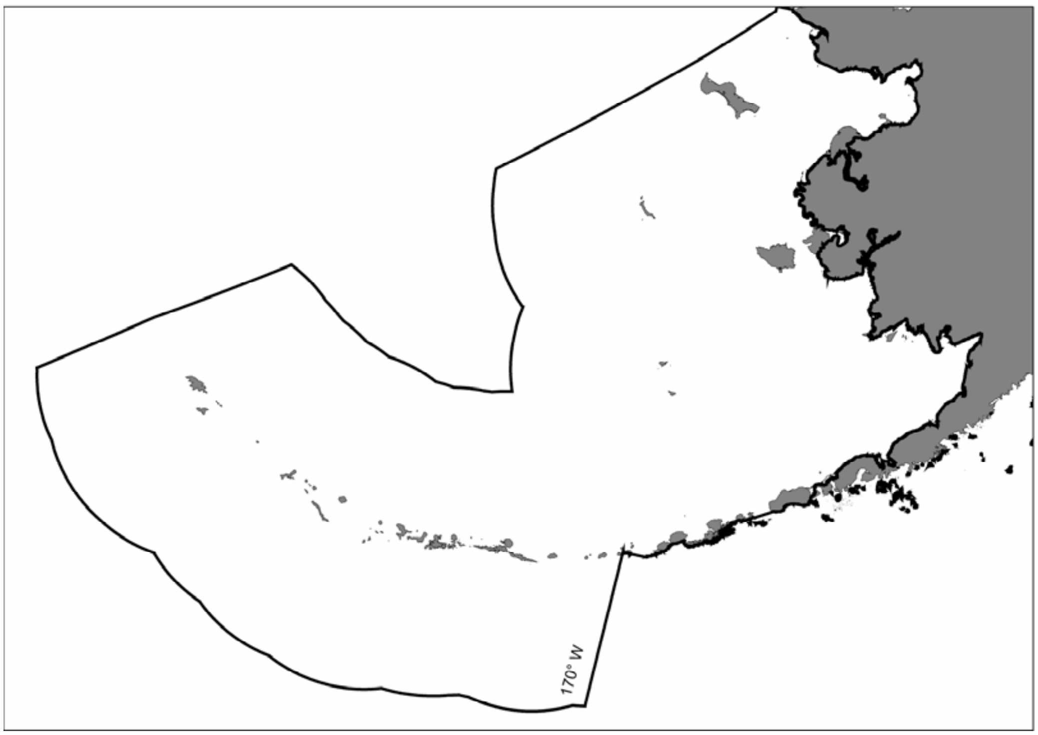
FISHERY MANAGEMENT PLAN

for Groundfish

of the Bering Sea and Aleutian Islands

Management Area



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Executive Summary

This Fishery Management Plan (FMP) governs groundfish fisheries of the Bering Sea and Aleutian Islands Management Area (BSAI). The FMP management area is the United States (U.S.) Exclusive Economic Zone (EEZ) of the Bering Sea and that portion of the North Pacific Ocean adjacent to the Aleutian Islands which is between 170° W. longitude and the U.S.-Russian Convention Line of 1867. The FMP covers fisheries for all stocks of finfish and marine invertebrates except salmonids, shrimps, scallops, snails, king crab, Tanner crab, Dungeness crab, corals, surf clams, horsehair crab, lyre crab, Pacific halibut, and Pacific herring.

The FMP was implemented on January 1, 1982. As of April 2004, it has been amended over seventy times, and its focus has changed from the regulation of mainly foreign fisheries to the management of fully domestic groundfish fisheries. This version of the FMP has been revised to remove or update obsolete references, as well as outdated catch data and other scientific information. The FMP has also been reorganized to provide readers with a clear understanding of the BSAI groundfish fishery and conservation and management measures promulgated by the FMP.

1.1 Management Policy

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) is the primary domestic legislation governing management of the nation's marine fisheries. In 1996, the United States Congress reauthorized the Magnuson-Stevens Act to include, among other things, a new emphasis on the precautionary approach in U.S. fishery management policy. The Magnuson-Stevens Act contains ten national standards, with which all FMPs must conform and which guide fishery management. Besides the Magnuson-Stevens Act, U.S. fisheries management must be consistent with the requirements of other regulations including the Marine Mammal Protection Act, the Endangered Species Act, the Migratory Bird Treaty Act, and several other Federal laws.

Under the Magnuson-Stevens Act, the North Pacific Fishery Management Council (Council) is authorized to prepare and submit to the Secretary of Commerce for approval, disapproval or partial approval, a FMP and any necessary amendments, for each fishery under its authority that requires conservation and management. The Council conducts public hearings so as to allow all interested persons an opportunity to be heard in the development of FMPs and amendments, and reviews and revises, as appropriate, the assessments and specifications with respect to the optimum yield from each fishery (16 U.S.C. 1852(h)).

The Council has developed a management policy and objectives to guide its development of management recommendations to the Secretary of Commerce. This management approach is described in Table ES- 1.

Table ES- 1 BSAI Groundfish Fisheries Management Approach

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, 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.

1.2 Summary of Management Measures

The management measures that govern the Bering Sea and Aleutian Islands groundfish fishery are summarized in Table ES-2.

Pursuant to Title II of the Magnuson-Stevens Act, there is no allowable level of foreign fishing for the groundfish fisheries covered by this FMP. Fishing vessels and fish processors of the U.S. have the capacity to harvest and process up to the level of optimum yield of all species subject to this FMP.

Table ES-2 Summary of Management Measures for the BSAI Groundfish Fishery

Management Area	U.S. Exclusive Economic Zone (EEZ) of the eastern Bering Sea and that portion of the North Pacific Ocean adjacent to the Aleutian Islands which is west of 170° W. up to the U.S.-Russian Convention Line of 1867. **Subareas:** The area is divided into two subareas, the Bering Sea and the Aleutian Islands.
Stocks	All stocks of finfish and marine invertebrates in the management area except salmonids, shrimps, scallops, snails, king crab, Tanner crab, Dungeness crab, corals, surf clams, horsehair crab, lyre crab, Pacific halibut, and Pacific herring. Those stocks and stock complexes that are commercially important and for which an annual TAC is established include: walleye pollock, Pacific cod, sablefish, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, flathead sole, Alaska plaice, "other flatfish", Pacific ocean perch, northern rockfish, shortraker and rougheye rockfish, "other rockfish", Atka mackerel, and squid.
Maximum Sustainable Yield (MSY)	The historical estimate of MSY for the BSAI groundfish complex is in the range of 1.7 to 2.4 million mt.
Optimum Yield (OY)	The OY of the BSAI groundfish complex (consisting of stocks listed in the 'target species' and 'other species' categories, as listed in Table 3-1) is 85% of the historical estimate of MSY, or 1.4 to 2.0 million mt, plus the incidental harvest of nonspecified species.
Procedure to set Total Allowable Catch (TAC)	Based on the annual Stock Assessment and Fishery Evaluation (SAFE) report, the Council will recommend to the Secretary of Commerce TACs and apportionments thereof for each target species and the "other species" category. The Secretary will implement annual TACs which may address up to 2 fishing years, following public comment and Council recommendations at the December Council meeting. **Reserve**: 15% of the TAC for each target species (except Aleutian Islands Pacific ocean perch, Atka mackerel, flathead sole, Pacific cod, rock sole, yellowfin sole, pollock and fixed-gear sablefish) and the "other species" category is set aside to form the reserve, used for correcting operational problems of the fleets, adjusting species TACs for conservation, or apportionments. The reserve is not designated by species or species groups.
Apportionment of TAC	**Pollock**: The amount of pollock that may be taken with non-pelagic trawls may be limited; pollock TAC shall be divided into roe-bearing ("A" season) and non roe-bearing ("B" season) allowances. **Sablefish**: Vessels using fixed gear may harvest no more than 50% of the TAC in the Bering Sea and 75% of the TAC in the Aleutian Islands; vessels using trawl gear may harvest no more than 50% of the TAC in the Bering Sea and 25% of the TAC in the Aleutian Islands. **Pacific cod**: After subtraction of the CDQ allowance, the remaining TAC shall be allocated 1.4% for vessels using jig gear, 2.3% for catcher processors using trawl gear listed in Section 208(e)(1)-(20) of the AFA, 13.4% for catcher processors using trawl gear as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447), 22.1% for catcher vessels using trawl gear, 48.7% for catcher processors using hook-and-line gear, 0.2% for catcher vessels ≥60' LOA using hook-and-line gear, 1.5% for catcher processors using pot gear, 8.4% for catcher vessels ≥60' LOA using pot gear, and 2.0% for catcher vessels <60' LOA that use either hook-and-line gear or pot gear. Allocations may be seasonally apportioned. **Atka mackerel**: After subtraction of the CDQ allowance, and incidental catch amount, up to 2% of the eastern Aleutian Islands and Bering Sea TACs will be allocated to vessels using jig gear, the remaining TAC is apportioned among vessels using trawl gear. Allocations may be seasonally apportioned. **Aleutian Islands Pacific ocean perch, flathead sole, rock sole and yellowfin sole**: After subtraction of the CDQ allowance, and incidental catch amount, the remaining TAC is apportioned among vessels using trawl gear. **Shortraker and rougheye rockfish**: after subtraction of reserves, the Aleutian Islands TAC will be allocated 70% to vessels using trawl gear and 30% to vessels using non-trawl gear.
Attainment of TAC	The attainment of a TAC for a species will result in the closure of the target fishery for that species. Further retention of that species will be prohibited.

Table ES-2 Summary of Management Measures for the BSAI Groundfish Fishery

Permit	All vessels participating in the BSAI groundfish fisheries, other than fixed gear sablefish, require a Federal groundfish license, except for: vessels fishing in State of Alaska waters; vessels less than 32' LOA; and jig gear vessels less than 60' LOA that meet specific effort restrictions. Licenses are endorsed with area, gear, and vessel type and length designations. Fixed gear vessels engaged in directed fishing for Pacific cod must qualify for a Pacific cod endorsement. Fishing permits may be authorized, for limited experimental purposes, for the target or incidental harvest of groundfish that would otherwise be prohibited.
Authorized Gear	Gear types authorized by the FMP are trawls, hook-and-line, pots, jigs, and other gear as defined in regulations. **Pollock**: The use of non-pelagic trawl gear in the directed fishery for pollock is prohibited.
Time and Area Restrictions	**All trawl**: Fishing with trawl vessels is not permitted year-round in the Crab and Halibut Protection Zone and the Pribilof Island Habitat Conservation Area. The Nearshore Bristol Bay Trawl Closure area is also closed year-round except for a subarea that remains open between April 1 and June 15 each year. The Chum Salmon Savings Area is closed to trawling from August 1 through August 31. **Nonpelagic trawl**: The Red King Crab Savings Area is closed to nonpelagic trawling year-round, except for a subarea that may be opened at the discretion of the Council and NMFS when a guideline harvest level for Bristol Bay red king crab has been established. The Aleutian Islands Habitat Conservation Area, Bering Sea Habitat Conservation Area, St. Matthew Island Habitat Conservation Area, St. Lawrence Island Habitat Conservation Area, Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area, and the Northern Bering Sea Research Area are closed to nonpelagic trawling year-round. **Bottom contact gear:** The use of bottom contact gear is prohibited in the Aleutian Islands Coral and Alaska Seamount Habitat Protection Areas year-round. The use of mobile bottom contact gear is prohibited year-round in Bowers Ridge Habitat Conservation Zone. **Directed pollock fishery**: Catcher/processor vessels identified in the American Fisheries Act are prohibited from engaging in directed fishing for pollock in the Catcher Vessel Operational Area during the non-roe (“B”) season unless they are participating in a community development quota fishery. **Marine mammal measures**: Regulations implementing the FMP may include conservation measures that temporally and spatially limit fishing effort around areas important to marine mammals. **Gear test area exemption**: Specific gear test areas for use when the fishing grounds are closed to that gear type, are established in regulations that implement the FMP.
Prohibited Species	Pacific halibut, Pacific herring, Pacific salmon and steelhead, king crab, and Tanner crab are prohibited species and must be returned to the sea with a minimum of injury except when their retention is authorized by other applicable law. Groundfish species and species under this FMP for which TAC has been achieved shall be treated in the same manner as prohibited species.

Table ES-2 Summary of Management Measures for the BSAI Groundfish Fishery

Prohibited Species Catch (PSC) Limits	When a target fishery attains a PSC limit apportionment or seasonal allocation, the bycatch zone or management area to which the PSC limit applies will be closed to that target fishery for the remainder of the year or season. **Red king crab**: Based on the size of the spawning biomass of red king crab, the PSC limit in Zone 1 for trawl fisheries is either 23,000, 97,000 or 197,000 red king crab; attainment closes Zone 1. ***C. bairdi* crab**: Established in regulation for trawl fisheries based on population abundance; attainment closes Zone 1 or Zone 2. ***C. opilio* crab**: Established in regulation for trawl fisheries in the C. opilio Bycatch Limitation Zone based on population abundance, with minimum and maximum limits; attainment closes zone. **Pacific halibut**: Halibut mortality limits established in regulation for trawl and non-trawl fisheries. **Pacific herring**: 1% of the annual biomass of eastern Bering Sea herring, for trawl fisheries; attainment may close the Herring Savings Areas. **Chum salmon**: Attainment of 42,000 fish limit in the Catcher Vessel Operational Area between August 15 and October 14 closes the Chum Salmon Savings Area for the rest of that time period. **Chinook salmon**: Attainment of chinook PSC limit established in regulation for the Bering Sea or the Aleutian Islands subarea closes the Bering Sea or Aleutian Island Chinook Salmon Savings Area to directed pollock trawl fishing. **Apportionment**: For trawl fisheries, may be apportioned by target fishery and season; for non-trawl fisheries, may be apportioned by target fishery, gear type, area, and season.
Retention and Utilization Requirements	**Pollock**: Roe-stripping is prohibited; see also below. **Improved Retention/Improved Utilization Program**: All pollock and Pacific cod must be retained and processed.
Fixed Gear Sablefish Fishery	The directed fixed gear sablefish fisheries are managed under an Individual Fishing Quota program. The FMP specifies requirements for the initial allocation of quota share in 1995, as well as transfer, use, ownership, and general provisions. **Annual Allocation**: The ratio of a person's quota share to the quota share pool is multiplied by the fixed gear TAC (adjusted for the community development quota allocation - see below), to arrive at the annual individual fishing quota.
Bering Sea Pollock Fishery	Subtitle II of the American Fisheries Act (AFA), incorporated by reference in the FMP, implemented a cooperative program for the pollock fishery. **Access**: Limits pollock fishery access to named vessels and processors; included a buyout of 9 catcher/processor vessels. **Allocation**: After adjustment for the community development quota allocation (see below) and incidental catch of pollock in other fisheries, the pollock TAC is apportioned 50% to vessels harvesting pollock for inshore processing, 40% to vessels harvesting pollock for catcher/processor processing, and 10% to vessels harvesting pollock for mothership processing. **Cooperatives**: Creates standards and limitations for the creation and operation of cooperatives. **Sideboards**: Establishes harvesting and processing restrictions on AFA pollock participants to protect other fisheries. **Catch monitoring**: Increases observer coverage and scale requirements for catcher/processors.
Aleutian Islands Pollock Fishery	The non-CDQ directed pollock fishery in the Aleutian Islands is fully allocated to the Aleut Corporation for the purpose of economic development in Adak, Alaska. **Allocation**: To be funded, to the extent possible in whole or in part, from the difference between the sum of all BSAI groundfish fishery TACs and the 2 million mt OY cap, if the difference is large enough to do so. The remainder of the funding comes from a reduction in the Bering Sea pollock recommended TAC. A mechanism for determining "A" and "B" season allowances is specified.

