inter-island passes that are pathways for water exchange and movement of marine organisms (Figure 6). The Aleutian Islands mark the furthest southward extent of seasonal sea ice of the Bering Sea, although in recent years warming trends have minimized formation of ice in the more southerly portions of the Bering Sea.

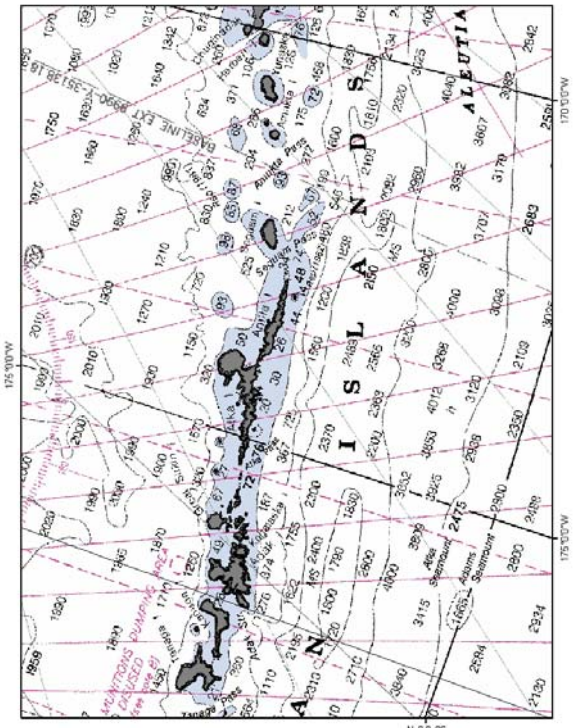
From 4,000 ft mountain peaks to the 24,000 ft depths of the Aleutian Trench, the Aleutian Islands offer a unique and dramatic diversity in landforms. Many of the Aleutian Islands are crests of submerged volcanoes. The region is highly volcanic and seismically active because of the tectonic convergence of the Pacific Plate and the North American Plate; the Aleutian Trench marks the convergent boundary of these plates. The region spawns some of the intense weather systems that greatly affect the oceanography and biological productivity in the North Pacific Ocean. The region supports a wide diversity of organisms, some in large numbers, including millions of seabirds, thousands of marine mammals, and abundant fish species, some of which support commercial fisheries.

The climate of the Aleutians is maritime and characterized by frequent cyclonic storms and high winds, and during calm periods the region often is covered by dense fog. Marine water flows through the various passes between islands, providing nutrients to fuel the productivity of the region and the adjacent Bering Sea. The Bering Sea and Aleutian Islands region is one of the most productive marine systems in the world. Plankton and forage fish species provide a nutritional base for millions of seabirds and marine mammals as well as abundant pelagic and demersal fish species.

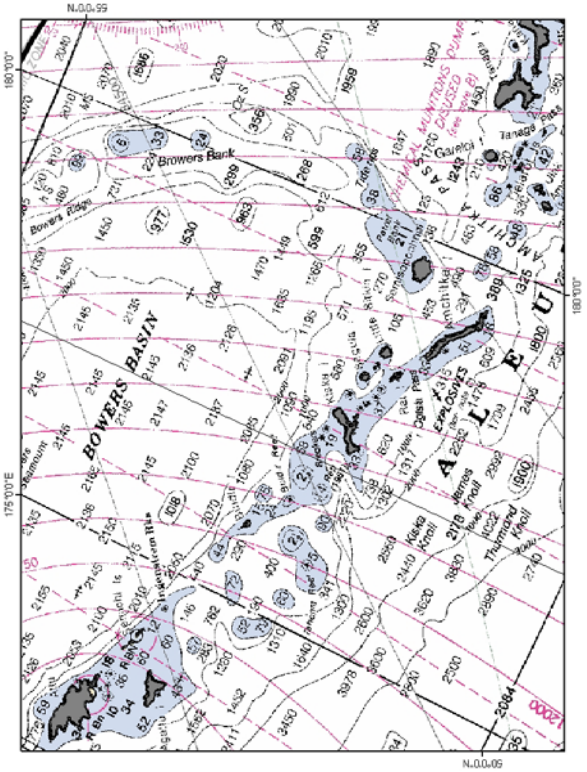
Figure 6 Map of the Aleutian Islands



Islands of Four Mountains to Unimak Island



Tanaga Island to Islands of Four Mountains



Attu Island to Tanaga

7.2.2 Species

The Alaska Fisheries Science Center's Resource Ecology & Ecosystem Modeling group researches food web models for Alaska region waters. Models have been in development for the eastern Bering Sea and the Gulf of Alaska for some time, however the unique characteristics of the Aleutian Islands require an area-specific food web model. Using ECOPATH/ECOSIM, a model is currently being developed for the Aleutian Islands.

Fish

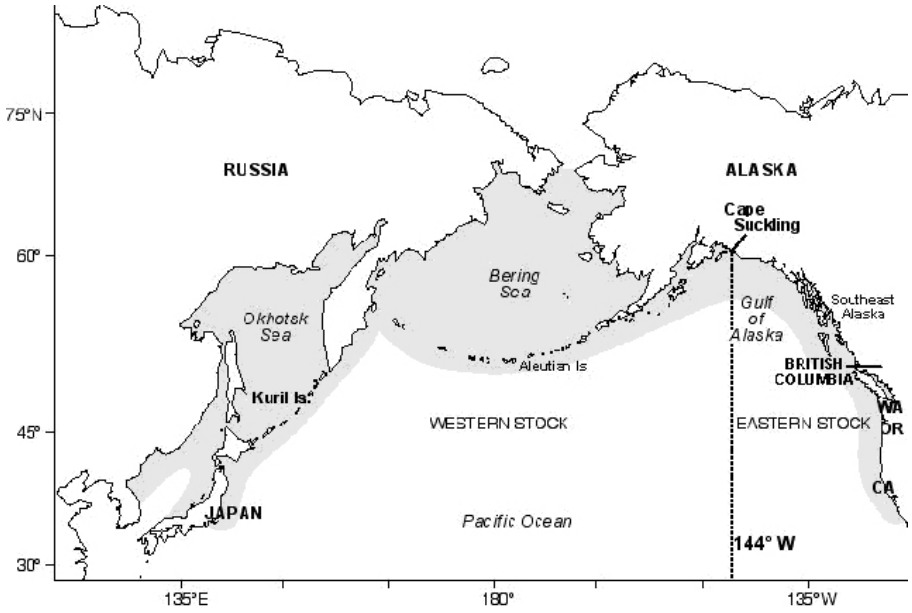
Marine Mammals and Seabirds

The Aleutian Islands are inhabited by diverse and abundant marine mammal and seabird populations. Many of these species feed on fish harvested in Federal or State fisheries, or otherwise interact with fishing activities, sometimes leading to injury or mortality. In the case of marine mammals, which are afforded special protection under the Marine Mammal Protection Act, any injury or mortality is illegal unless specially permitted. A similar situation exists for many of the seabirds in the area under the Migratory Bird Treaty Act. The Endangered Species Act also has considerable impact on activities in this region given the current listing status of many marine mammal and seabird species. The effects of these laws are magnified in the Aleutian Islands because of the abundance of species inhabiting this region, which are afforded these protections.

Steller sea lions

The Steller sea lion (*Eumetopias jubatus*) inhabits many of the shoreline areas of the Aleutian Islands, using these habitats as seasonal rookeries and year-round haulouts. Steller sea lions feed in the nearshore and offshore waters throughout the Aleutian Islands. The Steller sea lion was listed as threatened under the Endangered Species Act (ESA) on November 26, 1990 [55 FR 40204] and critical habitat for the species was designated August 27, 1993 [58 FR 45269]. In 1997 the SSL population was split into two stocks or Distinct Population Segments (DPS) based on genetic and demographic dissimilarities (Bickham et al 1996; Loughlin 1997)[62 FR 30772]. These are the western and eastern stocks. Because of a pattern of continued decline in the western DPS, the western DPS of SSL (wSSL) was listed as endangered on May 5, 1997 [62 FR 30772] while the eastern DPS remained under threatened status. The wSSL inhabits an area of Alaska approximately from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters (Figure 7).

Figure 7 Distribution of western and eastern distinct population segments of Steller sea lion



Throughout the 1990s, particularly after critical habitat was designated, various closures of feeding areas around rookeries and haulouts, and some offshore foraging areas, were designated to limit commercial harvest of pollock, Pacific cod, and Atka mackerel, which are important components of the wSSL diet. In 2001 a Biological Opinion was released that provided protection measures that would not jeopardize the continued existence of the wSSL nor adversely modify its critical habitat; that opinion was supplemented in 2003, and after court challenge, these protection measures remain in effect today (see Supplemental Figure A).

Over the past decade or more, the western Aleutian Islands wSSL sub-population was of particular concern. Non-pup counts declined from 14,011 in 1979 to just 817 animals in 2002. Although all other sub-populations in the western DPS increased between surveys conducted in 2000 and 2002, the western Aleutian Islands area group decreased by 23.7% in just two years. The cause of the steep decline observed in the area is unknown, although some researchers are finding links between prey composition and area. Other hypotheses involve changes in oceanic conditions such as salinity and temperature. Other possibilities for this sub-population include the taking of animals in Russian fisheries (e.g., herring). In 2004, scientists conducted another wSSL survey, and found that this Aleutian Islands sub-group is no longer declining. The overall wSSL population increased for a second consecutive survey (an increase was observed between the 2000 and the 2002 surveys.)

Because of the past declines observed in the wSSL population, special studies have been initiated in the Aleutian Islands area to determine the efficacy of the protection measures in providing areas closed to fishing where wSSLs can forage and obtain sufficient prey to meet nutritional requirements. These studies have been termed Fishery Interaction Studies, and have focused on fish movement patterns and the effect of commercial fisheries on Pacific cod and Atka mackerel in the Aleutian Islands. While results are very preliminary, no evidence of fishery-related localized depletion of these two species of fish have been detected, although the studies continue. These studies are unique in that they focus exclusively on fishery interactions with target species, with the objective of testing whether geographic closed areas are an appropriate tool for wSSL management.

While recent surveys show some possibility that the decline in abundance of the wSSL DPS may have halted, the entire DPS will be the subject of continued study and monitoring until persistent increases in

this population occur. Undoubtedly studies will continue to explore whether geographic closed areas or other wSSL protection measures may be part of this turn around. The Aleutian Islands wSSL population likely will be an integral part of this ongoing work.

Northern fur seal

The Northern fur seal (*Callorhinus ursinus*) seasonally occupies rookeries on the Pribilof Islands for mating and rearing of pups. This marine mammal uses Aleutian Island passes as important migratory pathways to and from the Pribilof Islands. The fur seal is pelagic for the winter months, although its habitat use patterns when not on the Pribilofs is largely unknown. The Northern fur seal has declined considerably in the past decade and is the subject of special study by NMFS and special attention by the Pribilof Islands Collaborative.

Harbor seals

Three separate stocks of harbor seals (*Phoca vitulina richardsi*) are identified in Alaska, with the Gulf of Alaska stock inhabiting the Aleutian Islands (Angliss and Lodge 2003). Ongoing genetic stock identification studies suggest possibly more stock differentiation in the Alaskan harbor seal population, but sufficient data are not available to change the current three-stock structure. Harbor seals have declined in portions of their range in Alaska. The Aleutian Islands group has not been surveyed since 1994, so trends in the region are unknown. Given the declines in some areas, the use of harbor seals as a Native subsistence food item, and the unclear population structure in Alaska, harbor seals are the focus of ongoing research, most of it by the State of Alaska.

Sea otters

The southwest Alaska distinct population segment of the northern sea otter (*Enhydra lutris*) has been proposed for ESA listing as threatened because of a steep decline in abundance of sea otters, particularly in the Aleutian Islands area. If listed, the USFWS intends to develop criteria for designating critical habitat and to begin the species recovery process. Groundfish fisheries have not been implicated in the decline of sea otters, and interactions between this species and fisheries are not believed to be significant.

The Aleutian Islands area provides important habitat for this coastally-oriented marine mammal, where it remains year-round to feed and rear young. In the 1980s, the sea otter population in the Aleutian Islands ranged from 55,100 to 73,700 individuals (Calkins and Schneider 1985). A 1992 count in the Aleutian Islands area was 8,042 sea otters, and in the spring 2000 surveys the count for this area was 2,442 animals. On February 11, 2004, the USFWS published a Proposed Rule to list the southwest DPS as threatened [69 FR 6600]. The southwest DPS is designated as a strategic stock by the USFWS because of the possible ESA listing, and it is likely that special research and management attention will focus on this species in coming years, particularly in the Aleutian Islands.