Table ES-2 Summary of Management Measures for the BSAI Groundfish Fishery

Aleutian Islands Pacific ocean perch, Atka mackerel, flathead sole, rocksole, Pacific cod, and yellowfin sole (Amendment 80 species)	**Access**: Limits trawl sector catch by creating allocations between non-AFA trawl catcher/processors (i.e., non-AFA trawl catcher/processors as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447), and all other trawl gear sectors. **Allocation**: After adjustment for the community development quota allocation (see below), incidental catch of these species (except Pacific cod) in other fisheries, and the allocation of Atka mackerel to jig gear, the TAC is apportioned between the non-AFA trawl catcher/processors and all other trawl fishery participants. **Cooperatives**: Creates standards and limitations for the creation and operation of cooperatives. **Sideboards**: Establishes harvesting and processing restrictions for non-AFA trawl catcher/processors in the GOA to protect other fisheries. **Catch monitoring**: Increases observer coverage and scale requirements for non-AFA catcher/processors.
Community Development Quota (CDQ) Multispecies Fishery	Eligible communities in western Alaska will receive a percentage of the TAC for each directed fishery of the BSAI and share of PSC species. **Sablefish**: 20% of the fixed gear allocation of the TAC and 7.5% of the trawl allocation of the TAC **Pollock**: 10% of the TAC as a directed fishing allowance **Other groundfish species listed in regulations which support a directed fishery**: 10.7% of the TAC for each directed groundfish fishery pursuant to Section 305(i)(1)(B) of the Magnuson-Stevens Act.
Flexible Authority	The Regional Administrator of NMFS is authorized to make inseason adjustments through gear modifications, closures, or fishing area/quota restrictions, for conservation reasons, to protect identified habitat problems, or to increase vessel safety.
Recordkeeping and Reporting	Recordkeeping that is necessary and appropriate to determine catch, production, effort, price, and other information necessary for conservation and management may be required. May include the use of catch and/or product logs, product transfer logs, effort logs, or other records as specified in regulations. **Processors**: Shall report necessary information for the management of the groundfish fisheries as specified in regulations. **At-sea processor vessels**: Must submit a weekly catch/receipt and product transfer report and record cargo transfer and off-loading information in a separate transfer log. Catcher/processors are also required to check in and check out of any fishing area for which TAC is established, as specified in regulations.
Observer Program	U.S. fishing vessels that catch groundfish in the EEZ, or receive groundfish caught in the EEZ, and shoreside processors that receive groundfish caught in the EEZ, are required to accommodate NMFS-certified observers as specified in regulations, in order to verify catch composition and quantity, including at-sea discards, and collect biological information on marine resources.
Evaluation and Review of the FMP	The Council will maintain a continuing review of the fisheries managed under this FMP, and all critical components of the FMP will be reviewed periodically. **Management Policy**: Objectives in the management policy statement will be reviewed annually. **Essential Fish Habitat (EFH)**: The Council will conduct a complete review of EFH once every 5 years, and in between will solicit proposals on Habitat Areas of Particular Concern and/or conservation and enhancement measures to minimize potential adverse effects from fishing. Annually, EFH information will be reviewed in the "Ecosystems Considerations" chapter of the SAFE report.

1.3 Organization of the FMP

The FMP is organized into six chapters. Chapter 1 contains an introduction to the FMP, and Chapter 2 describes the policy and management objectives of the FMP.

Chapter 3 contains the conservation and management measures that regulate the BSAI groundfish fisheries. Section 3.1 denotes the area and stocks governed by the FMP, and describes the five categories of species or species groups likely to be taken in the groundfish fishery. Section 3.2 specifies the procedures for determining harvest levels for the groundfish species, and includes the maximum sustainable yield and optimum yield of the groundfish complex. Sections 3.3 to 3.6 contain permit and participation, gear, time and area, and catch restrictions for the groundfish fisheries, respectively. Section 3.7 describes the specific management measures for the quota share programs in place in the fixed gear sablefish fishery, the pollock fishery, and the community development quota multispecies fishery. Measures that allow flexible management authority are addressed in Section 3.8, and Section 3.9 designates monitoring and reporting requirements for the fisheries. Section 3.10 describes the schedule and procedures for review of the FMP or FMP components.

Chapter 4 contains a description of the stocks and their habitat (including essential fish habitat definitions), fishing activities, the economic and socioeconomic characteristics of the fisheries and communities, and ecosystem characteristics. Additional descriptive information is also contained in the appendices. Chapter 5 specifies the relationship of the FMP with applicable law and other fisheries. Chapter 6 references additional sources of material about the groundfish fisheries, and includes the bibliography.

Appendices to the FMP include supplemental information. Appendix A contains a summary of its amendments. Appendix B describes the geographical coordinates for the areas specified in the FMP. Appendix C incorporates sections of the American Fisheries Act that are referenced in the BSAI groundfish fishery management measures. Appendices D, E, and F include, respectively, habitat information by life stage for managed species, maps of essential fish habitat, and a discussion of adverse effects on essential fish habitat. Appendix G summarizes FMP impacts on fishery participants and fishing communities. Appendix H examines research needs in the BSAI groundfish fisheries. Appendix I includes information about marine mammals and seabirds interacting with the BSAI groundfish fisheries, including species listed under the Endangered Species Act.

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List of Tables and Figures

Acronyms and Abbreviations Used in the FMP

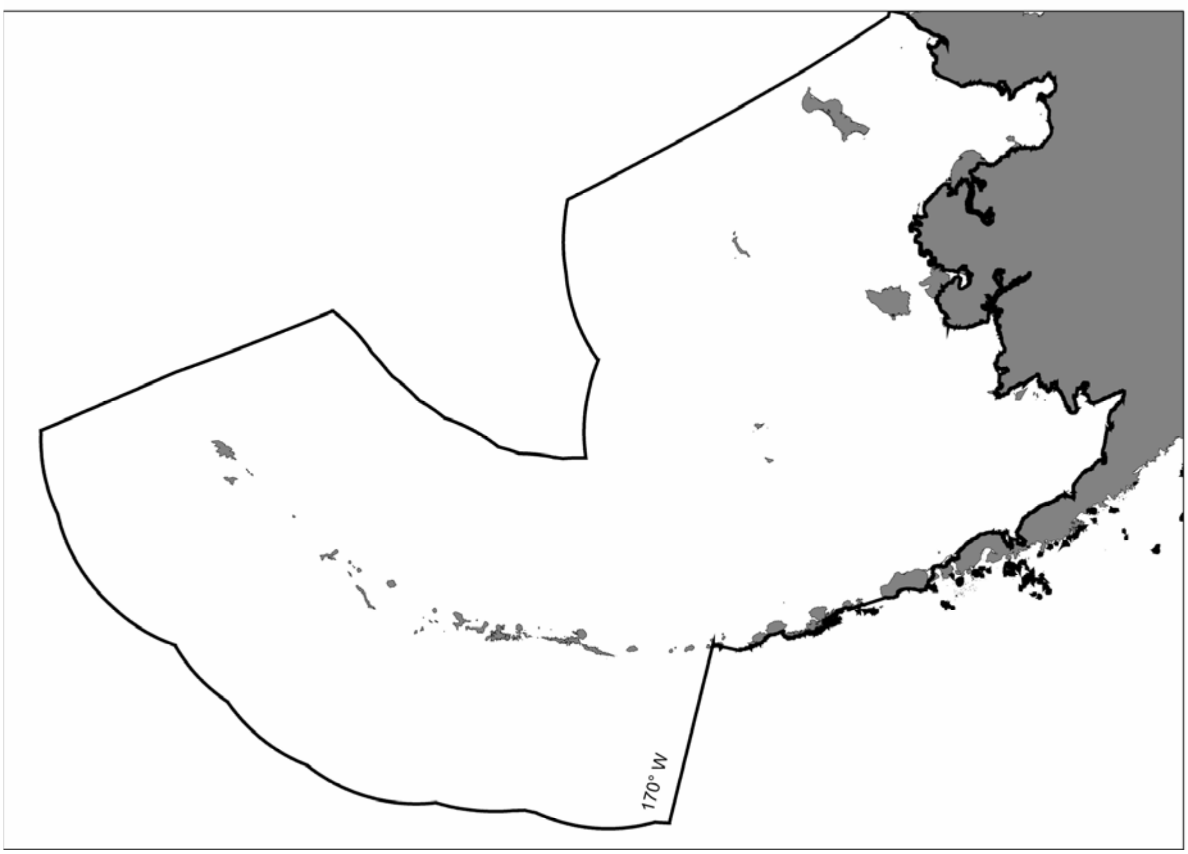
‘	Minutes
%	Percent
ABC	acceptable biological catch
ADF&G	Alaska Department of Fish and Game
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center (of the National Marine Fisheries Service)
AI	Aleutian Islands
ALT	Alaska Local Time
AP	North Pacific Fishery Management Council’s Advisory Panel
B	Biomass
BSAI	Bering Sea and Aleutian Islands
$B_{x\%}$	biomass that results from a fishing mortality rate of $F_{x\%}$
C	Celsius or Centigrade
C.F.R.	Code of Federal Regulations
CDP	community development plan
CDQ	community development quota
cm	centimeter(s)
COBLZ	*C. Opilio* Bycatch Limitation Zone
Council	North Pacific Fishery Management Council
CVOA	catcher vessel operational area
DAH	domestic annual harvest
DAP	domestic annual processed catch
DSR	demersal shelf rockfish
E.	East
EEZ	exclusive economic zone
EFH	essential fish habitat
ENSO	El Ni□o-Southern Oscillation
ESA	Endangered Species Act
F	fishing mortality rate
FMP	fishery management plan
FOCI	Fisheries-Oceanography Coordinated Investigations
ft	foot/feet
$F_{X\%}$	fishing mortality rate at which the SPR level would be reduced to X% of the SPR level in the absence of fishing
GHL	guideline harvest level
GMT	Greenwich mean time
HAPC	habitat area of particular concern
IFQ	individual fishing quota
IPHC	International Pacific Halibut Commission
IR/IU	Improved Retention/Improved Utilization Program
JVP	Joint venture processed catch
kg	kilogram(s)
km	kilometer(s)
lb	pound(s)
LLP	license limitation program
LOA	length overall
m	meter(s)
M	natural mortality rate
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
MSY	maximum sustainable yield
mt	metric ton(s)
N.	North
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
OFL	overfishing level
OY	optimum yield
PBR	potential biological removal
pdf	probability density function
POP	Pacific ocean perch
ppm	part(s) per million
ppt	part(s) per thousand
PRD	Protected Resources Division (of the National Marine Fisheries Service)
PSC	prohibited species catch
QS	quota share(s)
RKCSA	Red King Crab Savings Area
S.	South
SAFE	Stock Assessment and Fishery Evaluation
SPR	spawning per recruit
SSC	North Pacific Fishery Management Council’s Scientific and Statistical Committee
TAC	total allowable catch
TALFF	total allowable level of foreign fishing
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
U.S. GLOBEC	United States Global Ocean Ecosystems Dynamics
USSR	United Soviet Socialist Republics
W.	West
	degrees

Chapter 1 Introduction

This Fishery Management Plan (FMP) governs groundfish fisheries of the Bering Sea and Aleutian Islands (BSAI) Management Area. The geographical extent of the FMP management unit is the United States (U.S.) Exclusive Economic Zone (EEZ) of the Bering Sea, including Bristol Bay and Norton Sound, and that portion of the North Pacific Ocean adjacent to the Aleutian Islands which is between 170° W. longitude and the U.S.-Russian Convention Line of 1867 (Figure 1-1).

The FMP covers fisheries for all stocks of finfish and marine invertebrates except salmonids, shrimps, scallops, snails, king crab, Tanner crab, Dungeness crab, corals, surf clams, horsehair crab, lyre crab, Pacific halibut, and Pacific herring. In terms of both the fishery and the groundfish resource, the BSAI groundfish fishery forms a distinct management area. The history of fishery development, target species and species composition of the commercial catch, bathymetry, and oceanography are all much different in the BSAI than in the adjacent Gulf of Alaska. Although many species occur over a broader range than the BSAI management area, with only a few exceptions (e.g., sablefish), stocks of common species in this region are believed to be different from those in the adjacent Gulf of Alaska.

Figure 1-1 Management Area for the Bering Sea and Aleutian Islands



1.1 Foreign Fishing

Title II of the Magnuson-Stevens Act establishes the system for the regulation of foreign fishing within the U.S. EEZ. These regulations are published in 50 CFR 600. The regulations provide for the setting of a total allowable level of foreign fishing (TALFF) for species based on the portion of the optimum yield that will not be caught by U.S. vessels. At the present time, no TALFF is available for the fisheries covered by this FMP, because the U.S. has the capacity to harvest up to the level of optimum yield of all species subject to this FMP. Also, U.S. fish processors have the capacity to process all of the optimum yield of BSAI groundfish.

Chapter 2 Management Policy and Objectives

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) is the primary domestic legislation governing management of the nation's marine fisheries. In 1996, the United States Congress reauthorized the Magnuson-Stevens Act to include, among other things, a new emphasis on the precautionary approach in U.S. fishery management policy. The Magnuson-Stevens Act contains ten national standards, with which all fishery management plans (FMPs) must conform and which guide fishery management. The national standards are listed in Section 2.1, and provide the primary guidance for the management of the groundfish fisheries.

Under the Magnuson-Stevens Act, the North Pacific Fishery Management Council (Council) is authorized to prepare and submit to the Secretary of Commerce for approval, disapproval or partial approval, a FMP and any necessary amendments, for each fishery under its authority that requires conservation and management. The Council conducts public hearings so as to allow all interested persons an opportunity to be heard in the development of FMPs and amendments, and reviews and revises, as appropriate, the assessments and specifications with respect to the optimum yield from each fishery (16 U.S.C. 1852(h)).

The Council has developed a management policy and objectives to guide its development of management recommendations to the Secretary of Commerce for the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. This management approach is described in Section 2.2.

2.1 National Standards for Fishery Conservation and Management

The Magnuson-Stevens Act, as amended, sets out ten national standards for fishery conservation and management (16 U.S.C. § 1851), with which all fishery management plans must be consistent.

1. Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry.
2. Conservation and management measures shall be based upon the best scientific information available.
3. To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.
4. Conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be A) fair and equitable to all such fishermen; B) reasonably calculated to promote conservation; and C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.
5. Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose.
6. Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.
7. Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.
8. Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to A) provide for the sustained participation of such communities, and B) to the extent practicable, minimize adverse economic impacts on such communities.

9. Conservation and management measures shall, to the extent practicable, A) minimize bycatch and B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.
10. Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

2.2 Management Approach for the BSAI 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.
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.
22. Continue to improve the retention of groundfish where practicable, through establishment of minimum groundfish retention standards.

Avoid Impacts to Seabirds and Marine Mammals:

23. Continue to cooperate with U.S. Fish and Wildlife Service (USFWS) to protect ESA-listed species, and if appropriate and practicable, other seabird species.
24. 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.

25. Encourage programs to review status of endangered or threatened marine mammal stocks and fishing interactions and develop fishery management measures as appropriate.
26. 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:

27. Review and evaluate efficacy of existing habitat protection measures for managed species.
28. 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.
29. Develop a Marine Protected Area policy in coordination with national and state policies.
30. Encourage development of a research program to identify regional baseline habitat information and mapping, subject to funding and staff availability.
31. 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:

32. Provide economic and community stability to harvesting and processing sectors through fair allocation of fishery resources.
33. Maintain the license limitation program, modified as necessary, and further decrease excess fishing capacity and overcapitalization by eliminating latent licenses and extending programs such as community or rights-based management to some or all groundfish fisheries.
34. Provide for adaptive management by periodically evaluating the effectiveness of rationalization programs and the allocation of access rights based on performance.
35. 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:

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

Improve Data Quality, Monitoring and Enforcement:

39. Increase the utility of groundfish fishery observer data for the conservation and management of living marine resources.
40. Develop funding mechanisms that achieve equitable costs to the industry for implementation of the North Pacific Groundfish Observer Program.
41. Improve community and regional economic impact costs and benefits through increased data reporting requirements.
42. Increase the quality of monitoring and enforcement data through improved technology.
43. 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.
44. Cooperate with research institutions such as the North Pacific Research Board in identifying research needs to address pressing fishery issues.

45. Promote enhanced enforceability.
46. 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.

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Chapter 3 Conservation and Management Measures

The Fishery Management Plan (FMP) for Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area authorizes the commercial harvest of species listed in Section 3.1 of this FMP. Commercial fishing is authorized during the fishing year unless otherwise specified in the FMP. Section 3.2 describes the procedures for determining harvest levels for the groundfish species. Sections 3.3 to 3.6 address permit and participation, authorized gear, time and area, and catch restrictions, respectively. Section 3.7 describes the specific management measures for the fixed gear sablefish quota share program. Measures that allow flexible management authority are addressed in Section 3.8. Section 3.9 designates monitoring and reporting requirements for the fisheries. Section 3.10 describes the schedule and procedures for review of the FMP or FMP components.

The groundfish resources off Alaska have been harvested and processed entirely by U.S.-flagged vessels since 1991. Conservation and management measures contained in this FMP apply exclusively to domestic fishing activities. No portion of the annual optimum yield is allocated to foreign harvesters or foreign processors.

3.1 Areas and Stocks Involved

The FMP and its management regime governs fishing by United States (U.S.) vessels in the Bering Sea and Aleutian Islands management area described in Section 3.1.1, and for those stocks listed in Section 3.1.2. Fishing for groundfish by foreign vessels is not permitted in the BSAI.

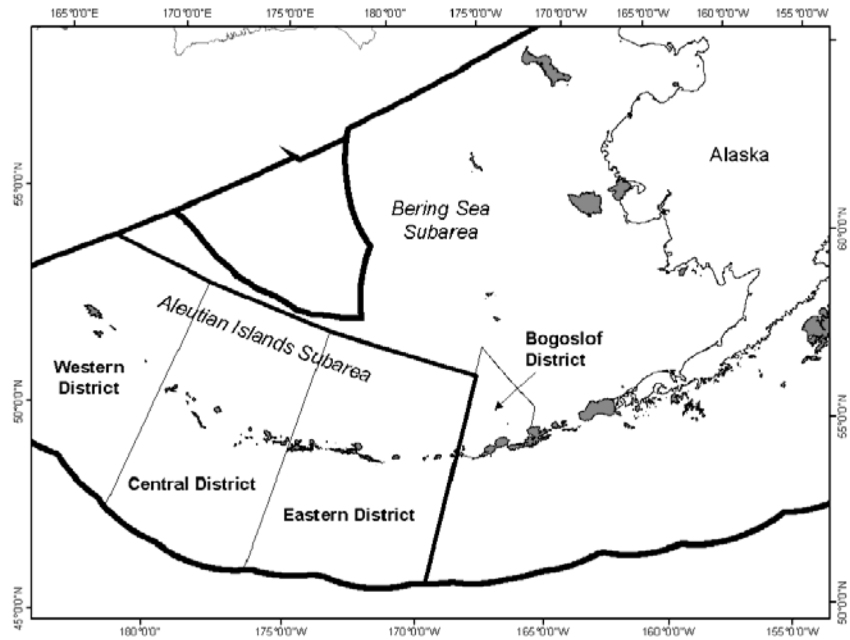
3.1.1 Management Area

The BSAI management area encompasses the U.S. Exclusive Economic Zone (EEZ) of the eastern Bering Sea and that portion of the North Pacific Ocean adjacent to the Aleutian Islands west of 170° W. longitude (Figure 1-1). The northern boundary of the Bering Sea is the Bering Strait, defined as a straight line from Cape Prince of Whales to Cape Dezhneva, Russia.

The FMP area is divided into two fishing areas, the Bering Sea subarea and the Aleutian Islands subarea. The Bering Sea subarea includes a defined area known as the Bogoslof District. For the purpose of spatially allocating total allowable catch, the Aleutian Islands subarea is divided into three districts, the eastern district (between 170° W. and 177° W. longitude), the central district (between 177° W. longitude and 177° E. longitude), and the western district (west of 177° E. longitude).

The subareas and districts of the BSAI management area are illustrated in Figure 3-1. Geographical coordinates for these areas are described in Appendix B.

Figure 3-1 Subareas and districts of the Bering Sea and Aleutian Islands management area.



3.1.2 Stocks

Stocks governed by the FMP are listed in Table 3-1 and include all stocks of finfish and marine invertebrates except salmonids, shrimps, scallops, snails, king crab, Tanner crab, Dungeness crab, corals, surf clams, horsehair crab, lyre crab, Pacific halibut, and Pacific herring, which are distributed or are exploited in the area described in Section 3.1.1.

Five categories of species or species groups are likely to be taken in the groundfish fishery. The optimum yield concept is applied to all except the "prohibited species" category. These categories are tabulated in Table 3-1 and are described as follows:

1. Prohibited Species – are those species and species groups the catch of which must be avoided while fishing for groundfish, and which must be returned to sea with a minimum of injury except when their retention is authorized by other applicable law (see also Prohibited Species Donation Program described in Section 3.6.2.1.1). Groundfish species and species groups under the FMP for which the quotas have been achieved shall be treated in the same manner as prohibited species.

2. Target species – are those species that support either a single species or mixed species target fishery, are commercially important, and for which a sufficient data base exists that allows each to be managed on its own biological merits. Accordingly, a specific TAC is established annually for each target species. Catch of each species must be recorded and reported. This category includes pollock, Pacific cod, sablefish, yellowfin sole, Greenland turbot, arrowtooth flounder, rock sole, flathead sole, Alaska plaice, "other flatfish", Pacific ocean perch, northern rockfish, shortraker rockfish, rougheye rockfish, "other rockfish", Atka mackerel, and squid.

3. Other Species – are those species or species groups that currently are of slight economic value and not generally targeted upon. This category, however, contains species with economic potential or which are important ecosystem components, but insufficient data exist to allow separate management. Accordingly, a single TAC applies to this category as a whole. Catch of

this category as a whole must be recorded and reported. The category includes sculpins, sharks, skates, and octopus.

4. Forage fish species – are those species, listed in Table 3-1, which are a critical food source for many marine mammal, seabird and fish species. The forage fish species category is established to allow for the management of these species in a manner that prevents the development of a commercial directed fishery for forage fish. Management measures for this species category will be specified in regulations and may include such measures as prohibitions on directed fishing, limitations on allowable bycatch retention amounts, or limitations on the sale, barter, trade or any other commercial exchange, as well as the processing of forage fish in a commercial processing facility.

5. Nonspecified species – are those species and species groups of no current economic value taken by the groundfish fishery only as an incidental catch in the target fisheries. Virtually no data exist which would allow population assessments. No record of catch is necessary. The allowable catch for this category is the amount which is taken incidentally while fishing for target and other species, whether retained or discarded.

Table 3-1 Species included in the FMP Species Categories

	Finfish	Marine Invertebrates
Prohibited Species[1]	Pacific halibut Pacific herring Pacific salmon Steelhead	King crab Tanner crab
Target Species[2]	Walleye pollock Pacific cod Sablefish Yellowfin sole Greenland turbot Arrowtooth flounder Rock sole Flathead sole Alaska plaice Other flatfish Pacific ocean perch Northern rockfish Shortraker rockfish Rougheye rockfish Other rockfish Atka mackerel	Squid
Other Species[3]	Sculpins Sharks Skates	Octopus
Forage Fish Species[4]	Osmeridae family (eulachon, capelin, and other smelts) Myctophidae family (lanternfishes) Bathylagidae family (deep-sea smelts) Ammodytidae family (Pacific sand lance) Trichodontidae family (Pacific sand fish) Pholidae family (gunnels) Stichaeidae family (pricklebacks, warbonnets, eelblennys, cockscombs, and shannys) Gonostomatidae family (bristlemouths, lightfishes, and anglemouths)	Order Euphausiacea (krill)

[1]Must be returned to the sea
[2]TAC for each listing
[3]Aggregate TAC for group
[4]Management measures for forage fish are established in regulations implementing the FMP

3.2 Determining Harvest Levels

This section of the FMP provides the basis for determining harvest levels in the groundfish fisheries. Section 3.2.1 defines terms used in the harvest specification process. The maximum sustainable yield and optimum yield of groundfish in the Bering Sea and Aleutian Islands are addressed in Sections 3.2.2 and 3.2.3. Criteria for determining overfishing are described in Section 3.2.4, followed by the procedures for setting total allowable catch in Section 3.2.5. Section 3.2.6 specifies those groundfish fisheries for which the total allowable catch is apportioned by gear type, area, or season.

The Council's harvest strategy was reviewed in 2002 by Goodman et al. The report contains a historical overview of the Council's approach to fishery harvest management, and an analysis of single-species, multispecies and ecosystem issues relating to the harvest strategy. The report is available by request from the Council office.

3.2.1 Definition of Terms

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.

Optimum yield (OY) is the amount of fish which–

a) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

b) is prescribed as such on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor; and

c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the MSY in such fishery.

Overfishing level (OFL) is a limit reference point set annually for a stock or stock complex during the assessment process, as described in Section3.2.4, Overfishing criteria. Overfishing occurs whenever a stock or stock complex is subjected to a rate or level of fishing mortality that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis. Operationally, overfishing occurs when the harvest exceeds the OFL.

Acceptable biological catch (ABC) is an annual sustainable target harvest (or range of harvests) for a stock or stock complex, determined by the Plan Team and the Science and Statistical Committee during the assessment process. It is derived from the status and dynamics of the stock, environmental conditions, and other ecological factors, given the prevailing technological characteristics of the fishery. The target reference point is set below the limit reference point for overfishing.

Total allowable catch (TAC) is the annual harvest limit for a stock or stock complex, derived from the ABC by considering social and economic factors.

In addition to definitional differences, OY differs from ABC and TAC in two practical respects. First, ABC and TAC are specified for each stock or stock complex within the “target species” and “other species” categories, whereas OY is specified for the groundfish fishery (comprising target species and other species categories) as a whole. Second, ABCs and TACs are specified annually whereas the OY range is constant. The sum of the stock-specific ABCs may fall within or outside of the OY range. If the sum of annual TACs falls outside the OY range, TACs must be adjusted or the FMP amended.

3.2.2 Maximum Sustainable Yield of the Groundfish Complex

The groundfish complex and its fishery are a distinct management unit of the Bering Sea. This complex forms a large subsystem of the Bering Sea ecosystem with intricate interrelationships between predators and prey, between competitors, and between those species and their environment. Ideally, concepts such as productivity and MSY should be viewed in terms of the groundfish complex as a unit rather than for individual species or species groups. Due to the difficulty of estimating the parameters that govern interactions between species, however, estimates of MSY for the groundfish complex have sometimes been computed by summing MSY estimates for the individual species and species groups.

Early studies estimated MSY for the groundfish complex in the range of 1.7 to 2.4 million mt. This range was obtained by summing the MSY ranges for each target species and the “other species” category, as defined in Section 3.2.2 of this FMP. By way of comparison, this range included both the average annual catch (1.8 million mt) and the maximum annual catch (2.4 million mt) taken during the period 1968-1977 (see Section 4.3.1, History of Exploitation). However, current multi-species models suggest that the sum of single-species MSYs provides a poor estimate of MSY for the groundfish complex as a whole (Walters et al., in press) because biological reference points for single stocks, such as F_{MSY}, may change substantially when multi-species interactions are taken into account (Gislason 1999; Collie and Gislason 2001). Fishing mortality rates for prey species that are consumed by other marine predators should be conditioned on the level of predation mortality, which may change over time depending on predator population levels.

An ecosystem perspective suggests that the MSY of the groundfish complex may change if an environmental regime shift occurs or if the present mix of species is altered substantially. Also, as new data are acquired and as statistical methodology evolves over time, it is to be expected that estimates of MSY will change, even if the ecosystem has remained relatively stationary. Therefore, estimates of MSY contained in this section should be viewed in context, as historical estimates that guided development of the FMP.

3.2.3 Optimum Yield of the Groundfish Complex

The optimum yield of the groundfish complex is specified as 85 percent of the historical estimate of the MSY range for the target species and the "other species" categories (1.4 to 2.0 million mt), to the extent this can be harvested consistently with the management measures specified in this FMP, plus the actual amount of the nonspecified species category that is taken incidentally to the harvest of target species and the "other species" category. This deviation from the historical estimate of MSY reflects the combined influence of ecological, social, and economic factors. The important ecological factors may be summarized as follows:

The OY range encompasses the summed ABCs of individual species for 1978-1981 (Low et al. 1978; and Bakkala et al. 1979, 1980, and 1981). This sum was used as an indicator of the biological productivity of the complex, although such use is not completely satisfactory because multi-species/ ecosystem interactions are not taken into account explicitly. The 15 percent reduction from MSY reduces the risk associated with incomplete data and questionable assumptions in assessment models used to determine the condition of stocks.