Whales

Several species of whales use Aleutian Island passes as migratory pathways to feeding grounds in the Bering Sea and then to return to seasonal wintering and calving areas further south. Of these whales, the endangered North Pacific right whale is perhaps of most concern given its very small known population size. This whale moves through the Aleutian Island region annually to occupy feeding habitat in the eastern Bering Sea; it is very rare, and only up to 25 individuals have been seen annually in recent surveys.

Other whales move through the Aleutian Islands area, including blue whales, sei and minke whales, humpback whales, and gray whales. The blue whale is the subject of more focused acoustic studies designed to determine population size and habitat use patterns; blue whales may inhabit the Aleutian Islands area year-round. Sperm whales also inhabit the Aleutian Islands area, and are known to depredate longline-caught sablefish. Killer whales also have been known to depredate longline catches, and have been implicated as predators of Steller sea lions, sea otters, and other marine mammals in the Aleutian Islands. The extent to which whales utilize the waters around the Aleutian Islands is largely unknown, but the Aleutian Islands area appears to be important whale feeding and migratory habitat for many species.

Short-tailed albatross

The short-tailed albatross (*Phoebastria albatrus*) is listed as endangered [65 FR 46643] under the ESA because of its low population size compared to historic levels throughout its range. This albatross breeds primarily on a small island offshore the east coast of Japan. Telemetry studies indicate that after leaving their breeding and nesting grounds, short-tailed albatross move fairly quickly northward to the North Pacific and into the Bering Sea in spring and summer where these birds feed and may remain year-round. This seabird appears to concentrate particularly in the Aleutian Islands area, feeding on the continental shelf and slope and within passes between islands. Given the importance of the Aleutian Islands region as feeding grounds for this endangered seabird, continued research and management will likely emphasize at-sea capture and tracking movement studies in the Aleutian Islands (Rob Suryan, OSU, pers. comm., Oct. 2004) to better understand its year-round distribution and movement patterns. All longline and trawl groundfish fisheries managed by the Council are under an incidental take limit. Future groundfish fishery management in the Aleutian Islands area will likely give special attention to these concerns given the prominence of this species in the Aleutian Islands.

Steller's eiders

The Steller's eider (*Polysticta stelleri*) is listed as threatened under the ESA. This species of sea duck molts and then winters in nearshore marine waters throughout the Aleutian Islands where it mixes with the more numerous Russian Pacific population of Steller's eider (USFWS 2003). The species utilizes protected bays and inlets as refuge during a flightless period after molting, and then remains in many of these areas to feed throughout the winter. Causes for their decline are unknown but may include such factors as lead poisoning, predation on breeding grounds, contaminants, and ecosystem change. Concerns have been expressed over disturbance of this bird from vessel traffic or release of petroleum products into the marine environment in coastal areas where this species winters. There will continue to be elevated concerns over any human activity or development in or near Steller's eider habitat in the Aleutian Islands and Alaska Peninsula area.

Other seabirds

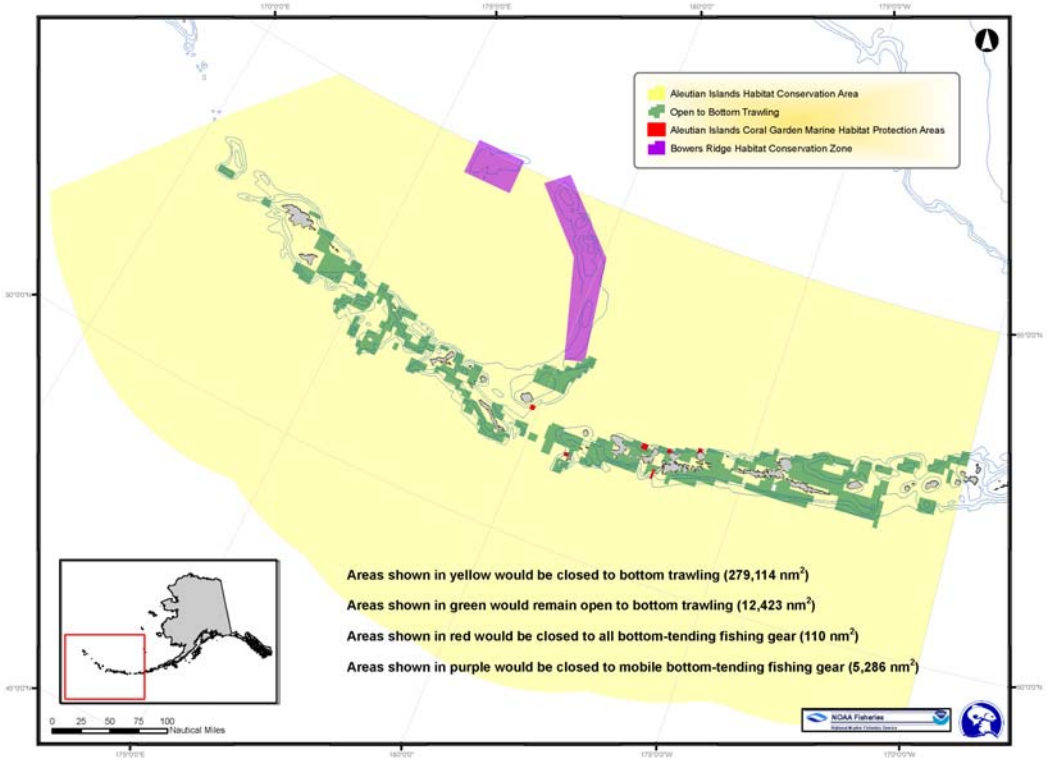
Millions of seabirds nest and fledge young from habitats on many of the Aleutian Islands. The Aleutian Islands area is considered one of the most important and significant seabird nesting areas in the North Pacific because of the unique habitats the islands provide. The Aleutian Islands marine waters over the continental shelf and slope and Aleutian Islands passes provide feeding grounds for millions of seabirds. The Aleutian Islands region seasonally supports thousands of cormorants, gulls, kittiwakes, guillemots, and murrelets and millions of storm-petrels, murres, auklets, and puffins. The Aleutian Islands also provide year-round habitat for large numbers of northern fulmar and smaller numbers of shearwaters and Laysan albatross and some black-footed albatross. One of the principal reasons the U.S. Congress established the Alaska Maritime National Wildlife Refuge, which encompasses nearly all land areas of the Aleutian Islands (and also other islands and coastal areas of Alaska; see heading at the end of this section), is because of the very high numbers of seabirds that nest and feed in this region.

Benthic Habitat

The continental shelf in this area extends only a small distance offshore, then breaks to an edge and slope descending to a seafloor that in some areas sustains unique assemblages of cold water corals, sponges, bryozoans, and other sessile invertebrates. Unlike the Bering Sea, the distribution of sediment type and texture is not known for the Aleutian Islands (NMFS 2004b), and these habitats have only recently been documented. The Aleutian Islands is thought to harbor the highest abundance and diversity of cold water corals in the world. Such benthic habitats and the fish and other organisms that associate with this habitat will likely be the focus of continued future research and observation, particularly using new submersible technology.

Under the Council's Essential Fish Habitat program, much of the Aleutian Islands area and several Habitat Areas of Particular Concern (HAPCs) have received special protection from fishing activities (Figure 8). In February 2005, the Council approved closing large areas in the Aleutian Islands to bottom trawling to protect unique seafloor biological assemblages, especially beds of cold water corals, sponges, bryozoans, and other associated organisms. These closed areas include six Aleutian Islands coral gardens, which are closed to all bottom contact gear, and Bowers Ridge, which is closed to mobile bottom contact gear that includes pelagic trawls that contact the sea floor, non-pelagic trawls, dredges, and troll gear that contacts the sea floor (including dinglebar gear).

Figure 8 Essential Fish Habitat mitigation areas and Habitat Areas of Particular Concern designated by the Council in February 2005



Gear on habitat

The Ecosystem Considerations chapter (Boldt 2005) provides information on the spatial pattern of fishing effort in the groundfish fisheries in the Aleutian Islands subarea. Figure 9 and Figure 10 demonstrate the spatial location and density of bottom trawl and hook and line effort in the AI between 1990 and 2004.

Figure 9 Spatial location and density of hook & line effort in the Aleutian Islands, 1990-2004

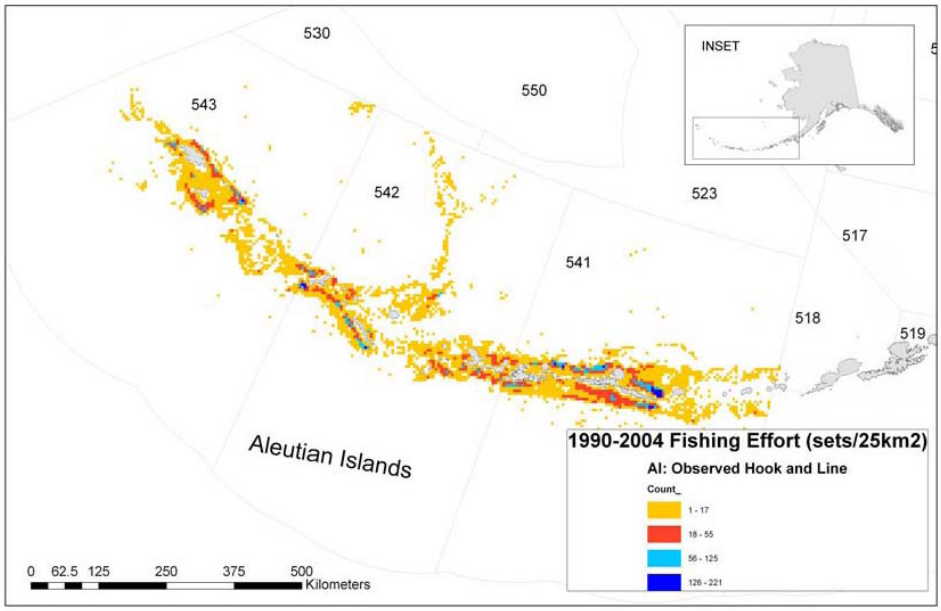
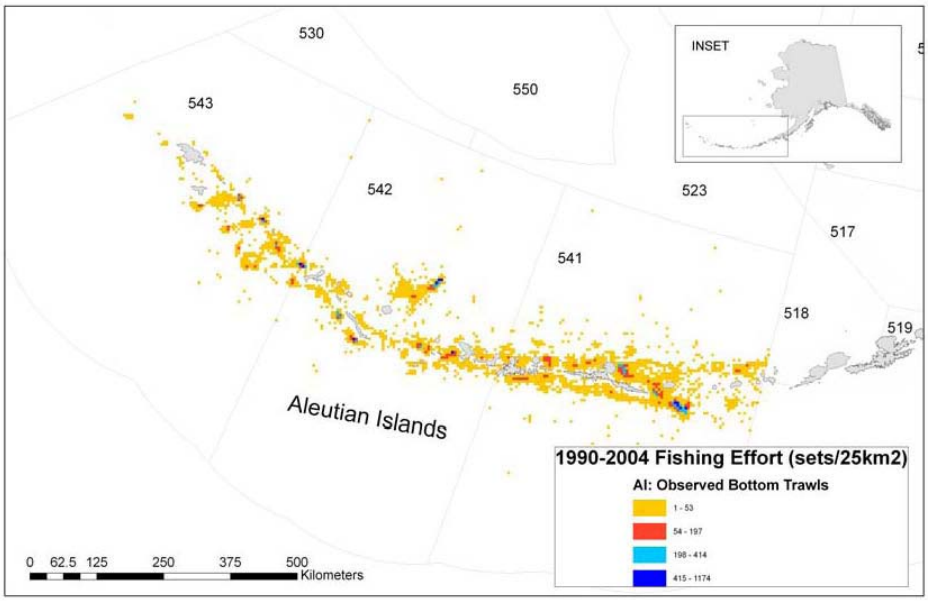


Figure 10 Spatial location and density of bottom trawl effort in the Aleutian Islands, 1990-2004



7.2.3 Human Activities

Fisheries

There are four federal fisheries that occur in the Aleutian Islands, for groundfish, halibut, scallops, and crab. The State of Alaska manages parallel and state-water fisheries for Pacific cod, salmon, herring, and black rockfish. Subsistence fisheries also occur for many marine species. Recreational fishing effort is small in the area.

Federal Groundfish Fisheries

Aleutian Islands groundfish fisheries are managed by the Council and the National Marine Fisheries Service (also referred to as NOAA Fisheries or NMFS) under the Bering Sea and Aleutian Islands (BSAI) Groundfish Fishery Management Plan (FMP). The Aleutian Islands is a subarea defined in the FMP as that area of the EEZ that is west of 170º W. longitude and south of 55º N. latitude, and it is divided into three districts (Figure 11).