The important social and economic factors may be summarized as follows:

1. The OY range is not likely to have any significant detrimental impact on the industry. On the contrary, specification of OY as a constant range helps to create a stable management environment in which the industry can plan its activities consistently, with an expectation that each year's total groundfish catch will be at least 1.4 million mt.
2. The OY range encompasses the annual catch levels taken in the period immediately prior to its implementation, during which the fishery operated profitably.

OY may need to be respecified in the future if major changes occur in the estimate of MSY for the groundfish complex. Likewise, OY may need to be respecified if major changes occur in the ecological, social, or economic factors governing the relationship between OY and MSY.

3.2.4 Overfishing Criteria

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The Council's Science and Statistical Committee (SSC) will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations.

For tier (1), a "pdf" refers to a probability density function. For tiers 1 and 2, if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers 1 to 5, if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers 1 to 3, the coefficient α is set at a default value of 0.05. This default value was established by applying the 10 percent rule suggested by Rosenberg et al. (1994) to the 1/2 B_{MSY} reference point. However, the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers 2 to 4, a designation of the form "$F_{X\%}$" refers to the fishing mortality rate (F) associated with an equilibrium level of spawning per recruit equal to $X\%$ of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view spawning per recruit calculations based on a knife-edge maturity assumption as reliable. For tier 3, the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

Tier 1 Information available: reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.
- 1a) Stock status: $B/B_{MSY} > 1$
  - $F_{OFL} = m_A$, the arithmetic mean of the pdf
  - $F_{ABC} \leq m_H$, the harmonic mean of the pdf
- 1b) Stock status: $a < B/B_{MSY} \leq 1$
  - $F_{OFL} = m_A \times (B/B_{MSY} - a)/(1 - a)$
  - $F_{ABC} \leq m_H \times (B/B_{MSY} - a)/(1 - a)$
- 1c) Stock status: $B/B_{MSY} \leq a$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

Tier 2 Information available: reliable point estimates of B, B_{MSY}, F_{MSY}, $F_{35\%}$, and $F_{40\%}$.
- 2a) Stock status: $B/B_{MSY} > 1$
  - $F_{OFL} = F_{MSY}$
  - $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$
- 2b) Stock status: $a < B/B_{MSY} \leq 1$
  - $F_{OFL} = F_{MSY} \times (B/B_{MSY} - a)/(1 - a)$
  - $F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - a)/(1 - a)$
- 2c) Stock status: $B/B_{MSY} \leq a$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

Tier 3 Information available: reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.
- 3a) Stock status: $B/B_{40\%} > 1$
  - $F_{OFL} = F_{35\%}$
  - $F_{ABC} \leq F_{40\%}$
- 3b) Stock status: $a < B/B_{40\%} \leq 1$
  - $F_{OFL} = F_{35\%} \times (B/B_{40\%} - a)/(1 - a)$
  - $F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - a)/(1 - a)$
- 3c) Stock status: $B/B_{40\%} \leq a$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

Tier 4 Information available: reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.
- $F_{OFL} = F_{35\%}$
- $F_{ABC} \leq F_{40\%}$

Tier 5 Information available: reliable point estimates of B and natural mortality rate M.
- $F_{OFL} = M$
- $F_{ABC} \leq 0.75 \times M$

Tier 6 Information available: reliable catch history from 1978 through 1995.

OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information

ABC ≤ 0.75 × OFL

3.2.5 Procedures for Setting Total Allowable Catch

The Secretary, after receiving recommendations from the Council, will determine up to 2 years of TACs and apportionments thereof, and reserves for each stock or stock complex in the "target species" and "other species" categories, by January 1 of the new fishing year, or as soon as practicable thereafter, by means of regulations implementing the FMP. Notwithstanding designated stocks or stock complexes listed by category in Table 3-1, the Council may recommend splitting or combining stocks or stock complexes in the "target species" category for purposes of establishing a new TAC if such action is desirable based on commercial importance of a stock or stock complex and whether sufficient biological information is available to manage a stock or stock complex on its own merits.

Prior to making final recommendations to the Secretary, the Council will make available to the public for comment as soon as practicable after its October meeting, proposed specifications of ABC and TAC for each target stock or stock complex and the "other species" category, and apportionments thereof, and reserves.

The Council will provide proposed recommendations for harvest specifications to the Secretary after its October meeting, including detailed information on the development of each proposed specification and any future information that is expected to affect the final specifications. As soon as practicable after the October meeting, the Secretary will publish in the *Federal Register* proposed harvest specifications based on the Council's October recommendations and make available for public review and comment, all information regarding the development of the specifications, identifying specifications that are likely to change, and possible reasons for changes, if known, from the proposed to final specifications. The prior public review and comment period on the published proposed specifications will be a minimum of 15 days.

At its December meeting, the Council will review the final SAFE reports, recommendations from the Groundfish Plan Teams, SSC, AP, and comments received. The Council will then make final harvest specifications recommendations to the Secretary for review, approval, and publication. New final annual specifications will supersede current annual specifications on the effective date of the new annual specifications.

3.2.5.1 Framework for Setting Total Allowable Catch

A procedure has been developed whereby the Council may set annual harvest levels by specifying a total allowable catch for each groundfish fishery on an annual basis. The procedure is used to determine TACs for every groundfish species and species group managed by the FMP.

Scientists from the Alaska Fisheries Science Center, the Alaska Department of Fish and Game, and other agencies and universities prepare *Stock Assessment and Fishery Evaluation* (SAFE) documents annually (see Section 3.2.5.2 for further information). These documents are first reviewed by the Groundfish Plan Team, and then by the Council's SSC and AP, and the Council. Reference point recommendations are made at each level of assessment. Usually, scientists recommend values for ABC and OFL, and the AP recommends values for TAC. The Council has final authority to approve all reference points, but focuses on setting TACs so that OY is achieved and OFLs are not exceeded.

The procedure for setting TAC consists of the following steps:

1. Determine the ABC for each managed species or species group. ABCs are recommended by the Council's SSC based on information presented by the Plan Team.

2. Determine a TAC based on biological and socioeconomic information. The TAC must be lower than or equal to the ABC. The TAC may be lower if bycatch considerations or socioeconomic considerations cause the Council to establish a lower harvest.

3. Sum TACs for "target species" and "other species" to assure that the sum is within the optimum yield range specified for the groundfish complex in the FMP. If the sum falls outside this range the TACs must be adjusted or the FMP amended.

3.2.5.2 Stock Assessment and Fishery Evaluation

For purposes of supplying scientific information to the Council for use in specifying TACs, a SAFE report is prepared annually.

The SAFE report will, at a minimum, contain or refer to the following:

1. current status of BSAI area groundfish resources, by major species or species group;
2. estimates of maximum sustainable yield and acceptable biological catch;
3. estimates of groundfish species mortality from nongroundfish fisheries, subsistence fisheries, and recreational fisheries, and difference between groundfish mortality and catch, if possible;
4. fishery statistics (landings and value) for the current year;
5. the projected responses of stocks and fisheries to alternative levels of fishing mortality;
6. any relevant information relating to changes in groundfish markets;
7. information to be used by the Council in establishing prohibited species catch limits for prohibited species with supporting justification and rationale (further detail in Section 3.6.2.3.2); and
8. any other biological, social, or economic information that may be useful to the Council.

3.2.5.3 Reserves

The groundfish reserve at the beginning of each fishing year shall equal the sum of 15 percent of each target species and the "other species" category TACs, except for pollock, fixed-gear sablefish, Atka mackerel, AI Pacific ocean perch, flathead sole, rocksole, yellowfin sole, and Pacific cod. When the TACs for the groundfish complex are determined by the Council, 15 percent of the sum of the TACs is set aside as a reserve. This reserve is used for a) correction of operational problems in the fishing fleets, to promote full and efficient use of groundfish resources, b) adjustments of species TACs according to the condition of stocks during the fishing year, and c) apportionments.

The reserve is not designated by species or species groups and will be apportioned to the fisheries during the fishing year by the Regional Administrator in amounts and by species that s/he determines to be appropriate. The apportionment of the reserve to target species or to the "other species" category must be consistent with the most recent assessments of resource conditions unless the Regional Administrator finds that the socioeconomic considerations listed above or specified fishery operational problems dictate otherwise. Except as provided for in the National Standard Guidelines, the Regional Administrator must also find that the apportionment of reserves will not result in overfishing as defined in the guidelines. The Regional Administrator may withhold reserves for conservation reasons.

3.2.6 Apportionment of Total Allowable Catch

When the TAC for each target species and the "other species" category, except for pollock, fixed-gear sablefish, Atka mackerel, AI Pacific ocean perch, flathead sole, rocksole, yellowfin sole, and Pacific cod, is determined, it is reduced by 15 percent to form the reserve, as described in Section 3.5.2.3. The remaining 85 percent of each TAC is then apportioned by the Regional Administrator.

Groundfish species and species groups under the FMP for which TAC has been achieved shall be treated in the same manner as prohibited species; they must be returned to the sea with a minimum of injury.

3.2.6.1 Pollock

3.2.6.1.1 Gear Allocation

The Regional Administrator, in consultation with the Council, may limit the amount of pollock that may be taken with trawls other than pelagic trawls. Prior to the Regional Administrator's determination, the Council will recommend to him or her a limit on the amount of pollock that may be taken with other than pelagic trawl gear. The Regional Administrator shall make the Council's recommendations available to the public for comment under the annual TAC specification process set forth under Section 3.2.5.

The following information must be considered by the Council when determining whether a limit will be recommended and what that limit should be:

a. PSC limits established under Section 3.6.2;

b. projected prohibited species bycatch levels with and without a limit on the amount of pollock that may be taken with other than pelagic trawl gear;

c. the cost of the limit on the bottom-trawl and pelagic trawl fisheries; and

d. other factors that determine the effects of the limit on the attainment of FMP goals and objectives.

3.2.6.1.2 Seasonal Allocation

The pollock TAC shall be divided into two allowances: roe-bearing ("A" season) and non-roe-bearing ("B" season). Each allowance will be available for harvest during the times specified in the regulations. The proportion of the annual pollock TAC assigned to each allowance will be determined annually during the groundfish specifications process. Proposed and final notices of the seasonal allowances of the pollock TAC will be published in the *Federal Register* with the proposed and final groundfish specifications.

The following factors will be considered when setting seasonal allowances of the pollock TAC:

1. estimated monthly pollock catch and effort in prior years;
2. expected changes in harvesting and processing capacity and associated pollock catch;
3. current estimates of and expected changes in pollock biomass and stock conditions; conditions of marine mammal stocks, and biomass and stock conditions of species taken as bycatch in directed pollock fisheries;
4. potential impacts of expected seasonal fishing for pollock on pollock stocks, marine mammals, and stocks of species taken as bycatch in directed pollock fisheries;
5. the need to obtain fishery-related data during all or part of the fishing year;
6. effects on operating costs and gross revenues;
7. the need to spread fishing effort over the year, minimize gear conflicts, and allow participation by various elements of the groundfish fleet and other fisheries;

8. potential allocative effects among users and indirect effects on coastal communities; and
9. other biological and socioeconomic information that affects the consistency of seasonal pollock harvests with the goals and objectives of the FMP.

3.2.6.2 Sablefish

Sablefish in the Bering Sea subarea

Vessels using fixed gear, including hook-and-line and pot gear, shall be permitted to harvest no more than 50 percent of the TAC specified for sablefish. Vessels using trawl gear shall be permitted to harvest no more than 50 percent of the TAC specified for sablefish.

Sablefish in the Aleutian Islands subarea

Vessels using fixed gear, including hook-and-line and pot gear, shall be permitted to harvest no more than 75 percent of the TAC specified for sablefish. Vessels using trawl gear shall be permitted to harvest no more than 25 percent of the TAC specified for sablefish.

3.2.6.3 Pacific Cod

3.2.6.3.1 Gear Allocations

Among gear groups

The BSAI Pacific cod TAC (excluding CDQ) shall be allocated among gear groups as follows:

a. 48.7 percent to catcher/processors using hook-and-line gear;
b. 0.2 percent to catcher vessels equal to or greater than 60 ft length overall using hook-and-line gear;
c. 1.5 percent to catcher/processors using pot gear;
d. 8.4 percent to catcher vessels equal to or greater than 60 ft length overall using pot gear;
e. 2.0 percent to catcher vessels less than 60 ft length overall that use either hook-and-line gear or pot gear;
f. 1.4 percent to vessels using jig gear;
g. 2.3 percent to catcher processors using trawl gear and listed in Section 208(e)(1) through (20) of the American Fisheries Act;
h. 13.4 percent to catcher processors using trawl gear as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447);
i. 22.1 percent to catcher vessels using trawl gear.

Inseason reallocations

Specific provisions for the accounting of these allocations and the transfer of unharvested amounts of these allocations to other vessels using hook-and-line or pot gear, trawl gear, or jig gear will be set forth in regulations.

Incidental catch allowances

The Regional Administrator annually will estimate the amount of Pacific cod taken as incidental catch in directed fisheries for groundfish other than Pacific cod. For vessels using hook-and-line or pot gear, the incidental catch allowance will be deducted from the aggregate amount of Pacific cod TAC annually allocated to hook-and-line and pot gear sectors combined.

3.2.6.3.2 Seasonal Allocations

The amount of Pacific cod allocated to gear groups under Section 3.2.6.3.1 may be seasonally apportioned. Criteria for seasonal apportionments and the seasons authorized to receive separate apportionments will be set forth in regulations.

3.2.6.4 Atka Mackerel

The Regional Administrator, in consultation with the Council, will annually allocate up to 2 percent of the TAC specified for Atka mackerel in the eastern Aleutian Islands District/Bering Sea subarea to vessels using jig gear in these areas. The jig gear allocation will be specified during the annual groundfish specifications process based on recent annual catches of Atka mackerel by vessels using jig gear and the anticipated harvest of this species by the jig gear fleet during the upcoming fishing year. The remaining TAC available for harvest will be apportioned for use by trawl gear as described under Section 3.7.5.

3.2.6.5 Shortraker and Rougheye Rockfish

After subtraction of reserves, the Aleutian Islands subarea TAC specified for shortraker and rougheye rockfish will be allocated 70 percent to vessels using trawl gear and 30 percent to vessels using non-trawl gear.

3.2.6.6 AI Pacific ocean perch, flathead sole, rock sole, and yellowfin sole

After subtraction of the CDQ allowance and incidental catch amount, the remaining TAC is apportioned among vessels using trawl gear as described under Section 3.7.5.

3.2.7 Attainment of Total Allowable Catch

The attainment of a TAC for a species will result in the closure of the target fishery for that species. That is, once the TAC is taken, further retention of that species will be prohibited. Other fisheries targeting on other species could be allowed to continue as long as the non-retainable bycatch of the closed species is found to be non-detrimental to that stock.

3.3 Permit and Participation Restrictions

Certain permits are required of participants in the BSAI groundfish fisheries. The framework of the License Limitation Program (Section 3.3.1) and the exempted fishing permit program (Section 3.3.2) are set out below, however specific requirements are found in regulations implementing the FMP.

3.3.1 License Limitation Program

A Federal groundfish license is required for catcher vessels (including catcher/processors) participating in all BSAI groundfish fisheries, other than fixed gear sablefish. However, the following vessel categories are exempt from the license program requirements:

a. vessels fishing in State of Alaska waters (0-3 miles offshore);

b. vessels less than 32 ft LOA; or

c. jig gear vessels less than 60 ft LOA using a maximum of 5 jig machines, one line per machine, and a maximum of 15 hooks per line.

Any vessel that meets the LLP qualification requirements will be issued a license, regardless of whether they are exempt from the program or not.

3.3.1.1 Elements of the License Limitation Program

1. Nature of Licenses. General licenses will be issued for the entire BSAI management area based on historical landings defined in Federal regulations. Vessels that qualify for both a BSAI and a Gulf of Alaska general license will be issued both as a non-severable package. Area endorsements for the Bering Sea and/or Aleutian Islands subareas will be issued along with the general license. General licenses and endorsements will remain a non-severable package.

2. License Recipients. Licenses will be issued to owners (as of June 17, 1995) of qualified vessels. The owners as of this date must be "persons eligible to document a fishing vessel" under Chapter 121, Title 46, U.S.C. In cases where the vessel was sold on or before June 17, 1995, and the disposition of the vessel's fishing history for license qualification was not mentioned in the contract, the license qualification history would go with the vessel. If the transfer occurred after June 17, 1995, the license qualification history would stay with the seller of the vessel unless the contract specified otherwise.

3. License Designations. Licenses and endorsements will be designated as Catcher Vessel or Catcher Processor and with one of three vessel length classes (less than 60 ft LOA, greater than or equal to 60 ft but less than 125 ft LOA, or greater than 125 ft LOA). Vessels less than 60 ft LOA with a catcher vessel designation may process up to 1 mt (round weight) of fish per day.

   General licenses will also contain a gear designation (trawl gear, non-trawl gear, or both) based on landings activity in any area through June 17, 1995. Vessels that used both trawl and non-trawl gear during the original qualification period would receive both gear designations, while vessels that used only trawl gear or only non-trawl gear during the original qualification period (general or endorsement period) would receive one or the other. For vessels that used only one gear type (trawl or non-trawl) in the original qualification period, and then used the other gear type between June 18, 1995 and February 7, 1998, the license recipient may choose one or the other gear designation, but will not receive both. For vessels that used only one gear type (trawl or non-trawl) in the original qualification period, but made a significant financial investment towards conversion to the other gear type or deployment of such gear on or before February 7, 1998, and made landings on that vessel with the new gear type by December 31, 1998, the license recipient may choose which gear designation to receive, but not both. A significant financial commitment is defined as a minimum purchase of $100,000 worth of equipment specific to trawling or having acquired groundline, hooks or pots, and hauling equipment for the purpose of prosecuting the non-trawl fisheries on or by February 7, 1998.

4. Who May Purchase Licenses. Licenses may be transferred only to "persons" defined as those "eligible to document a fishing vessel" under Chapter 121, Title 46, U.S.C. Licenses may not be leased.

5. Vessel/License Linkages. Licenses may be transferred without a vessel, i.e., licenses may be applied to vessels other than the one to which the license was initially issued. However, the new vessel is still subject to the license designations, vessel upgrade provisions, "20 percent upgrade rule" (defined in provision seven), and the no leasing provision. Licenses may be applied to vessels shorter than the maximum LOA allowed by the license regardless of the vessel's length designation. Vessels may also use catcher processor licenses on catcher vessels. However, the reverse is not allowed.

   Notwithstanding the above, licenses earned on vessels that did not hold a Federal fisheries permit prior to October 9, 1998, may be transferred only if the vessel originally assigned the license is transferred along with the license, unless a fishing history transfer occurred prior to February 7, 1998, in which case the vessel does not have to accompany the license earned from that fishing history; however, any future transfer of that license would have to include that vessel.

A license that was originally assigned to, or designates, a non-AFA trawl catcher/processor may only be used on a non-AFA trawl catcher/processor.

6. Separability of General Licenses and Endorsements. General licenses may be issued for the BSAI groundfish, Gulf of Alaska groundfish, and Bering Sea and Aleutian Islands crab fisheries. Those general licenses initially issued to a person based on a particular vessel's catch history are not separable and shall remain as a single "package". General licenses transferred after initial allocation shall remain separate "packages" in the form they were initially issued, and will not be combined with other general groundfish or crab licenses the person may own. Area endorsements are not separable from the general license they are initially issued under, and shall remain as a single "package", which includes the assigned catcher vessel or catcher processor and length designations.

7. Vessel Replacements and Upgrades. Vessels may be replaced or upgraded within the bounds of the vessel length designations and the "20 percent rule". This rule was originally defined for the vessel moratorium program. The maximum LOA with respect to a vessel means the greatest LOA of that vessel or its replacement that may qualify it to conduct directed fishing for groundfish covered under the license program, except as provided at § 679.4(d). The maximum LOA of a vessel with license qualification will be determined by the Regional Administrator as follows:

   a. For a vessel with license qualification that is less than 125 ft LOA, the maximum LOA will be equal to 1.2 times the vessel's original qualifying length or 125 ft, whichever is less; and

   b. For a vessel with license qualification that is equal to or greater that 125 ft, the maximum LOA will be equal to the vessel's original qualifying length.

   If a vessel upgrades under the "20 percent rule" to a length which falls into a larger license length designation after June 17, 1995, then the vessel owner would be initially allocated a license and endorsement(s) based on the vessels June 17, 1995, length. Those licenses and endorsements could not be used on the qualifying vessel, and the owner would be required to obtain a license for that vessel's designation before it could be fished.

8. License Ownership Caps. No more than 10 general groundfish licenses may be purchased or controlled by a "person", with grandfather rights to those persons who exceed this limit in the initial allocation. Persons with grandfather rights from the initial allocation must be under the 10 general license cap before they will be allowed to purchase any additional licenses. A "person" is defined as those eligible to document a fishing vessel under Chapter 121, Title 46, U.S.C. For corporations, the cap would apply to the corporation and not to share holders within the corporation.

9. Vessel License Use Caps. There is no limit on the number of licenses (or endorsements) that may be used on a vessel.

10. Changing Vessel Designations. If a vessel qualifies as a catcher processor, it may select a one time (permanent) conversion to a catcher vessel designation.

11. Implement a Skipper Reporting System. NMFS will implement a skipper reporting system that requires groundfish license holders to report skipper names, addresses, and service records.

12. Vessels Targeting Non-groundfish Species. Vessels targeting non-groundfish species that are allowed to land incidentally taken groundfish species without a Federal permit before implementation of the groundfish license program, will be allowed to continue to land bycatch amounts of groundfish without having a valid groundfish license. Additionally, vessels targeting

sablefish and halibut under the IFQ program will continue to be allowed to retain bycatch amounts of groundfish species.

13. CDQ Vessel Exemption. Vessels less than 125 ft LOA obtained under an approved CDQ plan to participate in both CDQ and non-CDQ fisheries will be allowed to continue to fish both fisheries without a license, provided such vessel was under construction or operating in an existing community development plan as of October 9, 1998. If the vessel is sold outside the CDQ plan, the vessel will no longer be exempt from the rules of the license program.

14. Lost Vessels. Vessels that qualified for the moratorium and were lost, damaged, or otherwise out of the fishery due to factors beyond the control of the owner and which were replaced or otherwise reentered the fishery in accordance with the moratorium rules, and which made a landing any time between the time the vessel left the fishery and June 17, 1995, will be qualified for a general license and endorsement for that area.

15. Licenses Represent a Use Privilege. The Council may alter or rescind this program without compensation to license holders; further, licenses may be suspended or revoked for (serious and/or multiple) violations of fisheries regulations.

3.3.1.2 Species and Gear Endorsements for Vessels Using Hook-and-line and Pot Gear

Vessels engaged in directed fishing for Pacific cod in the BSAI management area using hook-and-line and/or pot gear must qualify for a Pacific cod endorsement in addition to holding an area endorsement and general license. The following criteria apply to specific gear types and vessel classes:

- Hook-and-line catcher processors. Must have made at least 270 mt of landings in the directed commercial BSAI Pacific cod fishery (excluding discards) in any one of the years 1996, 1997, 1998, or 1999.
- Hook-and-line catcher vessels ≥60 ft LOA. Must have made at least 7.5 mt of cod landings in the directed commercial BSAI Pacific cod fishery (excluding discards) in any one of the years 1995, 1996, 1997, 1998, or 1999.
- Pot catcher/processors. Must have made at least 300,000 lbs of landings in the directed commercial BSAI Pacific cod fishery (excluding discards) in each of any two of the years 1995, 1996, 1997, or 1998.
- Pot catcher vessels ≥60 ft LOA. Must have made over 100,000 lbs of landings in the directed commercial BSAI Pacific cod fishery (excluding discards) in each of any two of the years 1995, 1996, 1997, 1998, or 1999.

Other Pacific cod endorsement requirements under the License Limitation Program apply as follows:

1. Harvest of CDQ Pacific cod. CDQ vessels shall not be exempt from the Pacific cod endorsements.

2. Vessels Earning Multiple Pacific Cod Endorsements. Vessels that qualify for a Pacific cod endorsement in more than one gear sector shall be issued an endorsement for each sector for which they qualify. Endorsements that are earned by a vessel shall be attached to that vessel's general license. The Pacific cod endorsement(s) shall not be severable from a general license, just as area endorsements are non-severable.

3. Vessels class exemptions. Vessels less than or equal to 32 ft LOA are exempt from the BSAI license limitation program and Pacific cod endorsements. Catcher vessels less than 60 ft LOA are exempt from the Pacific cod endorsements but are required to hold a general license.

4. Bait landings. Properly documented (Alaska Department of Fish and Game fishticket) commercial bait landings will count towards the landing requirements for a Pacific cod

endorsement. A Pacific cod endorsement is required to fish Pacific cod in the commercial bait fishery. A Pacific cod endorsement is not required to fish Pacific cod for personal use bait.

Specific hardship and grandfather provisions will be set forth in regulations.

3.3.2 Exempted Permits

The Regional Administrator, after consulting with the Director of the Alaska Fisheries Science Center and with the Council, may authorize for limited experimental purposes, the target or incidental harvest of groundfish that would otherwise be prohibited. Exempted fishing permits might be issued for fishing in areas closed to directed fishing, for continued fishing with gear otherwise prohibited, or for continued fishing for species for which the quota has been reached. Exempted fishing permits will be issued by means of procedures contained in regulations.

As well as other information required by regulations, each application for an exempted fishing permit must provide the following information: 1) experimental design (e.g., staffing and sampling procedures, the data and samples to be collected, and analysis of the data and samples), 2) provision for public release of all obtained information, and 3) submission of interim and final reports.

The Regional Administrator may deny an exempted fishing permit for reasons contained in regulations, including a finding that:

a. according to the best scientific information available, the harvest to be conducted under the permit would detrimentally affect living marine resources, including marine mammals and birds, and their habitat in a significant way;

b. issuance of the exempted fishing permit would inequitably allocate fishing privileges among domestic fishermen or would have economic allocation as its sole purpose;

c. activities to be conducted under the exempted fishing permit would be inconsistent with the intent of the management objectives of the FMP;

d. the applicant has failed to demonstrate a valid justification for the permit;

e. the activity proposed under the exempted fishing permit could create a significant enforcement problem; or

f. the applicant failed to make available to the public information that had been obtained under a previously issued exempted fishing permit.

3.4 Gear Restrictions

3.4.1 Authorized Gear

Gear types authorized by the FMP are trawls, hook-and-line, pots, jigs, and other gear as defined in regulations. Further restrictions on gear which are necessary for conservation and management of fishery resources and which are consistent with the goals and objectives of the FMP are found at 50 CFR Part 679. Additional gear limitations by specific target fishery are described in Section 3.4.2.

3.4.2 Target Fishery-Specific

Pollock

The use of nonpelagic trawl gear in the directed fishery for pollock is prohibited.

3.5 Time and Area Restrictions

Management measures in place in the BSAI groundfish fisheries constrain fishing both temporally and spatially. In Section 3.5.1, criteria for determining fishing seasons are described. Area restrictions by gear type are described in Section 3.5.2. The FMP also authorizes the use of either temporal or spatial restrictions for marine mammal conservation, as detailed in Section 3.5.3. Section 3.5.4 addresses exemptions to the time and area restrictions in the FMP or its implementing regulations.

3.5.1 Fishing Seasons

Fishing seasons are defined as periods when harvesting groundfish is permitted. Fishing seasons will normally be within a calendar year, if possible, for statistical purposes, but could span two calendar years if necessary. In consultation with the Council, the Secretary will establish all fishing seasons by regulations that implement the FMP, to accomplish the goals and objectives of the FMP, the Magnuson-Stevens Act, and other applicable law. Season openings will remain in effect unless amended by regulations implementing the FMP.

The Council will consider the following criteria when recommending regulatory amendments:

- biological: spawning periods, migration, and other biological factors;
- bycatch: biological and allocative effects of season changes;
- exvessel and wholesale prices: effects of season changes on prices;
- product quality: producing the highest quality product to the consumer;
- safety: potential adverse effects on people, vessels, fishing time, and equipment;
- cost: effects on operating costs incurred by the industry as a result of season changes;
- other fisheries: possible demands on the same harvesting, processing, and transportation systems needed in the groundfish fishery;
- coordinated season timing: the need to spread out fishing effort over the year, minimize gear conflicts, and allow participation by all elements of the groundfish fleet;
- enforcement and management costs: potential benefits of seasons changes relative to agency resources available to enforce and manage new seasons; and
- allocation: potential allocation effects among users and indirect effects on coastal communities.

3.5.2 Area Restrictions

3.5.2.1 Trawl Gear Only

The following time and area restrictions apply to some or all trawl vessels. Other time and area restrictions that may apply to trawl vessels are triggered by the attainment of a bycatch limit. These restrictions are described in Section 3.6.2.