Figure 11 Aleutian Islands subarea of the BSAI Groundfish FMP

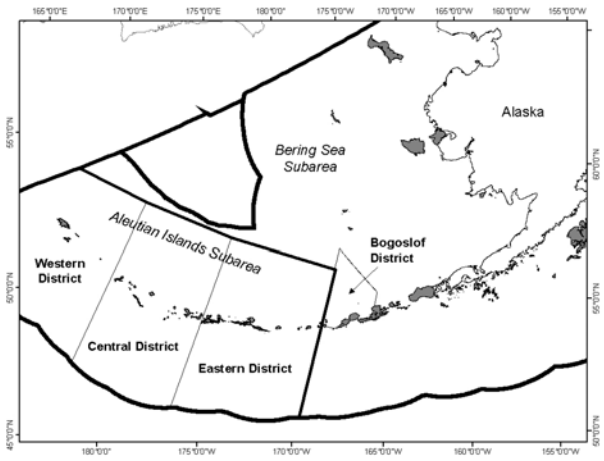


Table 3 lists the species managed under the BSAI Groundfish FMP, and the catch in 2003 for those species in the Aleutian Islands and Bering Sea subareas. For comparison, catch is also indicated for these groundfish in the western GOA regulatory area (which encompasses waters west of 170º W. longitude, to the south of the eastern Aleutian Islands) and the remainder of the GOA regulatory areas. Catches in the Aleutian Islands subarea (AI subarea) have always been much smaller than those in the Bering Sea subarea. Total catches from the AI subarea in recent years have been just over 100,000 mt annually, compared to over 1.8 million mt in the Bering Sea subarea. The historical species composition for each subarea is illustrated in . Management of these Federal fisheries is complex given the geographic size and extent of the region, its distance from research and management facilities, and enforcement and safety concerns.

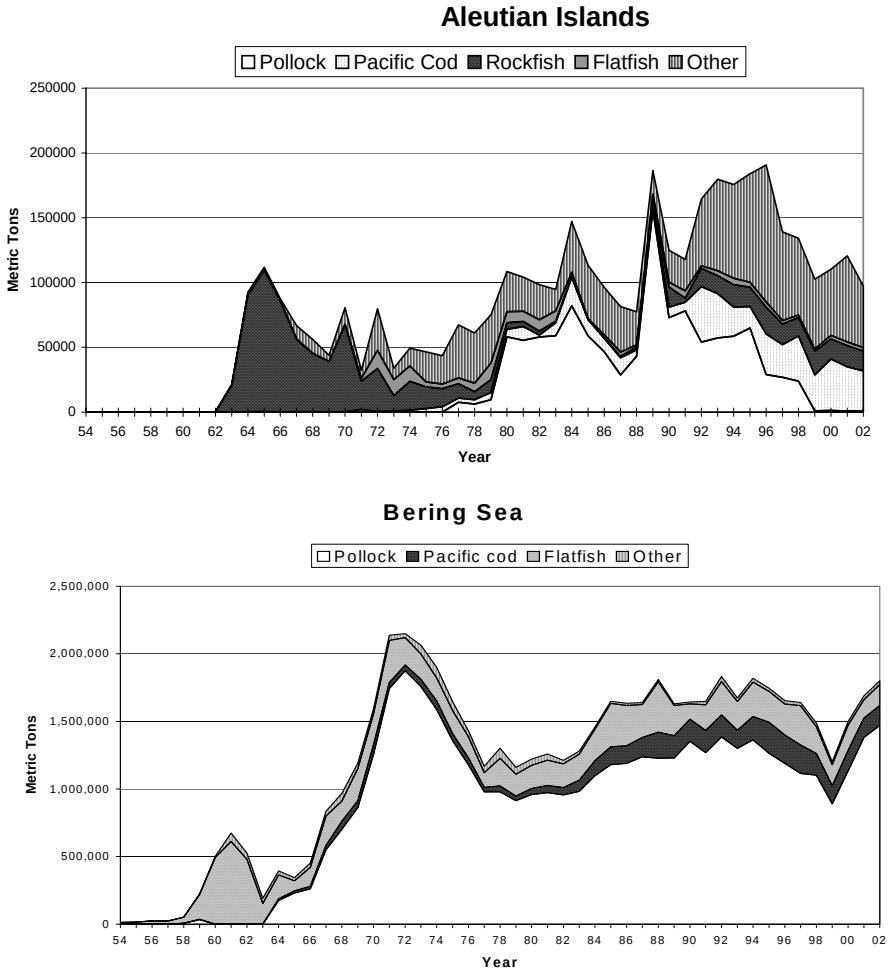
Table 3 Catch, in mt, of groundfish FMP-managed species in Alaska, in 2003.

BSAI Groundfish FMP managed species	Aleutian Islands	Bering Sea	Western GOA	Other GOA
Pollock	1,653	1,489,997	16,508	33,008
Pacific cod	32,455	176,659	16,189	24,831
Sablefish	1,119	969	2,110	8,912
Atka mackerel	51,742 [4]	5,368 [4]	578 [5]	-- [5]
Yellowfin sole	0	79,961	4 [6]	55 [6]
Greenland turbot	993	2,515	8 [6]	5 [6]
Rock sole	972	35,003	196 [6]	3,186 [6]
Arrowtooth flounder	987	12,292	8,201	30,705
Flathead sole	0	13,792	515	1,910
Other flatfish [1]	81	3,137	788 [6]	1,967 [6]

BSAI Groundfish FMP managed species	Aleutian Islands	Bering Sea	Western GOA	Other GOA
Alaska plaice	0	9,964	1 [6]	13 [6]
Pacific ocean perch	12,760	1,151	2,149	8,712
Northern rockfish	4,582	72	533	4,810
Shortraker and rougheye rockfish	230	90	225	1,177
Other rockfish [2]	411	328	664	4,621
Squid	36	1,198	na [7]	na [7]
Other species [3]	1,411	26,305	na [7]	na [7]

[1] Includes starry flounder, rex sole, longhead dab, butter sole, and all species of flatfish caught in the management area, other than flathead sole, Greenland turbot, rock sole, yellowfin sole, arrowtooth flounder, and Alaska plaice.
[2] Includes light dusky rockfish, shortspine thornyheads, and all species of Sebates and Sebastolobus caught in the management area, other than Pacific ocean perch, northern rockfish, rougheye rockfish, and shortraker rockfish.
[3] Includes sculpins, skates, sharks, and octopus.
[4] Atka mackerel for the combined Eastern Aleutian Islands district and Bering Sea subarea was 11,010 mt in 2003; it is reported under the Aleutian Islands.
[5] The Atka mackerel TAC is for the whole GOA, but is mostly caught in the western GOA.
[6] Flatfish categories differ in the GOA; for flatfish catch breakdown, see Turnock et al. 2003; data is for 2003 through October.
[7] Breakdown not available for squid and other species in the GOA; GOA-wide total catch was 6,339 mt.

Figure 12 Groundfish catch by subarea, Bering Sea and Aleutian Islands, 1954-2002.



Although the BSAI groundfish fisheries are managed under a single FMP, many of the management measures apply at a subarea level. Table 4 describes those FMP measures that are specific to the Aleutian Islands subarea, and those that apply to the management area as a whole.

Table 4 Current management measures in BSAI groundfish fisheries that apply across the management area, and those that are AI subarea-specific

Issue	FMP measures that apply BSAI-wide	FMP measures that apply to the Aleutian Islands only
Allocation	AI TAC + BS TAC ≤ 2 MMT AI Fisheries with BSAI TAC: • Directed: Pacific cod • Incidental: Northern, shortaker and rougheye rockfish, flatfish, squid, other species	AI Fisheries with AI subarea TAC: • Directed: Pollock (as of 2005), Pacific ocean perch (by district), Atka mackerel (by district, jig 1% in Eastern AI/BS district), sablefish (trawl 25%, fixed gear 75%), Greenland turbot • Incidental: 'other rockfish'
Permit	BSAI license • certain vessels exempted: vessels fishing only in State waters, vessels less than 32' LOA, or jig gear vessels less than 60' LOA with specific effort restrictions.	Must have AI subarea endorsement
Closures/gear restrictions	Steller sea lions: • 3 nm no-transit zones around rookeries, no trawling for pollock, Pacific cod, or Atka mackerel within 20 nm of rookeries and haulouts during some or all seasons Prohibited species • Attainment of PSC limits for crab, salmon, and herring closes areas Gear: • Non-pelagic trawl gear prohibited in directed pollock fishery	Steller sea lions • Many of the rookeries and haulouts in the AI EFH and HAPC: • Council has designated various AI EFH and HAPC areas with protections such as no bottom-trawling Prohibited species: • One closure area in the AI: Chinook Salmon Savings Area 1.
Prohibited species and bycatch	Halibut, herring, salmon, king crab, and tanner crab are prohibited species. • BSAI-wide halibut PSC limit for trawl fisheries (3,675 mt)	• PSC limit for Chinook salmon in AI pollock trawl fisheries
Share-based programs	• Fixed-gear sablefish fishery is IFQ program. • some CDQ allocations BSAI-wide	• Directed pollock fishery in the AI subarea is fully allocated to the Aleut Corporation. • AI subarea-specific CDQ fisheries for pollock (as of 2005), POP, Atka mackerel, sablefish, Greenland turbot, rockfish;
Monitoring and Reporting	• 100%/30%/0% on vessels >125'/60-124'/<60' LOA • Fish tickets, C/P and processor reports	• 200% observer coverage on AFA vessels harvesting AI pollock

Historically, groundfish fisheries prosecuted in the AI subarea have included Atka mackerel, Pacific cod, sablefish, flatfish, and rockfish. Prior to 1999, pollock were harvested in this area. Pollock in the Aleutian Islands region is considered to be a separate stock from the eastern Bering Sea pollock, with a tentative boundary identified at 174º W. longitude, although there is some exchange between the stocks. From 1999 through 2004, the directed fishery was closed. Some pollock are harvested incidentally in other target fisheries (e.g., Atka mackerel, Pacific Ocean perch); in 2003, pollock bycatch in other directed fisheries was 1,653 mt.

Beginning in 2005, the Council has authorized allocation of pollock quota in a directed pollock fishery in the Aleutian Islands (Amendment 82). The allocation is to the Aleut Corporation per recent Congressional action (PL 108-199). The annual quota for this fishery currently is set at no more than 19,000 mt, less the CDQ apportionment and incidental catch allowances for other directed groundfish fisheries. The Council intends to re-visit this quota level and other aspects of the fishery in June 2006. Historically, harvests in

the AI subarea pollock fishery have occurred in several areas of concentration, including areas north of Atka Island, northwest of Adak Island, and east of Attu Island and north of Shemya Island.

The Pacific cod fishery is managed under a quota apportioned to the entire BSAI management area, and there is no evidence of stock structure within the management area. Pacific cod catch statistics for the AI subarea for the period 2000-2003 showed harvests ranging from 28,649 to 39,684 mt (average 33,335 mt; Thompson and Dorn 2003). This fishery has historically occurred around Adak and Atka islands. Since 1999, when the AI subarea was closed to a directed pollock fishery, the Pacific cod fishery has been prosecuted under Steller sea lion (SSL) protection measures that allow Pacific cod fishing to occur closer to shore than a directed pollock fishery would be allowed. During 1997-2001, the AI subarea accounted for an average of about 16% of the BSAI Pacific cod quota.

The Atka mackerel fishery harvested 54,287 mt in 2003. The center of abundance of Atka mackerel appears to be the Aleutian Islands, although their distribution ranges from the Kamchatka peninsula to the Gulf of Alaska. The harvest quota has been distributed across the AI subarea districts since 1992, to minimize the risk of localized depletion. Although the fishery takes place primarily in the AI subarea, the fishery also occurs north of Akutan Island in the Bering Sea subarea. Areas of harvest concentration in the AI subarea in 2003 were south of Amukta and Tanaga passes, east of Attu Island, and scattered in the Rat Islands area (Lowe et al. 2003).

The sablefish fishery in 2003 harvested 1,008 mt, almost all of which from longline and pot fisheries. The population is considered to be a single stock throughout Alaska and northern British Columbia. The directed fishery is entirely under an IFQ management system and is prosecuted with fixed gear; a small amount is taken incidentally in some trawl fisheries (35 mt in 2003). The locations of the sablefish harvests from 1995-2003 suggest most of the fishing effort in the AI subarea occurs within 100 nm of Adak and Atka. This fishery is not under special restrictions for SSL protection, and occurs in waters within 20 nm of shore in the AI subarea.

The AI subarea rockfish fisheries include catch of Pacific ocean perch (POP), northern rockfish, shortraker and rougheye rockfish, and other rockfish. Rockfish harvested in the AI subarea in 2003 totaled 17,973 mt. Only the fishery for POP is directed, due to small harvest quotas; the other species are caught incidentally, primarily in the Atka mackerel and POP fisheries. 90% of northern rockfish are caught incidentally in the Atka mackerel fishery (Spencer and Ianelli 2003b). The Pacific ocean perch stock is spatially distributed in the AI subarea, where approximately 84% of the population is concentrated, according to survey data (Spencer and Ianelli 2003a). The fishery historically has occurred throughout the AI subarea with some concentration of harvests between Kiska and Agattu islands, around Amchitka Island and Petrel Bank, north of Atka Island, and in Amukta Pass. Shortraker and rougheye rockfish are caught incidentally in a variety of target fisheries. The majority of ‘other rockfish’ catch is light dusky rockfish and shortspine thornyheads. In the AI subarea, these species are mainly caught incidentally in the Atka mackerel trawl fishery, for light dusky rockfish, and in sablefish, grenadier or skate longline hauls or the POP trawl fishery, for shortspine thornyheads. ‘Other rockfish’ are also distributed in the Bering Sea subarea, north of Unalaska and Akutan Islands and on the slope (Reuter and Spencer 2003).

Most flatfish species are concentrated on the continental shelf of the Bering Sea, and have low abundance in the AI subarea. The only target flatfish fishery in the AI subarea is for Greenland turbot. About 25% of the Greenland turbot biomass is located in the area, and in 2003, the harvest total was 960 mt, mainly by hook and line gear. The fishery has historically occurred primarily within 100 nm of Adak and Atka islands.

Squid and other species (sculpins, skates, sharks, and octopi) are caught incidentally in other directed fisheries. Squid are caught primarily in the pollock trawl fishery. Skates represent the majority of the other species catch (over 21,000 mt for the BSAI in 2002), and are caught in the hook-and-line Pacific cod fishery (Gaichas et al. 2004).

CDQ fisheries occur in the AI subarea for sablefish, Atka mackerel, Greenland turbot, Pacific ocean perch, northern rockfish, shortraker and rougheye rockfish, and other rockfish. In 2005, there will also be a CDQ AI subarea pollock fishery. CDQ groups partner with commercial fishing corporations to harvest these allocations. Most of the CDQ groups have ownership interest in the partner corporations.

The Aleutian Islands has been surveyed biennially by bottom trawl since 2000, and was mostly surveyed triennially from 1980 to 1997. The 2002 survey area extends from Unimak Pass (165º W. longitude) to Statemate Bank (170º E. longitude), including Petrel Bank and Petrel Spur, and covers the continental shelf and upper continental slope to 500 m. The aims of the survey are to provide distribution and relative abundance data for the principal groundfish and commercially or ecologically important invertebrate species in the Aleutian Islands, and to collect data to define biological parameters such as growth rates, length-weight relationships, feeding habits, and size, sex, and age compositions. The most abundant species in the area are Atka mackerel, POP, northern rockfish, walleye pollock, Pacific cod, arrowtooth flounder, and giant grenadier. However, fish populations, such as many rockfish, which extend into areas that are either untrawlable with the survey gear or further up in the water column are not fully represented.

The Aleutian Islands has also been surveyed biennially by longline since 1996. Surveyed depths vary from 200m to 1000m. Survey objectives are to determine the relative abundance and size composition of sablefish, shortspine thornyhead, rougheye and shortraker rockfish, Pacific cod, arrowtooth flounder, grenadiers, and Greenland turbot. Tags to determine migration patterns of sablefish, shortspine thornyhead, and Greenland turbot are also implanted, and data to determine age composition of sablefish.

Ongoing groundfish research projects in the Aleutian Islands address the reproductive ecology of Atka mackerel, and the value of habitat, particularly coral and sponge habitat, to juvenile rockfish in the area.

Other Federal Fisheries

The halibut stock is managed by the International Pacific Halibut Commission (IPHC). Two of the IPHC statistical areas for the halibut fishery encompass portions of the Aleutian Islands, Areas 4A and 4B (Figure 13). Over the last five years, approximately 8,028,000 lb annually, or 14% of the Alaska halibut quota, have been allocated to these areas. Halibut allocations in Alaska are managed under an individual fishing quota program and a community development quota program.

The Federal scallop fishery is managed by the State of Alaska with Federal oversight. The Aleutian Islands scallop fishery is managed under registration Area O (Dutch Harbor). Area O extends from Scotch Cap Light (164º 44’ W. longitude) to the Maritime Boundary Agreement Line that separates U.S. and Russian waters, and encompasses both State and Federal waters. Scallop fishing in Area O generally occurs in the far east, to the north and south of Umnak Island (polygons marked on Figure 14). Area O was closed in 2000 due to management concerns over localized depletion. In 2002, the area was reopened with a reduced guideline harvest range ceiling of 10,000 lb, of which 61% was harvested. Area O represents approximately 1.5% of the statewide guideline harvest range for scallops.

Figure 13 Halibut Fishery Management Areas in the Aleutian Islands

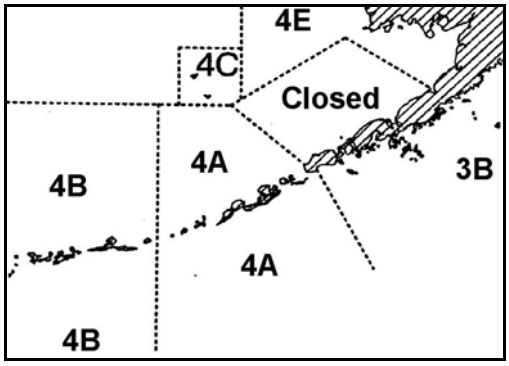
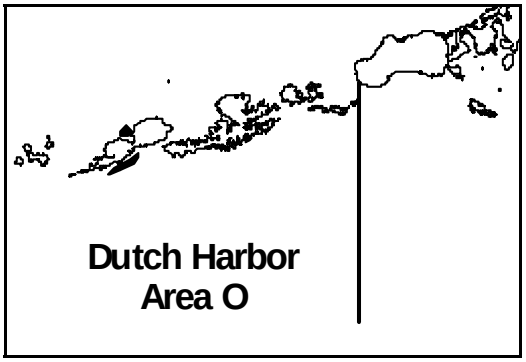
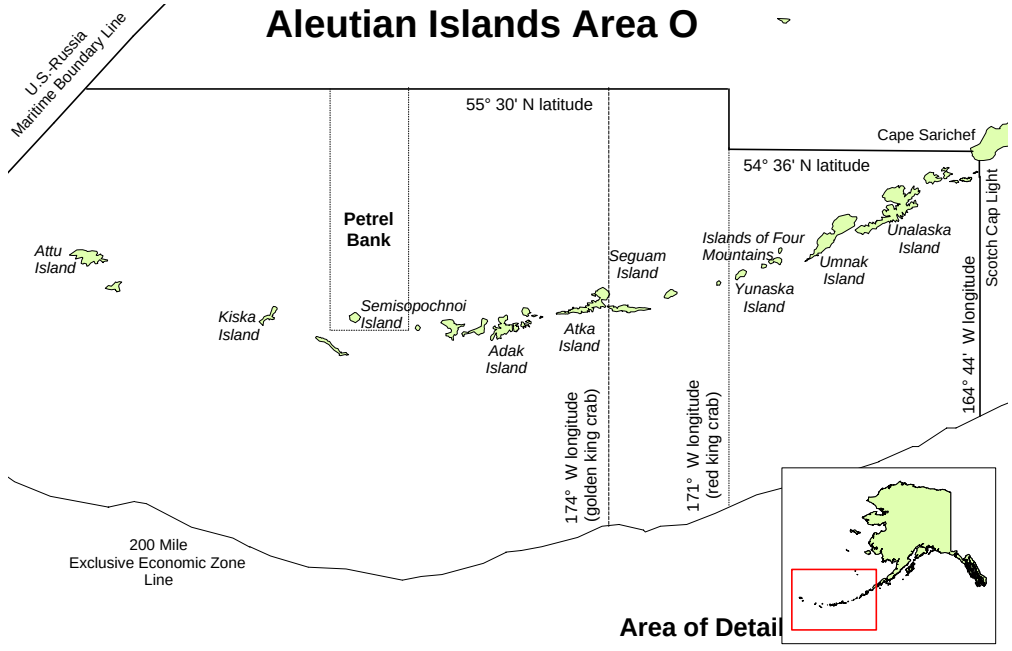


Figure 14 Scallop Registration Area O, with fishing concentration marked by the dark polygons.



The Federal king and tanner crab fishery is also managed by the State of Alaska with Federal oversight. In the Aleutian Islands, king crab fisheries are managed within registration Area O (Figure 15). The primary crab fishery that occurs in the region is the Aleutian Islands golden (brown) king crab fishery. Guideline harvest levels (GHLs), are established for the fishery east and west of 174º W. longitude. While effort and harvest have remained relatively stable in the eastern portion of the fishery, where the GHL for 2003-4 was 3.0 million lb, the western portion has experienced greater variability. The GHL for west of 174º W. longitude was 2.7 million lb, and both GHLs remain unchanged for 2004-5. Seasons in the golden king crab fisheries last several months, in contrast to other Bering Sea crab fisheries.

Figure 15 Aleutian Islands, Area O, king crab management area

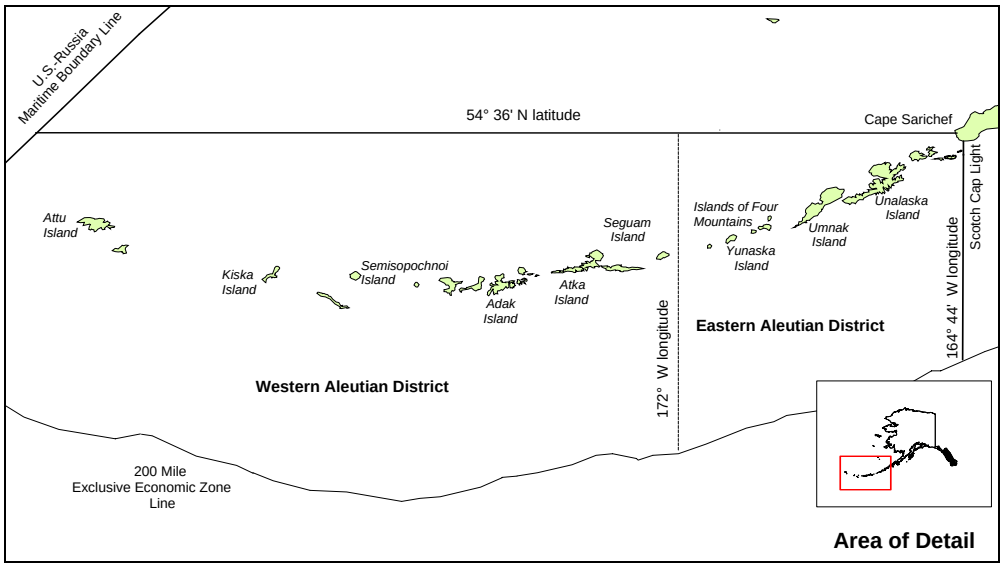


There is also an Aleutian Islands red king crab fishery in Area O. The eastern portion of the red king crab fishery has been closed since 1983, and the western portion, which operates in the Petrel Bank area, has opened sporadically in recent years. The fishery did not open in 2004.

Small tanner crab fisheries in the Aleutian Islands are managed in registration Area J (Figure 16). Tanner crab populations in this area are small, and, when open, are mainly authorized for incidental harvest only.

There are currently no CDQ crab fisheries in the Aleutian Islands. However, under crab rationalization, which will be implemented in 2005, CDQ groups will receive a 10% allocation of the western Aleutian Islands golden and red king crab fisheries.

Figure 16 Tanner crab Registration Area J, with Eastern and Western Aleutian Districts



State Managed or Parallel Fisheries

Future groundfish fishery management in the Aleutian Islands could include expanded parallel fisheries in State waters. Parallel fisheries are managed by the State of Alaska and may occur concurrently with the Federal groundfish fisheries, mirroring the Federal closures and harvest restrictions. Currently, the only directed parallel fishery in the Aleutian Islands occurs for Pacific cod, although other species are taken incidentally.

As outlined in the EA/RIR for Amendment 82 to the BSAI FMP, the potential exists for the State of Alaska to pursue a State-managed or State water pollock fishery in the Aleutian Islands, in which the State regulates the fishery and controls the closures and harvest restrictions. Were the State to initiate such a fishery without adopting the same restrictions as the Federal Steller sea lion protection measures, reinitiation of Section 7 consultation on the Steller sea lion protection measures likely would be required to determine the cumulative effects of the State-managed pollock fishery.

Other State-managed fisheries include sablefish (within State waters), salmon (primarily pink salmon and some sockeye salmon), herring for sac roe or food and bait, and black rockfish. These fisheries are prosecuted wholly within State waters. With increases in human populations in the Aleutian Islands that may accompany military, port, and community development, there may be additional participation in these fisheries and perhaps other, new State fisheries may evolve.