3.5.2.1.1 Crab and Halibut Protection Zone

The crab and halibut protection zone is closed to all trawling from January 1 to December 31. For the period March 15 to June 15, the western border of the zone extends westward. See Appendix B and Figure 3-2.

3.5.2.1.2 Pribilof Islands Habitat Conservation Area

The Pribilof Islands Habitat Conservation Area is closed to all trawling from January 1 to December 31. See Appendix B and Figure 3-3.

3.5.2.1.3 Chum Salmon Savings Area

The Chum Salmon Savings Area is closed to directed fishing for pollock with trawl gear from August 1 through August 31, unless the vessel directed fishing for pollock is operating under a salmon bycatch reduction inter-cooperative agreement. See Appendix B and Figure 3-4. Directed fishing for pollock with trawl gear is also prohibited in this area upon the attainment of an ‘other salmon’ bycatch limit, unless the vessel directed fishing for pollock is operating under a salmon bycatch reduction inter-cooperative agreement. See description under Section 3.6.2.

3.5.2.1.4 Red King Crab Savings Area

The Red King Crab Savings Area is closed to non-pelagic trawling year round, except that when the Regional Administrator of NMFS, in consultation with the Council, determines that a guideline harvest level for Bristol Bay red king crab has been established, he or she may open a subarea of the Red King Crab Savings Area to non-pelagic trawling. See Appendix B and Figure 3-5.

3.5.2.1.5 Nearshore Bristol Bay Trawl Closure

The Nearshore Bristol Bay area is closed to all trawling on a year round basis, except a subarea that remains open to trawling during the period April 1 to June 15 each year. See Appendix B and Figure 3-6.

3.5.2.1.6 Catcher Vessel Operational Area

Catcher/processors identified in the American Fisheries Act (see Section 3.7.2) are prohibited from engaging in directed fishing for pollock in the catcher vessel operational area (CVOA) during the non-roe (“B”) season, unless they are participating in a community development quota fishery (see Section 3.7.3). See Appendix B and Figure 3-7.

3.5.2.1.7 Aleutian Islands Habitat Conservation Area

The use of nonpelagic trawl gear, as described in 50 CFR part 679, in the Aleutian Islands Habitat Conservation Area is prohibited. See Appendix B and **Error! Reference source not found.**.

Figure 3-2 Crab and Halibut Protection Zone.

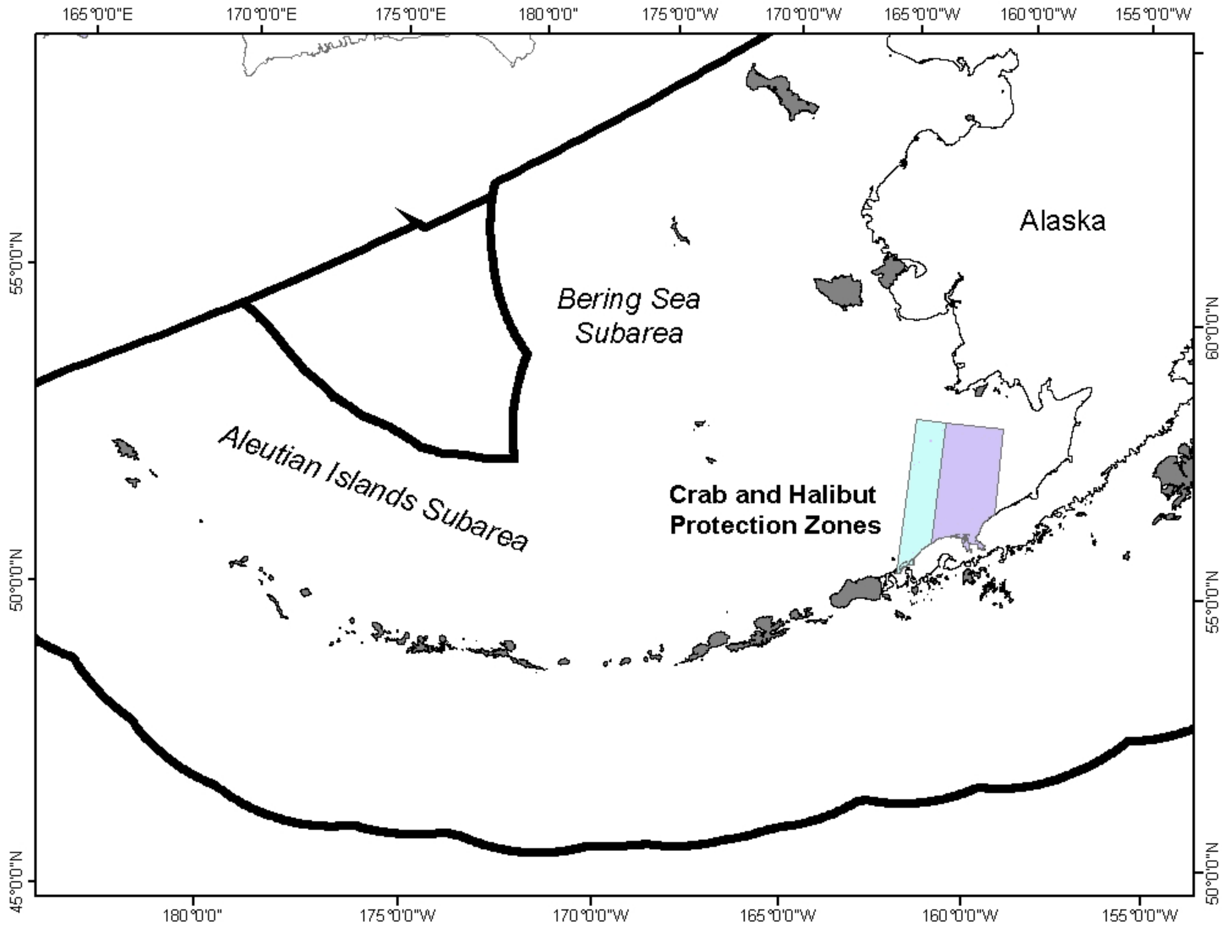
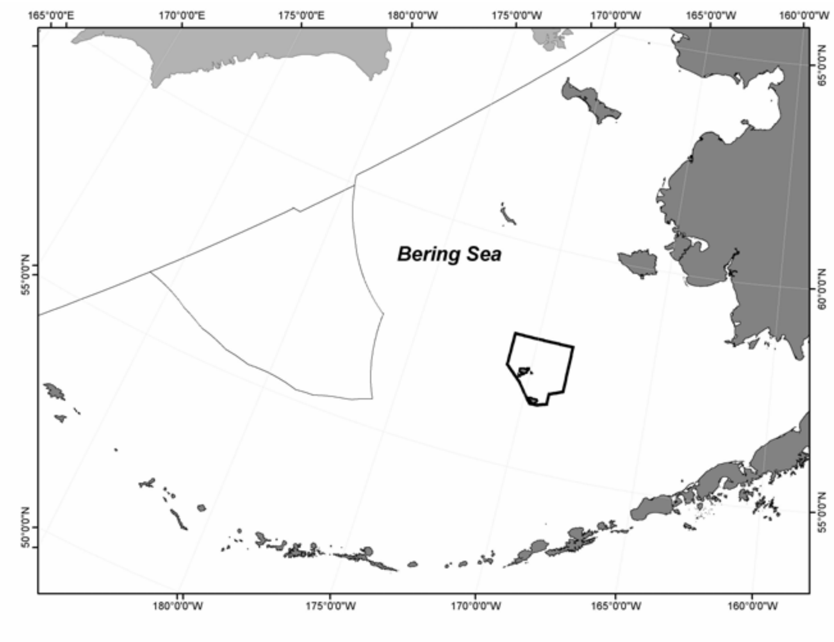


Figure 3-3 Pribilof Island Habitat Conservation Area.



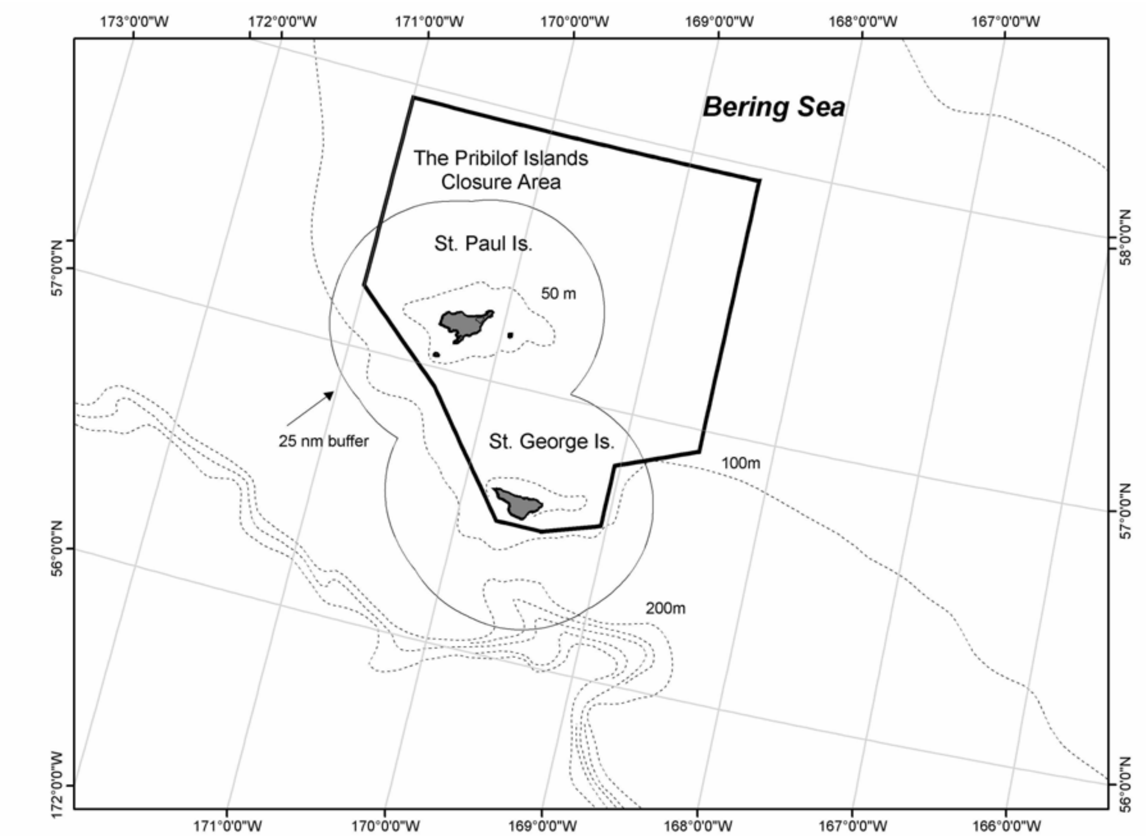


Figure 3-4 Chum Salmon Savings Area.

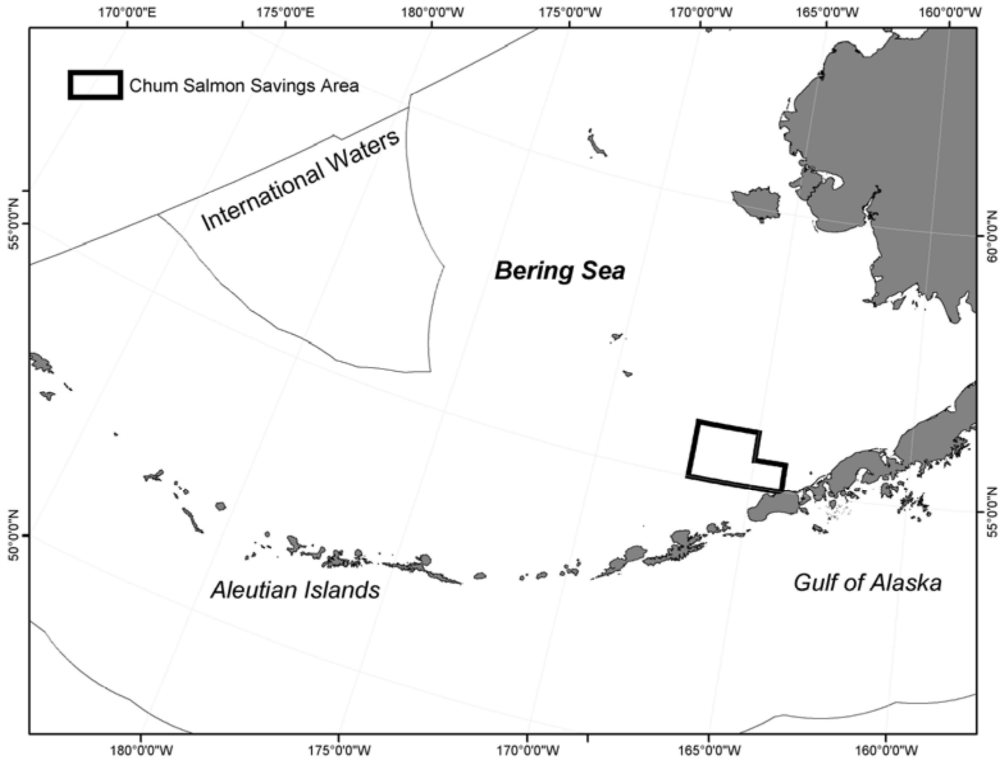


Figure 3-5 Red King Crab Savings Area.

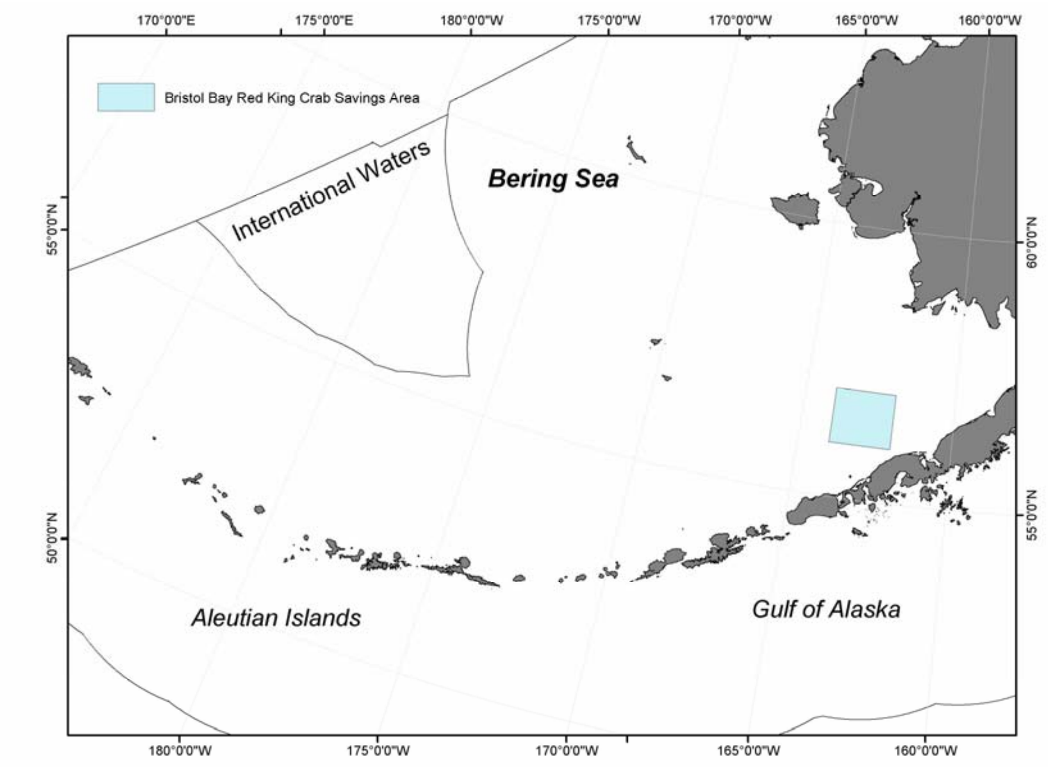


Figure 3-6 Nearshore Bristol Bay Trawl Closure.