Subsistence and Personal Use Fisheries

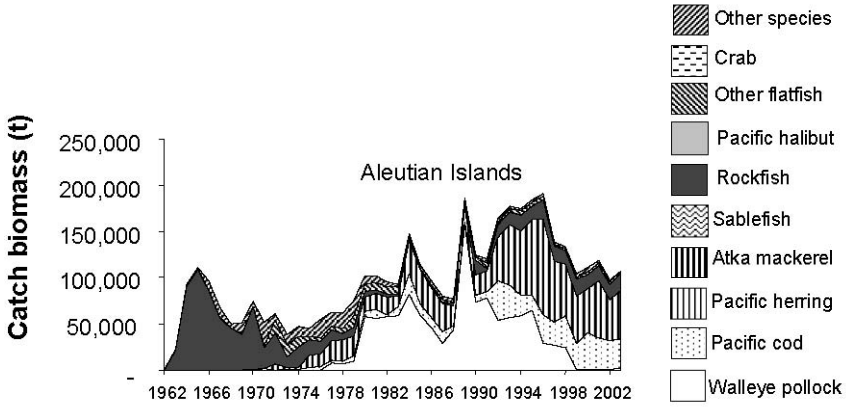
The earliest fisheries in the Aleutian Islands were native subsistence fisheries. Today, subsistence fishing takes place in nearshore waters utilizing such species as cod, halibut, rockfish, and other species. These small-scale subsistence fisheries have continued to the present time. Subsistence activities continue to be a central element in contemporary village life and culture, and are also important to many of Alaska's non-Native residents. Total subsistence consumption ranges from about 200 lb per capita to over 450 lb

per capita. Fish, including salmon, halibut, cod, and rockfish, contribute between 57 and 75% of total subsistence resource consumption in the Aleutian Islands. Other subsistence resources include marine and land mammals, seabirds, and marine invertebrates (NMFS 2004a).

Trophic Level of Catch

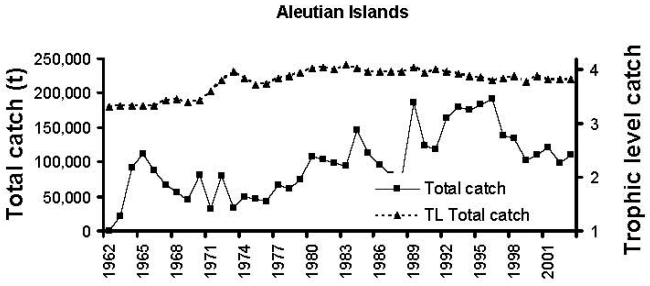
The Ecosystem Considerations chapter (Boldt 2005) looks at the trophic level of the catch to assess how well fishery management is meeting the goal of sustainability, for consumptive and non-consumptive uses. Figure 17 and Figure 18 indicate the catch composition of the total biomass in the Aleutian Islands from 1962 through 2003, and the trophic level of the catch, and concludes that the trophic level has been high and stable over the last 25 years.

Figure 17 Catch composition of total catch biomass (except salmon) in the AI through 2003



Source: Boldt 2005.

Figure 18 Total catch (groundfish, herring, shellfish, and halibut) and trophic level of catch in the AI through 2003



Source: Boldt 2005.

Marine Mammal and Fishery Management Issues

Two situations exist in the Aleutian Islands area that may merit special consideration. One is the geographic extent of the SSL protection measure closures. Over 41% of the AI subarea shelf and slope, to 1000 m, is closed to trawl fishing seasonally or year-round (NMFS 2004a). And a second is the potential changes in how pollock stocks are managed, which may have effects on how the AI subarea pollock fishery evolves in future years.

Steller Sea Lion Protection Measures

Steller sea lion protection measures include areas closed to all or some groundfish fisheries around rookeries and many haulouts along the Alaskan coast (see Supplemental Figure). These measures were put in place as a result of the steep decline in the SSL population and the hypothesis that this decline could be from nutritional stress. Fishing for pollock, Pacific cod, and Atka mackerel is restricted in these areas to limit fishing on prey items that are important in SSL diets. Closures are widespread in the Aleutian Islands. Recent concerns over the broad extent of closures, and recent research that suggests other hypotheses for the Steller sea lion decline, have led to public proposals for relaxing these measures and opening some areas to allow fishing.

A large proportion of the historical pollock harvest in the Aleutian Islands has come from waters that are now closed to pollock fishing by SSL protection measures. Under the current SSL protection measures, vessels generally must fish at least 20 miles from shore. The inclement weather conditions prevailing during the winter, when the AI subarea pollock "A" season fishery will occur, will likely impede growth of a small vessel pollock fishery that is a goal of Amendment 82. Proposals to change SSL protection measures in the Aleutian Islands area have been brought to the Council and its Steller Sea Lion Mitigation Committee, but the Council has decided not to pursue such changes at this time until more SSL research information becomes available. Nonetheless, it is likely that this issue will remain a concern given the Council's approval of Amendment 82 and the initiation of a directed pollock fishery.

Evolving Understanding of Pollock Stock Structure in the Aleutian Islands

Aleutian Islands pollock stock assessments are evolving, and in the near future, stock assessment biologists may recommend subdividing the Aleutian Islands subarea for the purposes of pollock management. Barbeaux et al. (2003) have examined the Aleutian Islands pollock stock and have suggested alternative approaches to assessing pollock resources in the AI subarea that account for spatial patterns in stock distribution. The population of pollock west of 174° W. longitude appears different in size structure and abundance, and it may be recommended that it be separated from the pollock stock east of 174° W. longitude. Barbeaux et al. (2003) recommend closing the area east of 174° W. to a directed pollock fishery, to form a contiguous closed area with the Bogoslof District (see Figure 11). This pollock conservation zone would provide a buffer between management areas and address uncertainties regarding stock structure. This proposal was discussed by the BSAI Groundfish Plan Team in 2003 and 2004.

Recent pollock stock assessment analyses have suggested that spatial considerations be reflected in recommending ABC levels. This may result in TAC recommendations for areas smaller than the AI subarea, which, in order to have catch proportional to biomass distribution, could impact the amount of pollock available to harvest in the central Aleutian Islands. There are currently three districts identified within the AI subarea in the BSAI Groundfish FMP (see Figure 11), and the 174° W. longitude line bisects the Eastern Aleutian Islands District. A recommendation for spatial apportionment of the AI pollock TAC is a reasonably foreseeable issue that the Council will need to weigh as decisions are made on future management of fisheries in the Aleutian Islands.

Cultural Heritage and Human Development Issues

The Aleutian Islands were likely settled by Aleut peoples that moved to Alaska across the Bering Land Bridge perhaps 15,000 years ago. Aleuts subsisted on what the Aleutian Islands and surrounding marine environment provided. With the arrival of Russian explorers and fur traders starting in 1742, the Aleutian Islands became a focus for fur harvests until 1867 when Russia sold Alaska to the United States. U.S. territorial management continued the fur trade and imposed many changes in the region. In the early

1940s, several islands became World War II battlegrounds and staging areas for the U.S. Aleutian Campaign, dramatically changing the landscape on many islands.

Thus the Aleutian Islands have a rich cultural heritage based on the early inhabitant Aleut peoples and subsequent waves of human occupation including the Russian fur trade, management of Alaska as a territory of the U.S., World War II and Japanese occupation, and in past decades a variety of human endeavors including defense installations, atomic energy research and testing, and commercial fisheries. These various human activities have left their mark on the Aleutians in a unique way, providing an historic and archeological heritage found nowhere else in North America.

Development at Adak

Adak Island was the site of a military naval air station until 1997. The site of an early Aleut community, the Aleut Corporation obtained a portion of the island and incorporated the City of Adak in 2001. With passage of PL 108-199 and the Council's recent action to provide for an Aleutian Islands directed pollock fishery, Adak community development will likely increase in the coming years. The Council's action, which allocates AI subarea pollock to the Aleut Corporation, will contribute to the growth of the port and community of Adak. Some connected with the Aleut Corporation have suggested that they would like to see Adak grow from a community of under 200 persons to a community of about 1,000 persons. The City of Adak and the Aleut Corporation are pursuing a wide range of development projects, seeking to take advantage of the facilities (harbor, airport, fuel storage, buildings) left behind by the Navy when the base was closed. Other regional development may result as Adak grows and services in the community expand.

Decontamination Work Resulting from Military Sites

A byproduct of the presence of military facilities throughout the Aleutian Islands has been varying levels of contamination from facility usage, military activities, and weapons testing. The US Navy, Army, and Air Force have developed installation restoration programs that are in varying stages of completion. Monitoring and cleanup is ongoing in many of these sites.

Amchitka Island was the site of three underground nuclear tests between 1965 and 1971. The Consortium for Risk Evaluation with Stakeholder Participation (CRESP), at the request of the DOE and the State of Alaska, designed and executed an *Independent Science Plan* to determine whether the foods from the marine environment around Amchitka were safe, to investigate the biological and geophysical aspects of potential radionuclide exposure, and to develop information for planning long-term biomonitoring. The key biological conclusions were that the foods tested are currently safe for human consumption, there is a rich and diverse marine ecosystem that may be at risk if there were significant seepage, and there are species at different trophic levels that could serve as bioindicators for a long-term stewardship plan at Amchitka. CRESP's recommendations, particularly with respect to what radionuclides to examine, what species should serve as bioindicators, where to monitor, and when to monitor, are under consideration by DOE and ADEC.

Other Regional Development

In addition to expansion of Adak and growth of a commercial fishery based there, the Aleutian Islands are slated for additional development. Military development in the Aleutian Islands may expand, possibly including missile defense systems in the region; development on Shemya Island, or possible activities on Amchitka Island to mitigate lingering effects of nuclear testing, also may occur. It would be speculative to determine any specific activity, since much of this is anecdotal or militarily classified. However, in April 2003, Adak was selected as the site for a $900 million radar system as part of the national missile defense

system. This facility is expected to arrive in Adak by summer 2005. Port expansion is also being proposed in the Dutch Harbor/Unalaska area; the Little South America port facility is being studied and environmental and other studies are still progressing. A new port development at the head of Akutan Bay is the subject of a recent Corps of Engineers EIS; a decision on that development may be made soon. Continuing or new military activity, and these port developments, collectively would add vessel and aircraft traffic in the Aleutian Islands area.

Research, Scientific Issues, and Public Interest

Alaska Maritime National Wildlife Refuge

Most of the islands in the Aleutian chain are part of the Alaska Maritime National Wildlife Refuge, which is administered by the US Fish & Wildlife Service (Figure 19). The Refuge was established to protect breeding habitat for seabirds, marine mammals, and other wildlife. Some islands hold unique species not found elsewhere. The Refuge hosts seabird populations of national and international significance, providing nesting habitat for an estimated 40 million seabirds representing over half of all the nesting seabirds of the U.S. The Refuge also provides important habitat for Steller sea lions, harbor seals, and sea otters.

Figure 19 Map of the Alaska Maritime National Wildlife Reserve.

The Refuge also was established to make possible a program of scientific research on marine ecosystems. Scientists from the U.S. and other nations frequent the Aleutian Islands to conduct a variety of research projects. The region has high scientific visibility given its unique habitats and plants and animals. The research program and scientific activities within the refuge include the eradication of rats and foxes from the islands, and annual seabird and nesting surveys.

Public Interest and Ecotourism

Conservation organizations have been publicizing the unique environmental attributes of the Aleutian Islands for many years. Dozens of colorful publications, brochures, and website advertisements have highlighted the benthic habitats, coral and sponge assemblages, and fish habitat characteristics of the

Aleutian Islands. Cruise ship traffic has increased and brings the public closer to this region than has been the case in the past. Public awareness of these unique aspects of the Aleutian archipelago has increased, and thus the region is now more visible and the focus of public education campaigns for additional conservation, habitat and species preservation movements.

7.3 Management Goals

The Council would develop management goals for the FEP. Some work has already been done in this arena. Appendix B excerpts the management goals for the groundfish fisheries, which were extensively revised in 2004 to present a comprehensive, ecosystem-based policy approach. Appendix C excerpts the crab FMP management objectives, which have not been revised recently. Additionally, the Ecosystem SAFE chapter identifies some general ecosystem goals, which are used for the annual ecosystem assessment. These are provided in Appendix D.

7.4 Assessment of the AI Ecosystem

This section would identify ecological indicators that would tie in to the management goals selected in the section above. Assessment techniques developed by the AFSC in the SAFE chapter, would be used to describe the state of the ecosystem relative to the management goals. A selection of ecological indicators relating to the Aleutian Islands, from the Ecosystem SAFE chapter, is listed in Table 5.

Table 5 Extracts from Indicator Summary Table in the Ecosystem Considerations chapter (Boldt 2005)

INDICATOR	OBSERVATION	INTERPRETATION
AI summer bottom temperature	2004 temperatures were average	Average year
Area closed to trawling BSAI and GOA	2005 had same closures as 2004 plus new closures to protect EFH. Largest closure: AI Habitat Conservation area	Less trawling than prior to 1999 on bottom in certain areas though may concentrate trawling in other areas
Groundfish bottom trawling effort in AI	About the same in 2004 compared to 2003 generally stable trend since 1998	Less trawling on bottom relative to 1990-97
Scallop tows in EBS/AI	Number of tows decreased in 2001/02 in western AK	Generally decreasing number of scallop tows since 1997/98
Longline effort in BSAI	Higher in 2004 relative to 2003 in the BS; slight increase in 2004 relative to 2003 in AI	Generally increasing levels of longline effort in 1990's to present in the BS
HAPC biota bycatch in EBS/AI groundfish fisheries	Estimated at 2191 t for BSAI in 2002; ranged from 923 to 2548 t since 1997.	Similar to 2001 catches.
HAPC biota biomass indices in the AI bottom trawl survey	Survey may provide biomass index for seapens, anemones, and sponges.	More research needed to understand trends
Total groundfish catch AI	Total catch in 2003 shows decline since about 1996, Atka mackerel dominant	Total catch returning to lower levels
Total biomass EBS/AI	Total about the same in 2004 as in 2003, slight decreasing trend in pollock, pollock dominant	Relatively high total biomass since about 1981
BSAI groundfish stock status	In 2003, 0 overfished, 12 not subjected to overfishing	All major stocks are not overfished

INDICATOR	OBSERVATION	INTERPRETATION
Forage biomass indices from AI bottom trawl survey	Survey may not sample these well enough to provide biomass indices	
NMFS bottom trawl survey – AI	Increased jellyfish catches in all AI areas in 2004	More research needed to interpret trends
Crab stock status - BSAI	4 stocks overfished (BS Tanner, EBS snow crab, and Pribilof Is. and St. Mathew Is. blue king)	Mixed crab stock status
Scallop stock status	1 stock- not overfished	
Prohibited species bycatch	A large increase in bycatch rates of other salmon and herring in 2003 and 2004. Other 2004 bycatch rates show a decrease in bairdi, other tanner, and red king crabs; increases in Chinook salmon, and little change in halibut bycatch rates relative to 2003	Prohibited species bycatch rates are mixed.
Non-specified species bycatch	Non-specified species bycatch was the lowest in 2001 (11,122 t), compared to other years (13,368 to 24,634 t). Bycatch in 2002 was 13,368 t.	Dominant species in non-specified bycatch were jellyfish, grenadier and starfish
Alaskan sea lion western stock non-pup counts	2004 non-pup counts increased by 6-7% from 2002. Regional differences in trends.	Continued increase or stable counts in most areas; however, continued decline in central GOA
Seabird breeding chronology	Overall seabird breeding chronology was earlier than average or unchanged in 2002	Earlier hatching times are associated with higher breeding success
Seabird productivity	Overall, productivity of plankton feeding seabirds was average or above average in 2002; whereas, productivity of piscivorous seabirds was average or above average in 2002 (but varied across colonies and regions).	Variable chick production
Population trends	Mixed: majority showed no trend, 18 decreased, 17 increased through to 2002	Variable depending on species and site
Seabird bycatch	2003 BSAI longline bycatch is slightly higher than 2002, N. fulmars dominate the catch (GOA longline bycatch is small and relatively constant) Trawl bycatch rates are variable and perhaps increasing	Unclear relationship between bycatch and colony population trends
Trophic level catch EBS and AI	Constant, relatively high trophic level of catch since 1960's	Not fishing down the food web
Combined standardized indices of groundfish recruitment	Positive values 1976/77 - 1989, negative values in early 1970's and most of 1990's in GOA and BSAI	Above-average groundfish recruitments from 1976/77 - 1989, below average recruitments in early 1970's and most of 1990's.
Combined standardized indices of groundfish survival	Varying patterns	Relatively low survival of demersal stocks in 1990's

7.5 Implications for Fishery Management

7.5.1 Assess areas of uncertainty

Based on conceptual models and evaluations of fishery management measures, identify areas of uncertainty. Provide information on alternative management procedures, and conduct management strategy evaluations to allow the Council to realistically decide on the appropriate level of risk.

7.5.2 Consider tradeoffs and reconcile conflicting goals

The FEP would consider tradeoffs among sectors, fisheries, cumulative effects, external impacts to provide the Council with more information to reconcile conflicting goals.

Interactions among fisheries

BSAI Groundfish FMP and GOA Groundfish FMP

The BSAI and GOA groundfish fisheries are managed in close connetion with one another. While many of the same groundfish species occur in both the BSAI and GOA management areas, they are generally considered to be separate stocks. There is some overlap between participants in the BSAI and GOA groundfish fisheries. Many of the management measures and much of the stock assessment science are similar for the two areas. Management measures proposed for the BSAI groundfish fisheries are analyzed for potential impacts on GOA fisheries. Where necessary, mitigation measures are adopted to protect one area or the other (for example, sideboard measures in the AFA pollock cooperatives).

Groundfish FMP and crab FMP

Domestic fishing for crab for the most part predates the domestic groundfish fishery, and since the inception of the BSAI Groundfish FMP the consideration of crab bycatch in the groundfish fisheries has been paramount. The crab species are considered prohibited in the BSAI groundfish fisheries, with any catch required to be returned immediately to the sea with a minimum of injury so as to discourage targeting on those species. Other management measures have also been instituted to minimize the bycatch of crab in the groundfish fisheries, including area closures, gear modifications, and catch limits. Some participants in the BSAI crab fishery also target groundfish. The crab FMP contains sideboard measures constraining AFA pollock fishery participants from increasing their participation in the crab fishery.

Groundfish FMP and scallop FMP

There is very little interaction between the scallop FMP and the BSAI groundfish FMP. Virtually none of the vessels in the scallop fishery target groundfish. The scallop FMP contains sideboard measures constraining AFA pollock fishery participants from participating in the scallop fishery.

Groundfish FMP and salmon FMP

Pacific salmon are also a prohibited species in the BSAI groundfish FMP. There is no fishing of salmon allowed in the EEZ, therefore there is no overlap of participants or grounds conflicts. The BSAI groundfish FMP includes management measures to reduce the bycatch of salmon in federal waters, including catch limits and area closures.

Groundfish FMP and halibut

The fishery for Pacific halibut in the BSAI is conducted under an Individual Fishing Quota (IFQ) program, in conjunction with the FMP-managed sablefish resource. A realized benefit of the IFQ program is the reduction in halibut bycatch mortality. Much of the longline bycatch of halibut occurred in sablefish fisheries. To the extent that sablefish fishers have halibut IFQ, this halibut is now retained and counted against target quotas.

As long as Council and IPHC objectives concerning halibut utilization remain similar, coordination between the two organizations is easily affected. Should halibut management philosophies diverge – for example, because the broader-based Council constituency objects to constraints on fishery development caused by overriding halibut-saving measures – a major social, political, and, perhaps, diplomatic (because of Canadian involvement in IPHC and in the halibut fishery) confrontation could be precipitated. Furthermore, management actions taken in the Bering Sea that adversely affect halibut are likely to have a significant impact on the Gulf of Alaska halibut stock and fishery because of the interchange of halibut between the two regions.

Groundfish FMP and state groundfish

A parallel groundfish fishery occurs where the State allows the federal species TAC (total allowable catch) to be harvested in State waters. Parallel fisheries occur for pollock, Pacific cod, and Atka mackerel species, for some or all gear types. In addition, the State also has state managed fisheries for Pacific cod and rockfish species. Opening state waters allows the effective harvesting of fishery resources because many fish stocks straddle State and Federal jurisdiction and in some cases a significant portion of the overall federal TAC is harvested within State waters. Although the State cannot require vessels fishing inside state waters during the Federal fishery to hold a Federal permit, it can adopt regulations similar to those in place for the Federal fishery if those regulations are approved by the Board of Fisheries and meet State statute. An example of Federal fishery regulations that were concurrently adopted by the Board of Fisheries are the Steller sea lion protection measures implemented in 2001.

Groundfish FMP and other state fisheries:

State shellfish fishery: King and tanner crab species are considered prohibited species in the BSAI groundfish fisheries, with any catch required to be returned immediately to the sea with a minimum of injury so as to discourage targeting on those species. Other management measures have also been instituted to minimize the bycatch of crab in the groundfish fisheries, including area closures, gear modifications, and catch limits.

State salmon fishery: Pacific salmonids are prohibited species in the BSAI groundfish FMP, and must be immediately returned to the sea with a minimum of injury. Some controversy exists regarding the degree to which salmon bycatch in the groundfish fisheries affects State salmon runs, particularly in times of declining returns. The Council has established and reduced salmon bycatch limits in the BSAI groundfish trawl fisheries in response to increased salmon bycatch concerns.

State herring fishery: Pacific herring are considered a prohibited species in the groundfish fishery, and must be immediately returned to the sea with a minimum of injury. Historically, bycatch of herring was high in the Bering Sea pollock fishery. But, in the early 1990s the Council adopted a catch limit of 1 percent of the herring biomass. Once reached, the cap triggers closure of a predetermined “herring savings area” for the remainder of the season. This measure has succeeded in limiting herring bycatch in the pollock fishery. Herring bycatch in other target groundfish fisheries is very low.

State water subsistence fishery: Subsistence fisheries in Alaska are managed by the State, and take place primarily in state waters. Groundfish fishery participants and fishing communities engage in subsistence activities, however groundfish are a minor target of subsistence fishing (see Section 4.3.3 for a description of the subsistence groundfish fishery). Where appropriate, subsistence groundfish harvests are accounted for in annual groundfish stock assessment.

7.6 Priorities for the Aleutian Islands

Based on the above discussions, the FEP should identify priorities for research and management for the AI.

8 Summary: Plan of action for developing the AI FEP

The following provides a description of how the development of the AI FEP would unfold, should the Council decide to initiate the project. Table 6 provides a summary of those parts of the FEP for which the Council would need to provide direct input, and those which would need to be prepared by AFSC scientists.

1. Council initiates FEP development

Option 1: Council identifies specific options for the AI boundary and AI Ecosystem Team
Option 2: Council defers decision on AI boundary and AI Ecosystem Team

2. Council, perhaps through Ecosystem Committee, works on Council-portion of FEP content

- definition of AI boundary
- management goals

3. AFSC and staff work on AFSC portion of FEP content

- developing models (oceanographic, climatic, dynamic food web)
- developing indicators for Council's management goals, and ecosystem assessment based on goals

4. Feedback loop of AFSC work products through Council/Ecosystem Committee

- based on assessment of management goals, Council identifies priority areas for management evaluations: areas of increased uncertainty, or tradeoffs, or unreconciled goals
- management strategy evaluations on priority issues, using models (AFSC)
- Council decides whether changes to management are needed (e.g., changes to FMPs, contact with other agencies, etc.)

5. Council approves FEP

- not a legal requirement, as FEP is a guidance document; but Council may choose to approve the FEP and identify that it will follow its guidance in actions relating to the Aleutian Islands

6. Council creates AI Ecosystem Team to advise Council/SSC on AI issues, update FEP, etc.

- AI Ecosystem Team will monitor AI FEP to make sure it remains up-to-date, will advise Council on actions related to the AI
- Council will select composition of Ecosystem Team based on options in staff discussion paper

Table 6 Roles of responsibility regarding development of the FEP

FEP Content	Responsible Party
1 Purpose and need 1.1 What is the FEP 1.2 Council's purpose statement	**Council** – written up in staff discussion paper, and will be adopted as working draft when FEP is initiated; will be revised as necessary during course of project
2 Understanding the ecosystem area – what do we know about oceanographic and climate features of the AI ecosystem area, about species present in the ecosystem and their interactions, and about human activities influencing the ecosystem. This section should integrate existing models, and be a summary or inventory of other sources, rather than an encyclopedic listing. 2.1 Description of AI boundary 2.2 Oceanographic, climatic factors (oceanographic and climatic models) 2.3 Biological factors (food web model, with life history characteristics and spatial variation) 2.4 Fisheries and other human development activities	**2.1 – Council** to select one of the options in the discussion paper. May do so upon initiation of project, or wait until development of models and management goals provides more information. **2.2, 2.3, 2.4 – AFSC/staff** will develop models and analyses to mimic interactions in the AI, and support management strategy evaluations
3 Management Goals – based on our understanding of the ecosystem area, what are our management goals? These should reflect societal objectives.	**Council** – once FEP is initiated, Council (perhaps through Ecosystem Committee) will review existing management objectives and goals (groundfish, other FMPs, ecosystem assessment) to come up with management goals for the AI
4 Ecosystem assessment – using the identified management goals, how can we define appropriate ecological indicators to assess the state of the ecosystem by integrating models and indicators. This section would be similar to the AFSC work in the PSEIS and the Ecosystem SAFE chapter. 4.1 For each management goal, identify indicators and assess status of ecosystem relative to management goal	**AFSC/staff** – identify ecological indicators or metrics that assess the degree to which management goals are being met; analyze indicators compared to goals
5 Implications for fishery management – identify areas of uncertainty, conduct management strategy evaluations (MSE) to assess management measures calculated over a realistic range of uncertainty 5.1 Assess areas of uncertainty 5.2 Consider tradeoffs and reconcile conflicting goals	**Council** – based on assessment of management goals, identify priority areas of uncertainty or unreconciled goals **AFSC/staff** – using models, conduct MSE or other evaluations to address Council's priorities
6 Priorities – based on the above, what are priorities for future research or management 6.1 General 6.2 FMP-specific (groundfish, crab, scallop, state-water fisheries)	**AFSC/staff** – use model to identify critical data gaps **Council** – prioritize needs for future research or management

9 References

Angliss, R.P. and K.L. Lodge. 2003. Alaska Marine Mammal Stock Assessments, 2003. NOAA Tech. Memo NMFS-AFSC-144. 230 p.