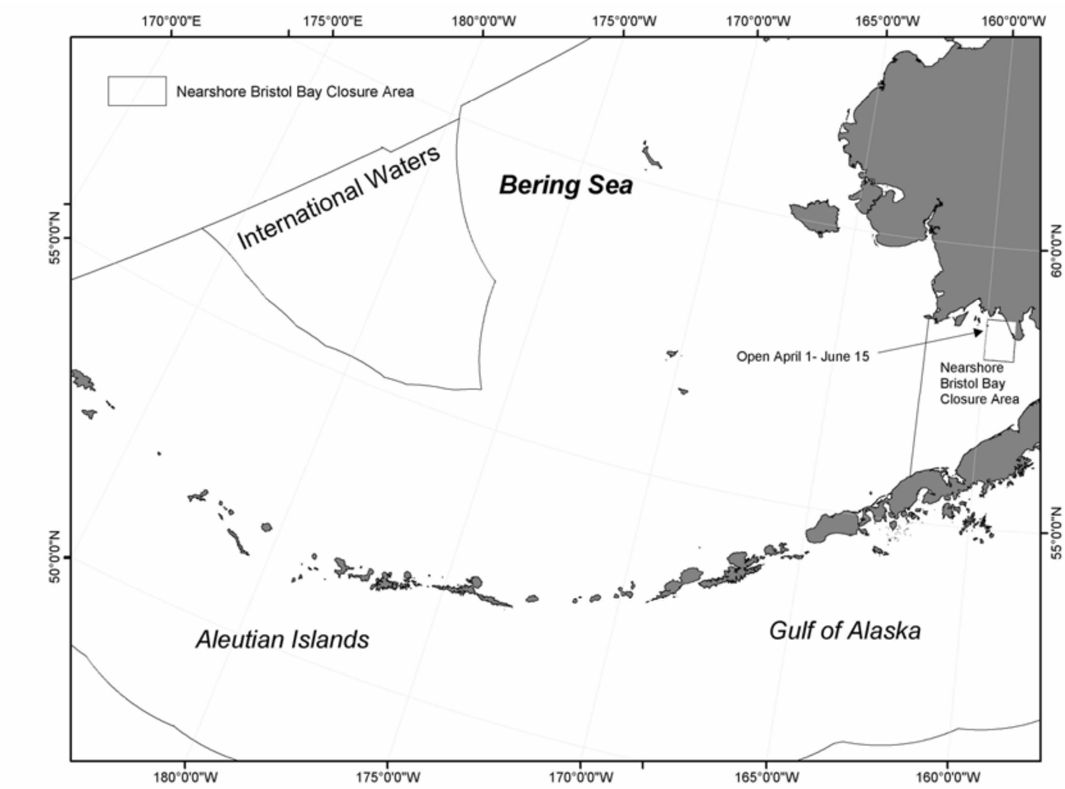


Figure 3-7 Catcher Vessel Operational Area.

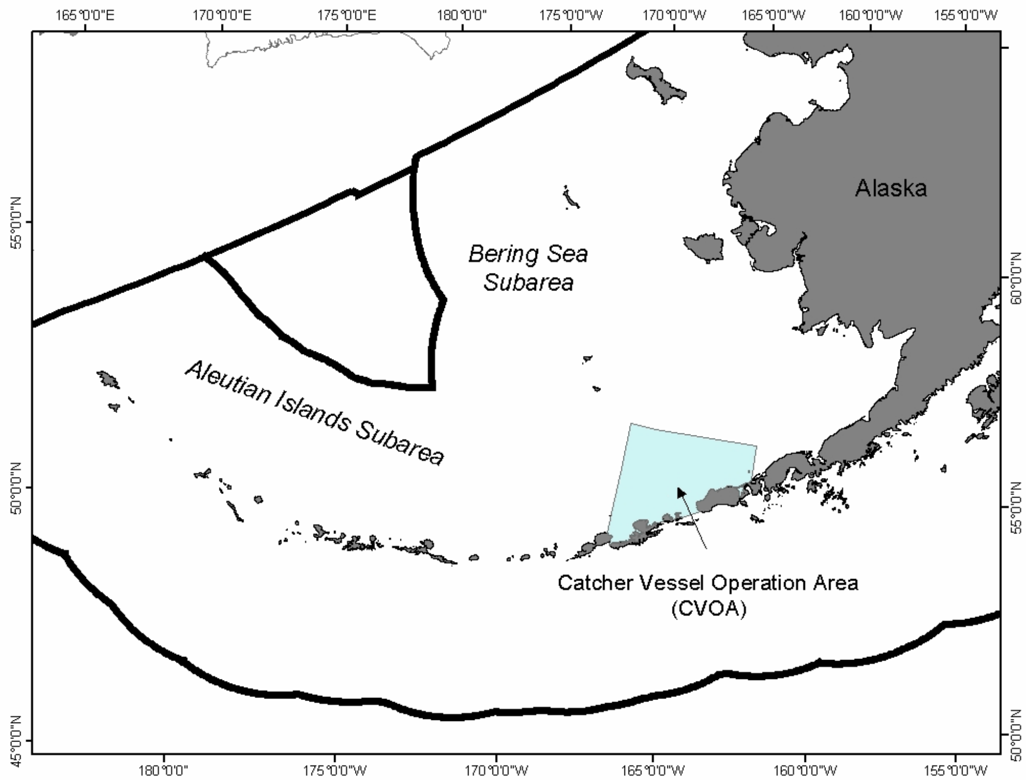
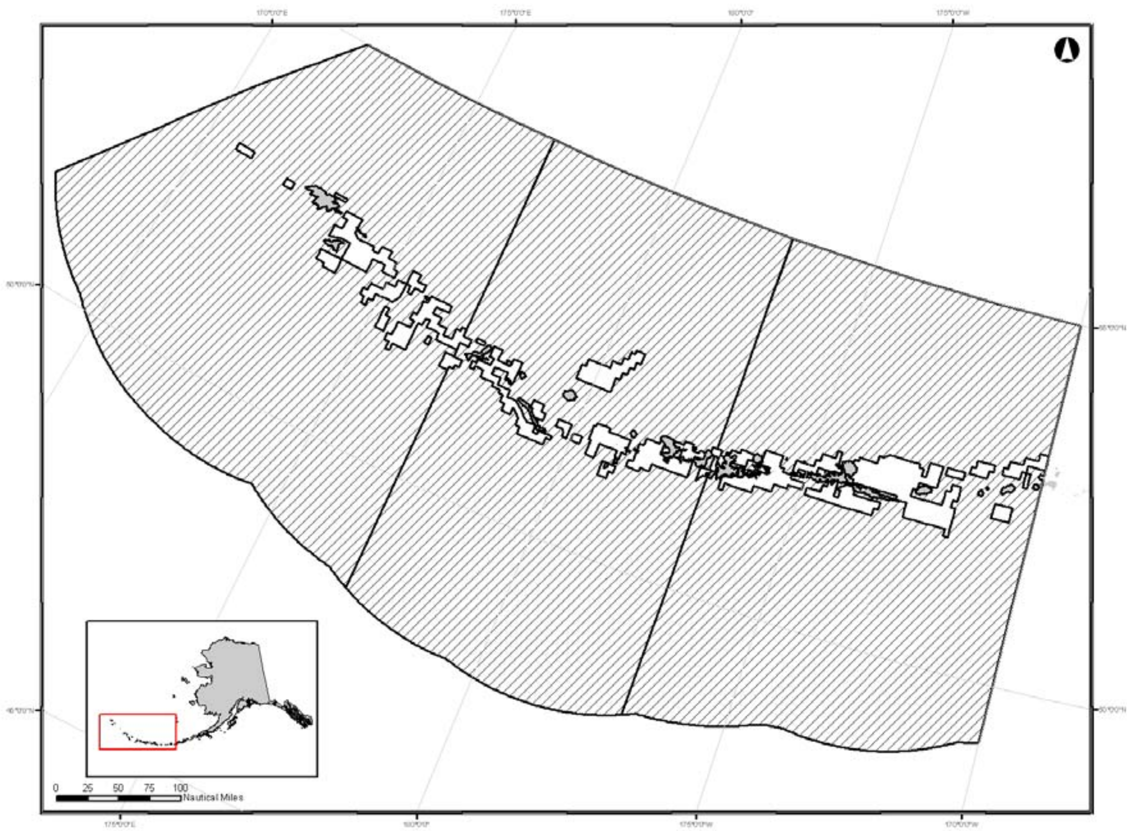


Figure 3-8 Aleutian Islands Habitat Conservation Area (AIHCA). The AIHCA is the Aleutian Islands subarea except within the polygons.



3.5.2.1.8 Bering Sea Habitat Conservation Area

The use of nonpelagic trawl gear, as described in 50 CFR part 679, in the Bering Sea Habitat Conservation Area is prohibited. See Appendix B and Figure 3-16.

3.5.2.1.9 St. Matthew Island Habitat Conservation Area

The use of nonpelagic trawl gear, as described in 50 CFR part 679, in the St. Matthew Island Habitat Conservation Area is prohibited. See Appendix B and Figure 3-17.

3.5.2.1.10 St. Lawrence Island Habitat Conservation Area

The use of nonpelagic trawl gear, as described in 50 CFR part 679, in the St. Lawrence Island Habitat Conservation Area is prohibited. See Appendix B and Figure 3-18

3.5.2.1.11 Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area

The use of nonpelagic trawl gear, as described in 50 CFR part 679, in the Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area is prohibited. See Appendix B and Figure 3-19.

3.5.2.1.12 Northern Bering Sea Research Area

The use of nonpelagic trawl gear, as described in 50 CFR part 679, in the Northern Bering Sea Research Area is prohibited, except as allowed through exempted fishing permits under 50 CFR 679.6 that are consistent with a Council approved research plan to examine the effects of nonpelagic trawling on the management of crab species, marine mammals, ESA-listed species, and subsistence needs for Western Alaska communities. See Appendix B and Figure 3-20.

3.5.2.2 Bottom Contact Gear

3.5.2.2.1 Aleutian Islands Coral Habitat Protection Areas

The use of bottom contact gear by a federally permitted fishing vessel, as described in 50 CFR part 679, is prohibited in the Aleutian Islands Coral Habitat Protection Areas. See Appendix B and Figure 3-9.

3.5.2.2.2 Alaska Seamount Habitat Protection Areas

The use of bottom contact gear by a federally permitted fishing vessel, as described in 50 CFR part 679, is prohibited in the Alaska Seamount Habitat Protection Areas. See Appendix B and Figure 3-10.

Figure 3-9 Aleutian Islands Coral Habitat Protection Areas.

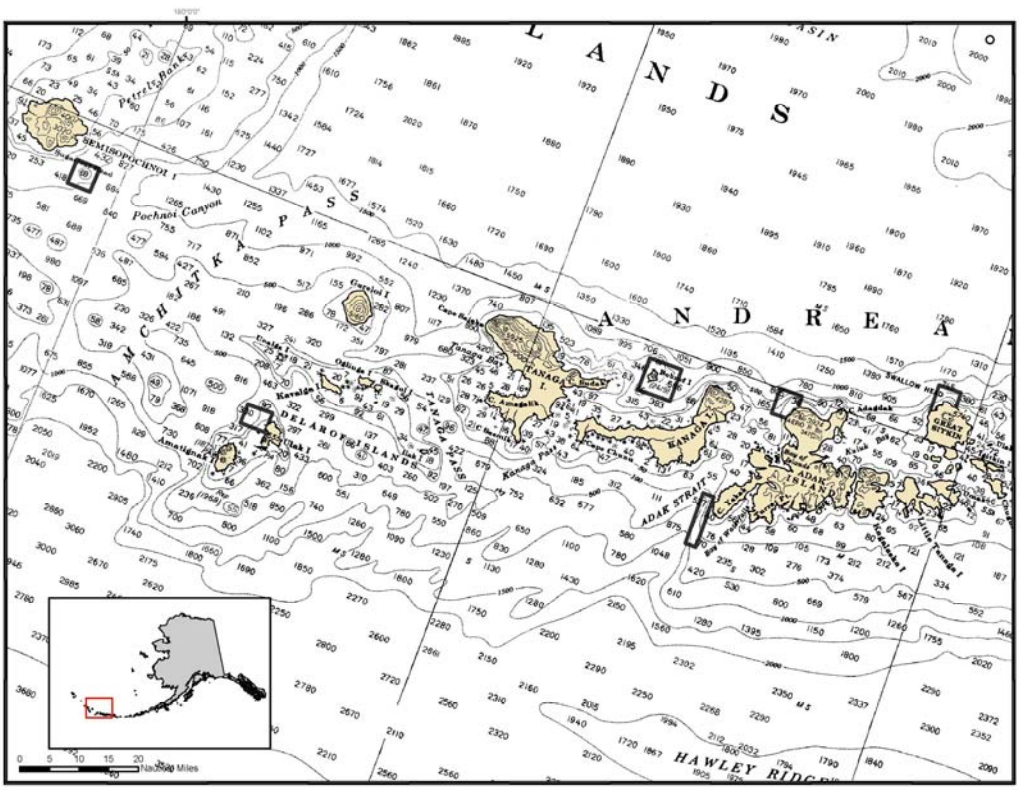
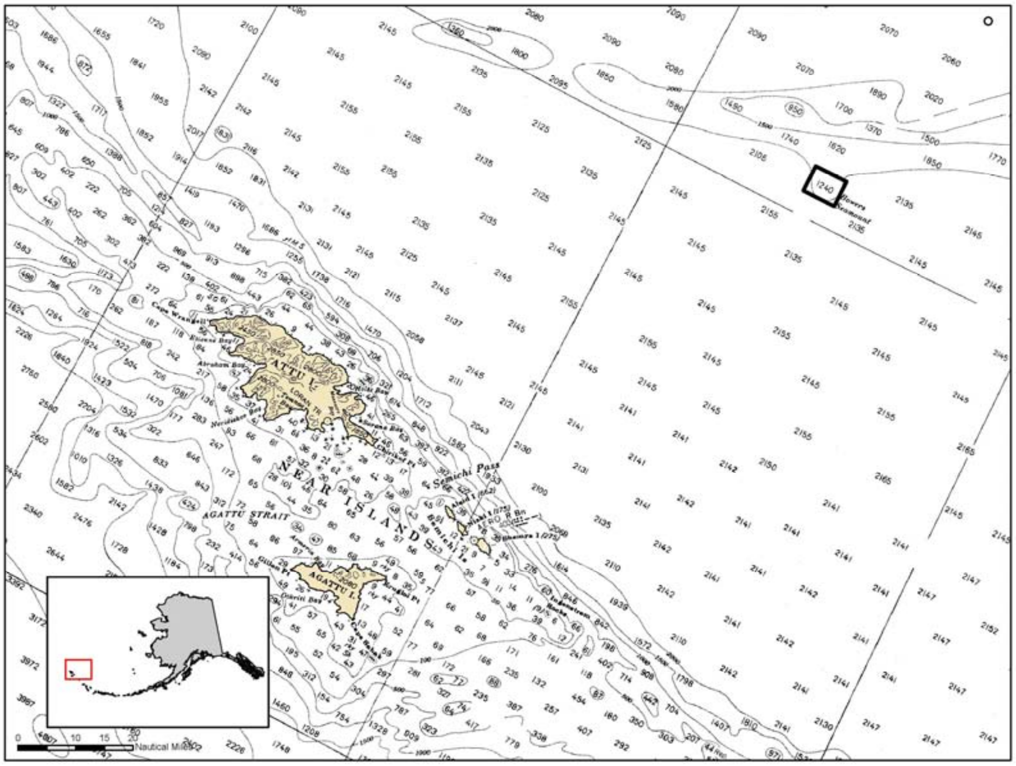


Figure 3-10 Alaska Seamount Habitat Protection Area in the Aleutian Islands Subarea.