Barbeaux, S., J. Ianelli, and E. Brown. 2003. Aleutian Islands walleye Pollock SAFE. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 839-888.

Bickham, J.W., J.C. Patton, and T.R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: implications for conservation and biogeography of Steller sea lions (*Eumetopias jubatus*). J. Mammal. 77(1):95-108.

Boldt, J. (ed). Ecosystem Considerations for 2006. North Pacific Fishery Management Council, 605 W 4th Ave suite 306. Anchorage, AK. November 2006. 314 pp.

Calkins, D.G. and K.B. Schneider. 1985. The sea otter (*Enhydra lutris*). Pages 37-45 in Marine Mammals Species Accounts. J.J. Burns, K.J. Frost, and L.F. Lowry, Eds. Alaska Dept. of Fish & Game, Technical Bulletin 7.

Ciannelli, L., B.W. Robson, R.C. Francis, K. Aydin, and R.D. Brodeur. 2004. Boundaries of open marine ecosystems: an application to the Pribilof Archipelago, southeast Bering Sea. Ecol. App. 14(3):942-953.

Gaichas, S., D. Courtney, T. TenBrink, M. Nelson, S. Low, J. Hoff, B. Matta, and J. Boldt. 2004. BSAI Squid and Other Species Stock Assessment. In: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK.

Heifetz, J. R.P. Stone, P.W. Malecha, D.L. Courtney, J.T. Fujioka, and P.W. Rigby. 2003. Research at the Auke Bay Laboratory on Benthic Habitat. AFSC Quarterly Report, July-August-September 2003. US DOC, NOAA, AFSC, Seattle, WA. p. 1-10.

Hunt, G.L., Jr. and P. Stabeno. 2005. "Oceanography and Ecology of the Aleutian Archipelago: Spatial and Temporal Variation." *In* Fisheries Oceanography, v14 s1. November 2005.

Loughlin, T.R. 1997. Using the phylogeographic method to identify Steller sea lion stocks. Molecular Genetics of Marine Mammals, Spec. Pub. 3:159-171.

Lowe, S., J. Ianelli, H. Zenger, and R. Lauth. 2003. Stock Assessment of Aleutian Islands Atka Mackerel. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 711-776.

Murawski, S. 2005. Managing our nation's fisheries II: focus on the future. Proceedings of a conference on fisheries management in the United States held in Washington, D.C., March 24-26, 2005. pp. 163-171.

National Marine Fisheries Service (NMFS). 1999. Ecosystem-based Fishery Management: A Report to Congress by the Ecosystem Principles Advisory Panel. US DOC, NOAA, NMFS. April 1999.

NMFS. 2003. Strategic Guidance for Implementing an Ecosystem-based Approach to Fisheries Management. Prepared for the Marine Fisheries Advisory Committee by the Ecosystem Approach Task Force. US DOC, NOAA, NMFS, Silver Spring, MD.

NMFS. 2004a. Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement. US DOC, NOAA, NMFS Alaska Region, Juneau, AK. June 2004.

NMFS. 2004b. Draft Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. US DOC, NOAA, NMFS Alaska Region, Juneau, AK. January 2004.

Pacific States Marine Fisheries Commission (PSMFC). 2005. Strengthening Scientific Input and Ecosystem-Based Fishery Management for the Pacific and North Pacific Fishery Management Councils. Suggestions from a panel discussion, July 19-20, 2005, Seattle Washington.

Reuter, R.F. and P.D. Spencer. 2003. 2003 BSAI Other Rockfish. In: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 681-710.

Sayles, M.A., Aagaard, K., and Coachman, C.K. 1979. Oceanographic Atlas of the Bering Sea Basin. University of Washington Press. Seattle. 158 pp.

Sigler, M.F., C.R. Lunsford, J.T. Fujioka, and S.A. Lowe. 2003. Alaska Sablefish Assessment for 2004. In: Stock Assessment and Fishery Evaluation Report for Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 839-888.

Spencer P.D., and J.N. Ianelli. 2003a. Pacific Ocean Perch. In: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 563-610.

Spencer P.D., and J.N. Ianelli. 2003b. Northern Rockfish. In: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 611-652.

Thompson, G.G. and M.W. Dorn. 2003. Assessment of the pacific cod stock in the eastern Bering Sea and the Aleutian Islands Area. In: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC, Anchorage, AK, p. 127-222.

Turnock, B.J., T.K. Wilderbuer, and E.S. Brown. 2004. Gulf of Alaska Flatfish. In: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of ALaska. NPFMC, Anchorage, AK, p. 313-340.

USFWS (U.S. Fish & Wildlife Service). 2003. Alaska's Threatened and Endangered Species. Unpubl. Report. US Fish & Wildlife Service, Western Alaska Ecological Services Office, Anchorage, AK.

Appendix A Excerpt from Ecosystem Principles Advisory Panel (1999)

Principles

- The ability to predict ecosystem behavior is limited.
- Ecosystems have real thresholds and limits which, when exceeded, can effect major system restructuring.
- Once thresholds and limits have been exceeded, changes can be irreversible.
- Diversity is important to ecosystem functioning.
- Multiple scales interact within and among ecosystems.
- Components of ecosystems are linked.
- Ecosystem boundaries are open.
- Ecosystems change with time.

Goals

- Maintain ecosystem health and sustainability.

Policies

- Change the burden of proof.
- Apply the precautionary approach.
- Purchase "insurance" against unforeseen, adverse ecosystem impacts.
- Learn from management experiences.
- Make local incentives compatible with global goals.
- Promote participation, fairness, and equity in policy and management.

Recommendations

Develop a Fisheries Ecosystem Plan

- Delineate the geographic extent of the ecosystem(s) that occur(s) within Council authority, including characterization of the biological, chemical, and physical dynamics of those ecosystems, and "zone" the area for alternative uses.
- Develop a conceptual model of the food web.
- Describe the habitat needs of different life history stages for all plants and animals that represent the "significant food web" and how they are considered in conservation and management measures.
- Calculate total removals – including incidental mortality – and show how they relate to standing biomass, production, optimum yields, natural mortality, and tropic structure.
- Assess how uncertainty is characterized and what kind of buffers against uncertainty are included in conservation and management measures.
- Develop indices of ecosystem health as targets for management.
- Describe available long-term monitoring data and how they are used.
- Assess the ecological, human, and institutional elements of the ecosystem which most significantly affect fisheries, and are outside Council/Department of Commerce (DOC) authority. Included should be a strategy to address those influences in order to achieve both FMP and FEP objectives.

Measures to Implement FEPs

- Encourage the Councils to apply ecosystem Principles, Goals, and Policies to ongoing activities.
- Provide training to Council members and staff.
- Prepare guidelines for FEPs.
- Develop demonstration FEPs.
- Provide oversight to ensure development of and compliance with FEPs.
- Enact legislation requiring FEPs.

Research Required to Support Management

- Determine the ecosystem effects of fishing.
- Monitor trends and dynamics in marine ecosystems (ECOWATCH).
- Explore ecosystem-based approaches to governance.

Appendix B Excerpt from chapter 2 of the BSAI [GOA] Groundfish FMPs

2.2 Management Approach for the BSAI [GOA] Groundfish Fisheries

The Council's policy is to apply judicious and responsible fisheries management practices, based on sound scientific research and analysis, proactively rather than reactively, to ensure the sustainability of fishery resources and associated ecosystems for the benefit of future, as well as current generations. The productivity of the North Pacific ecosystem is acknowledged to be among the highest in the world. For the past 25 years, the Council management approach has incorporated forward looking conservation measures that address differing levels of uncertainty. This management approach has in recent years been labeled the precautionary approach. Recognizing that potential changes in productivity may be caused by fluctuations in natural oceanographic conditions, fisheries, and other, non-fishing activities, the Council intends to continue to take appropriate measures to insure the continued sustainability of the managed species. It will carry out this objective by considering reasonable, adaptive management measures, as described in the Magnuson-Stevens Act and in conformance with the National Standards, the Endangered Species Act (ESA), the National Environmental Policy Act, and other applicable law. This management approach takes into account the National Academy of Science's recommendations on Sustainable Fisheries Policy.

As part of its policy, the Council intends to consider and adopt, as appropriate, measures that accelerate the Council's precautionary, adaptive management approach through community-based or rights-based management, ecosystem-based management principles that protect managed species from overfishing, and where appropriate and practicable, increase habitat protection and bycatch constraints. All management measures will be based on the best scientific information available. Given this intent, the fishery management goal is to provide sound conservation of the living marine resources; provide socially and economically viable fisheries for the well-being of fishing communities; minimize human-caused threats to protected species; maintain a healthy marine resource habitat; and incorporate ecosystem-based considerations into management decisions.

This management approach recognizes the need to balance many competing uses of marine resources and different social and economic goals for sustainable fishery management, including protection of the long-term health of the resource and the optimization of yield. This policy will use and improve upon the Council's existing open and transparent process of public involvement in decision-making.

2.2.1 Management Objectives

Adaptive management requires regular and periodic review. Objectives identified in this policy statement will be reviewed annually by the Council. The Council will also review, modify, eliminate, or consider new issues, as appropriate, to best carry out the goals and objectives of this management policy.

To meet the goals of this overall management approach, the Council and NMFS will use the Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement (PSEIS) (NMFS 2004) as a planning document. To help focus consideration of potential management measures, the Council and NMFS will use the following objectives as guideposts, to be re-evaluated, as amendments to the FMP are considered over the life of the PSEIS.

Prevent Overfishing:

1. Adopt conservative harvest levels for multi-species and single species fisheries and specify optimum yield.

2. Continue to use the 2 million mt optimum yield cap for the BSAI groundfish fisheries. [Continue to use the existing optimum yield cap for the GOA groundfish fisheries.]
3. Provide for adaptive management by continuing to specify optimum yield as a range.
4. Provide for periodic reviews of the adequacy of F_{40} and adopt improvements, as appropriate.
5. Continue to improve the management of species through species categories.

Promote Sustainable Fisheries and Communities:

6. Promote conservation while providing for optimum yield in terms of the greatest overall benefit to the nation with particular reference to food production, and sustainable opportunities for recreational, subsistence, and commercial fishing participants and fishing communities.
7. Promote management measures that, while meeting conservation objectives, are also designed to avoid significant disruption of existing social and economic structures.
8. Promote fair and equitable allocation of identified available resources in a manner such that no particular sector, group or entity acquires an excessive share of the privileges.
9. Promote increased safety at sea.

Preserve Food Web:

10. Develop indices of ecosystem health as targets for management.
11. Improve the procedure to adjust acceptable biological catch levels as necessary to account for uncertainty and ecosystem factors.
12. Continue to protect the integrity of the food web through limits on harvest of forage species.
13. Incorporate ecosystem-based considerations into fishery management decisions, as appropriate.

Manage Incidental Catch and Reduce Bycatch and Waste:

14. Continue and improve current incidental catch and bycatch management program.
15. Develop incentive programs for bycatch reduction including the development of mechanisms to facilitate the formation of bycatch pools, vessel bycatch allowances, or other bycatch incentive systems.
16. Encourage research programs to evaluate current population estimates for non-target species with a view to setting appropriate bycatch limits, as information becomes available.
17. Continue program to reduce discards by developing management measures that encourage the use of gear and fishing techniques that reduce bycatch which includes economic discards.
18. Continue to manage incidental catch and bycatch through seasonal distribution of total allowable catch and geographical gear restrictions.
19. Continue to account for bycatch mortality in total allowable catch accounting and improve the accuracy of mortality assessments for target, prohibited species catch, and non-commercial species.
20. Control the bycatch of prohibited species through prohibited species catch limits or other appropriate measures.
21. Reduce waste to biologically and socially acceptable levels.

Avoid Impacts to Seabirds and Marine Mammals:

22. Continue to cooperate with U.S. Fish and Wildlife Service (USFWS) to protect ESA-listed species, and if appropriate and practicable, other seabird species.
23. Maintain or adjust current protection measures as appropriate to avoid jeopardy of extinction or adverse modification to critical habitat for ESA-listed Steller sea lions.
24. Encourage programs to review status of endangered or threatened marine mammal stocks and fishing interactions and develop fishery management measures as appropriate.
25. Continue to cooperate with NMFS and USFWS to protect ESA-listed marine mammal species, and if appropriate and practicable, other marine mammal species.

Reduce and Avoid Impacts to Habitat:

26. Review and evaluate efficacy of existing habitat protection measures for managed species.
27. Identify and designate essential fish habitat and habitat areas of particular concern pursuant to Magnuson-Stevens Act rules, and mitigate fishery impacts as necessary and practicable to continue the sustainability of managed species.
28. Develop a Marine Protected Area policy in coordination with national and state policies.
29. Encourage development of a research program to identify regional baseline habitat information and mapping, subject to funding and staff availability.
30. Develop goals, objectives and criteria to evaluate the efficacy and suitable design of marine protected areas and no-take marine reserves as tools to maintain abundance, diversity, and productivity. Implement marine protected areas if and where appropriate.

Promote Equitable and Efficient Use of Fishery Resources:

31. Provide economic and community stability to harvesting and processing sectors through fair allocation of fishery resources.
32. Maintain the license limitation program, modified as necessary, and further decrease excess fishing capacity and overcapitalization by eliminating latent licences and extending programs such as community or rights-based management to some or all groundfish fisheries.
33. Provide for adaptive management by periodically evaluating the effectiveness of rationalization programs and the allocation of access rights based on performance.
34. Develop management measures that, when practicable, consider the efficient use of fishery resources taking into account the interest of harvesters, processors, and communities.

Increase Alaska Native Consultation:

35. Continue to incorporate local and traditional knowledge in fishery management.
36. Consider ways to enhance collection of local and traditional knowledge from communities, and incorporate such knowledge in fishery management where appropriate.
37. Increase Alaska Native participation and consultation in fishery management.

Improve Data Quality, Monitoring and Enforcement:

38. Increase the utility of groundfish fishery observer data for the conservation and management of living marine resources.

39. Develop funding mechanisms that achieve equitable costs to the industry for implementation of the North Pacific Groundfish Observer Program.
40. Improve community and regional economic impact costs and benefits through increased data reporting requirements.
41. Increase the quality of monitoring and enforcement data through improved technology.
42. Encourage a coordinated, long-term ecosystem monitoring program to collect baseline information and compile existing information from a variety of ongoing research initiatives, subject to funding and staff availability.
43. Cooperate with research institutions such as the North Pacific Research Board in identifying research needs to address pressing fishery issues.
44. Promote enhanced enforceability.
45. Continue to cooperate and coordinate management and enforcement programs with the Alaska Board of Fish, Alaska Department of Fish and Game, and Alaska Fish and Wildlife Protection, the U.S. Coast Guard, NMFS Enforcement, International Pacific Halibut Commission, Federal agencies, and other organizations to meet conservation requirements; promote economically healthy and sustainable fisheries and fishing communities; and maximize efficiencies in management and enforcement programs through continued consultation, coordination, and cooperation.

Appendix C Chapter 7 from the BSAI King and Tanner Crab FMP

7.0 GOAL AND OBJECTIVES

The Council, in cooperation with the State, is committed to developing a long-range plan for managing BS/AI crab fisheries that will promote a stable regulatory environment for the seafood industry and maintain the health of the resources and environment. The management system conforms to the Magnuson-Stevens Act's national standards as listed in Appendix B and the comprehensive Statement of Goals adopted by the Council on December 7, 1984.

7.1 Management Goal

The management goal is to maximize the overall long-term benefit to the nation of BS/AI stocks of king and Tanner crabs by coordinated Federal and State management, consistent with responsible stewardship for conservation of the crab resources and their habitats.

7.2 Management Objectives

Within the scope of the management goal, seven specific objectives have been identified. These relate to stock condition, economic and social objectives of the fishery, gear conflicts, habitat, weather and ocean conditions affecting safe access to the fishery, access of all interested parties to the process of revising this FMP and any implementing regulations, and necessary research and management. Each of these objectives requires relevant management measures (see Chapter 8). Several management measures may contribute to more than one objective, and several objectives may mesh in any given management decision on a case-by-case basis.

7.2.1 Biological Conservation Objective : Ensure the long-term reproductive viability of king and Tanner crab populations.

To ensure the continued reproductive viability of each king and Tanner crab population through protection of reproductive potential, management must prevent overfishing (see definition in Chapter 4). Management measures may also be adopted to address other biological concerns such as: restricting harvest of crabs during soft shell periods and maintaining low incidental catch of nonlegal crab. Other factors, including those currently under investigation, such as the effects of cold air temperatures on incidentally-caught egg bearing females and their resultant larvae (Carls 1987), could also be considered. The maintenance of adequate reproductive potential in each crab stock will take precedence over economic and social considerations.

7.2.2 Economic and Social Objective: Maximize economic and social benefits to the nation over time.

Economic benefits are broadly defined to include, but are not limited to: profits, income, employment, benefits to consumers, and less tangible or less quantifiable social benefits such as the economic stability of coastal communities. To ensure that economic and social benefits derived for fisheries covered by this FMP are maximized over time, the following will be examined in the selection of management measures:

1. The value of crab harvested (adjusted for the amount of crab dying prior to processing and discarded, which is known as deadloss) during the season for which management measures are considered,

2. The future value of crab, based on the value of a crab as a member of both the parent and harvestable stock,

3. Subsistence harvests within the registration area, and

4. Economic impacts on coastal communities.

This examination will be accomplished by considering, to the extent that data allow, the impact of management alternatives on the size of the catch during the current and future seasons and their associated prices, harvesting costs, processing costs, employment, the distribution of benefits among members of the harvesting, processing and consumer communities, management costs, and other factors affecting the ability to maximize the economic and social benefits as defined in this section.

Social benefits are tied to economic stability and impacts of commercial fishing associated with coastal communities. While social benefits can be difficult to quantify, economic indices may serve as proxy measures of the social benefits which accrue from commercial fishing. In 1984, 7 percent of total personal income or 27 percent of total personal income in the private sector in Alaska was derived from commercial fishing industries. However, in coastal communities most impacted by commercial fishing in the BS/AI area, the impacts were much greater. In 1984, 47 percent of the total personal income earned in the Southwest Region of Alaska (Aleutian Islands, Bethel, Bristol Bay Borough, Dillingham, and Wade Hampton Census Areas) or 98 percent of the total personal income in the private sector for this region was derived from commercial fishing activities (Berman and Hull 1987). Some coastal communities in this region are even more heavily dependent on commercial fish harvesting and/or processing than this. On a statewide basis, shellfish accounted for 21 percent of the total exvessel value of commercial fish harvested in Alaska in 1984. Therefore, social and economic impacts of BS/AI crab fisheries on coastal communities can be quite significant and must be considered in attempts to attain the economic and social objective.

Subsistence harvests must also be considered to ensure that subsistence requirements are met as required by law. Basically, State law requires that a reasonable opportunity be provided for subsistence use before other consumptive use is allowed. It is very difficult to evaluate the economic impact of subsistence fishing. Yet, fish, shellfish, and game harvested by subsistence users to provide food for the family or social group can greatly exceed the economic value of the product itself (R. Wolfe, ADF&G, Division of Subsistence, personal communication). Data on subsistence red king crab fishing have been obtained in the Norton Sound-Bering Strait area of the BS/AI management unit (Thomas 1981; Magdanz 1982, 1983; and Magdanz and Olanna 1984, 1985), and declines in subsistence harvests have been associated with changes in crab distributions, poor ice conditions, and reductions in crab stocks due to commercial harvest and poor recruitment (ADF&G 1986).

7.2.3 Gear Conflict Objective : Minimize gear conflict among fisheries.

Management measures developed for the king and Tanner crab fisheries will take into account the interaction of those fisheries, and the people engaged in them, with other fisheries. To minimize gear conflict among fisheries, the compatibility of different types of fishing gear and activities on the same fishing grounds should be considered. King and Tanner crab fisheries are conducted with pots, which are stationary gear. Many other fisheries in the fishery management unit, both domestic and foreign, are conducted with mobile trawl or seine gear. Seasons, gear storage, and fishing areas may be arranged to eliminate, insofar as possible, conflicts between gear types and preemption of fishing grounds by one form of gear over another.

7.2.4 Habitat Objective : Preserve the quality and extent of suitable habitat.

The quality and availability of habitat supporting the BS/AI area king and Tanner crab populations are important. Fishery managers should strive to ensure that optimal habitat is available for juvenile and breeding, as well as the exploitable, segments of the population. It also will be important to consider the potential impact of crab fisheries on other fish and shellfish populations. The BS/AI habitat of king and Tanner crabs, and the potential effects of changes in that habitat on the fishery are described in Appendix F of this FMP.

Those involved in both management and exploitation of crab resources will actively review actions by other human users of the BS/AI area to ensure that their actions do not cause deterioration of habitat. Any action by a State or Federal agency potentially affecting crab habitat in an adverse manner may be reviewed by the Council for possible action under the Magnuson-Stevens Act. The Council will also consider the effect on crab habitat of its own management decisions in other fisheries.

7.2.5 Vessel Safety Objective: Provide public access to the regulatory process for vessel safety considerations.

Upon request, and when appropriate, the Council and the State shall consider, and may provide for, temporary adjustments, after consultation with the Coast Guard and persons utilizing the fishery, regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of vessels.

7.2.6 Due Process Objective: Ensure that access to the regulatory process and opportunity for redress are available to all interested parties.

In order to attain the maximum benefit to the nation, the interrelated biological, economic and social, habitat, and vessel safety objectives outlined above must be balanced against one another. A continuing dialogue between fishery managers, fishery scientists, fishermen, processors, consumers, and other interested parties is necessary to keep this balance. Insofar as is practical, management meetings will be scheduled around fishing seasons and in places where they can be attended by fishermen, processors, or other interested parties.

Access to the FMP development and regulatory process is available through membership in a Council work group, testimony on the record before the Council's Advisory Panel or SSC, or before the Council itself, testimony before the Board, conversations with members of the plan team or officials of regulatory agencies, and by commenting on the FMP, any subsequent amendments and any regulations proposed for their implementation.
This FMP defers much of day-to-day crab management to the State. Means of access to the regulatory process at the State level and of redress of perceived wrongs by the State are necessary. Appendix C describes the State management system and mechanisms for public input. Chapters 9 and 10 of this FMP contain procedures for challenge of State laws or regulations regarding management of these fisheries alleged to be inconsistent with the Magnuson-Stevens Act, the FMP, or any other applicable Federal law.

7.2.7 Research and Management Objective : Provide fisheries research, data collection, and analysis to ensure a sound information base for management decisions.

Necessary data must be collected and analyzed in order to measure progress relative to other objectives and to ensure that management actions are adjusted to reflect new knowledge. Achieving the objective will require new and ongoing research and analysis relative to stock conditions, dynamic feedback to market conditions, and adaptive management strategies. For example, some possible research topics could include (1) the basis for exclusive registration areas, (2) the basis for sex restrictions in retained catch, (3) the basis for size limits, (4) the process for determining GHLs, (5) bioeconomic analyses of

specific regulatory proposals, and (6) defining oceanographic conditions important to maximizing productivity of crab stocks.

An annual area management report to the Board discussing current biological and economic status of the fisheries, GHL ranges, and support for different management decisions or changes in harvest strategies will be prepared by the State (ADF&G lead agency), with NMFS and crab plan team input when appropriate. This will be available for public comment, and presented to the Council on an annual basis. GHLs will be revised when new information is available. Such information will be made available to the public.

Appendix D Ecosystem objectives from the annual Ecosystem SAFE chapter

Maintain predator-prey relationships by examining:

- pelagic forage availability
- spatial/temporal conc. of fishery impact on forage fish
- removals of top predators
- introduction of non-native species

Maintain diversity by examining:

- species diversity
- functional (trophic, structural habitat) diversity
- genetic diversity

Maintain energy flow and balance by examining:

- human-induced energy redirection
- system impacts attributable to energy removal