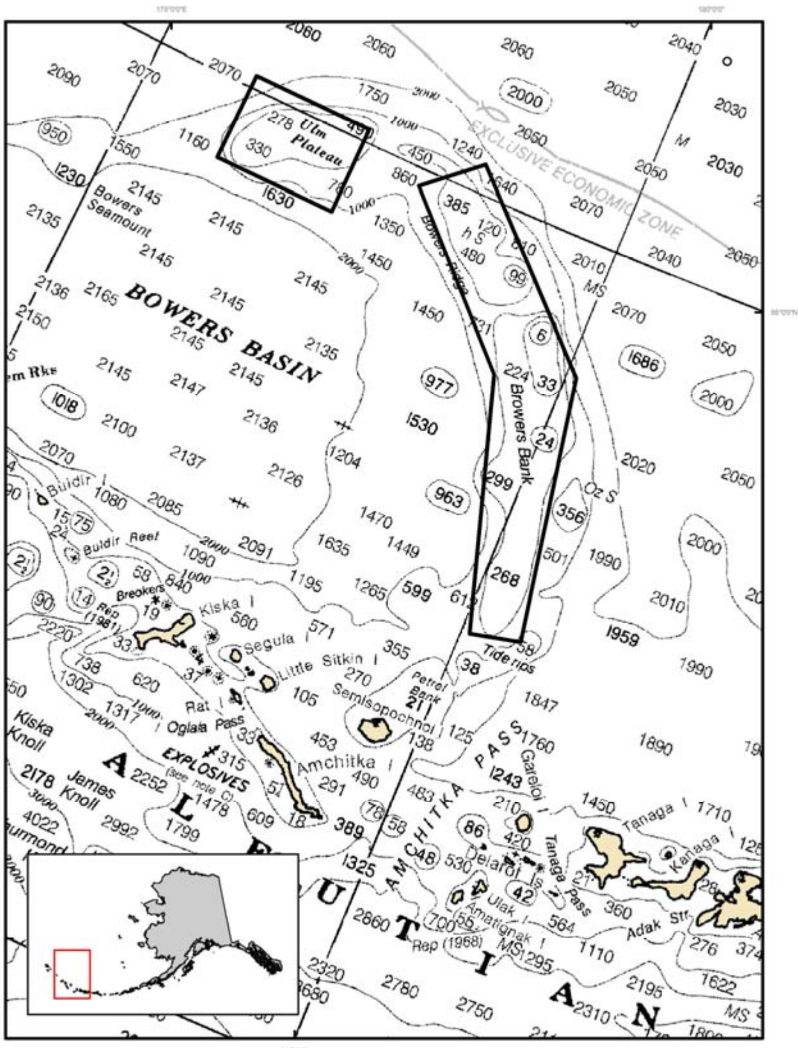


3.5.2.3 Mobile Bottom Contact Gear

3.5.2.3.1 Bowers Ridge Habitat Conservation

The use of mobile bottom contact gear, as described in 50 CFR part 679, is prohibited in the Bowers Ridge Habitat Conservation Zone. See Appendix B and Figure 3-11.

Figure 3-11 Bowers Ridge Habitat Conservation Zone.



3.5.2.4 All Gear

3.5.2.4.1 Anchoring

Anchoring by a federally permitted fishing vessel, as described in 50 CFR part 679, is prohibited in the Aleutian Islands Coral and Alaska Seamount Habitat Protection Areas. See Appendix B and Figure 3-9 and Figure 3-10.

3.5.3 Marine Mammal Conservation Measures

Regulations implementing the FMP may include special groundfish management measures intended to afford species of marine mammals additional protection other than that provided by other legislation. These regulations may be especially necessary when marine mammal species are reduced in abundance. Regulations may be necessary to prevent interactions between commercial fishing operations and marine mammal populations when information indicates that such interactions may adversely affect marine mammals, resulting in reduced abundance and/or reduced use of areas important to marine mammals. These areas include breeding and nursery grounds, haul out sites, and foraging areas that are important to adult and juvenile marine mammals during sensitive life stages.

Regulations intended to protect marine mammals might include those that would limit fishing effort, both temporarily and spatially, around areas important to marine mammals. Examples of temporal measures are seasonal apportionments of TAC specifications. Examples of spatial measures could be closures around areas important to marine mammals. The purpose of limiting fishing effort would be to prevent harvesting excessive amounts of the available TAC or seasonal apportionments thereof at any one time or in any one area.

3.5.4 Gear Test Areas

The Council may promulgate regulations establishing areas where specific types of fishing gear may be tested, to be available for use when the fishing grounds are closed to that gear type. Specific gear test areas contained in regulations that implement the FMP, and changes to the regulations, will be done by regulatory amendment. These gear test areas would be established in order to provide fishermen the opportunity to ensure that their gear is in proper working order prior to a directed fishery opening. The test areas must conform to the following conditions:

1. depth and bottom type must be suitable for testing the particular gear type;
2. must be outside State waters;
3. must be in areas not normally closed to fishing with that gear type;
4. must be in areas that are not usually fished heavily by that gear type; and
5. must not be within a designated Steller sea lion protection area at any time of the year.

3.6 Catch Restrictions

This section describes the retention and utilization restrictions for the groundfish fisheries, including prohibited species restrictions and incentive programs to reduce bycatch.

3.6.1 Prohibited Species

Pacific halibut, Pacific herring, Pacific salmon and steelhead, king crab, and Tanner crab are prohi

bited species and must be avoided while fishing for groundfish and must be returned to the sea with a minimum of injury except when their retention is authorized by other applicable law.

Groundfish species and species groups under this FMP for which the TAC has been achieved shall be treated in the same manner as prohibited species.

3.6.1.1 Prohibited Species Donation Program

The Prohibited Species Donation Program authorizes the distribution of specified prohibited species, taken as bycatch in the groundfish trawl fisheries off Alaska, to economically disadvantaged individuals through a NMFS-authorized distributor selected by the Regional Administrator in accordance with regulations that implement the FMP. The program is limited to the following species:

1. Pacific salmon
2. Pacific halibut

3.6.2 Prohibited Species Catch Limits

When a target fishery, as specified in regulations implementing the FMP, attains a prohibited species catch (PSC) limit apportionment or seasonal allocation as described in the FMP (Section 3.6.2.1) and specified in regulations implementing the FMP, the bycatch zone(s) or management area(s) to which the PSC limit apportionment or seasonal allocation applies (described in Section 3.6.2.2) will be closed to that target fishery (or components thereof) for the remainder of the year or season, whichever is applicable. The procedure for apportioning PSC limits is detailed in Section 3.6.2.3. PSC assigned to a non-AFA trawl catcher/processor cooperative under Section 3.7.5 is not subject to fishery or seasonal apportionment.

3.6.2.1 Individual Species Limits

The following species have PSC limits specified either in the FMP or in regulations implementing the FMP: red king crab, *Chionoecetes bairdi*, *C. opilio*, Pacific halibut, Pacific herring, Chinook salmon, and other salmon.

3.6.2.1.1 Red King Crab

A PSC limit for red king crab in Zone 1 (as described in Section 3.6.2.2.1) is established in the following manner:

- When the number of mature female red king crab is below or equal to the threshold of 8.4 million mature crab, or the spawning biomass is less than 14.5 million lbs, the Zone 1 PSC limit will be 32,000 red king crab.
- When the number of mature female red king crab is above the threshold of 8.4 million mature crab and the effective spawning biomass is equal to or greater than 14.5 but less than 55 million lbs, the Zone 1 PSC limit will be 97,000 red king crab.
- When the number of mature female red king crab is above the threshold of 8.4 million mature crab, and the effective spawning biomass is equal to or greater than 55 million lbs, the Zone 1 PSC limit will be 197,000 red king crab.

3.6.2.1.2 *C. bairdi* Crab

The PSC limit for *C. bairdi* Tanner crab is established in regulations implementing the FMP based on their abundance as indicated by the NMFS bottom trawl survey.

3.6.2.1.3 *C. opilio* Crab

The PSC limit for *C. opilio* crab is established in regulations implementing the FMP based on their total abundance as estimated by the NMFS bottom trawl survey. Minimum and maximum PSC limits are also established in regulation.

3.6.2.1.4 Pacific Halibut

Annual BSAI-wide Pacific halibut bycatch mortality limits for trawl and non-trawl gear fisheries will be established in regulations and may be amended by regulatory amendment. When initiating a regulatory amendment to change a halibut bycatch mortality limit, the Secretary, after consultation with the Council, will consider information that includes:

1. estimated change in halibut biomass and stock condition;

2. potential impacts on halibut stocks and fisheries;
3. potential impacts on groundfish fisheries;
4. estimated bycatch mortality during prior years;
5. expected halibut bycatch mortality;
6. methods available to reduce halibut bycatch mortality;
7. the cost of reducing halibut bycatch mortality; and
8. other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives.

3.6.2.1.5 Pacific Herring

The annual PSC limit of Pacific herring caught while conducting a trawl fishery for groundfish in the BSAI management area is one percent of the annual biomass of herring in the eastern Bering Sea.

3.6.2.1.6 Chinook Salmon

PSC limits for Chinook salmon are established for the Bering Sea and Aleutian Islands subareas in regulations implementing the FMP.

3.6.2.1.7 Other Salmon

When the Regional Administrator determines that 42,000 non-Chinook salmon have been caught by vessels using trawl gear during the time period of August 15 through October 14 in the catcher vessel operational area (see Section 3.5.2.1.6), NMFS will prohibit directed fishing for pollock with trawl gear for the remainder of the period September 14 through October 14 in the chum salmon savings area (see Section 3.6.2.2.4), unless the vessel is operating under a salmon bycatch reduction inter-cooperative agreement. Accounting for the 42,000 fish PSC limit will begin on August 15.

3.6.2.2 PSC Limitation Zones

Restrictions within the following areas are triggered by the attainment of bycatch limits as described in the FMP (Section 3.6.2.1) or specified in regulations implementing the FMP. Annual area closures that may also serve to limit the bycatch of prohibited species are listed in Section 3.5.2.

3.6.2.2.1 Zones 1 and 2

Zones 1 and 2 close to directed fishing when crab bycatch limits, as specified in regulations, are attained in specific fisheries. The areas are described in Appendix B and **Error! Reference source not found.**.

3.6.2.2.2 *C. Opilio* Bycatch Limitation Zone

Upon attainment of the *C. Opilio* Bycatch Limitation Zone (COBLZ) bycatch allowance of *C. opilio* crab specified for a particular fishery category, the COBLZ will be closed to directed fishing for each category for the remainder of the year or for the remainder of the season. The area is described in Appendix B and Figure 3-9.

3.6.2.2.3 Herring Savings Areas

If the Regional Administrator determines that the PSC limit of herring is attained, the herring savings areas may be closed for the remainder of the year or season. The herring savings areas are any of the three areas described in Appendix B and Figure 3-10. Summer Herring Savings Area 1 applies from June 15 through July 1 of a fishing year. Summer Herring Savings Area 2 applies July 1 through August 15 of a fishing year. Winter Herring Savings Area applies from September 1 through March 1 of the succeeding fishing year. Openings and closures begin and end at noon local time.

3.6.2.2.4 Chum Salmon Savings Area

Upon attainment of the limit described in Section 3.6.2.1.7, NMFS will prohibit directed fishing for pollock with trawl gear for the remainder of the period September 14 through October 14 in the chum salmon savings area (described in Appendix B and Figure 3-4), unless the vessel is operating under a salmon bycatch reduction inter-cooperative agreement. This area is also closed to vessels directed fishing for pollock and not operating under a salmon bycatch reduction inter-cooperative agreement from August 1 through August 31, as described in Section 3.5.2.1.3.

3.6.2.2.5 Chinook Salmon Savings Areas

If the Regional Administrator determines that the Bering Sea subarea PSC limit of Chinook salmon is caught while harvesting pollock with trawl gear in the Bering Sea subarea between January 1 and December 31, NMFS will prohibit directed fishing for pollock with trawl gear in Chinook salmon savings areas 1 and 2 (described in Appendix B and Figure 3-11) during time periods specified in regulations. Vessels operating under a salmon bycatch reduction inter-cooperative agreement may participate in directed fishing for pollock by trawl gear in area 2.

If the Regional Administrator determines that the Aleutian Islands subarea PSC limit of Chinook salmon is caught while harvesting pollock with trawl gear in the Aleutian Islands subarea between January 1 and December 31, NMFS will prohibit directed fishing for pollock with trawl gear in Chinook salmon savings area 1 (described in Appendix B and Figure 3-11), during time periods specified in regulations.

Figure 3-12 Crab PSC Limitation Zones 1 and 2.

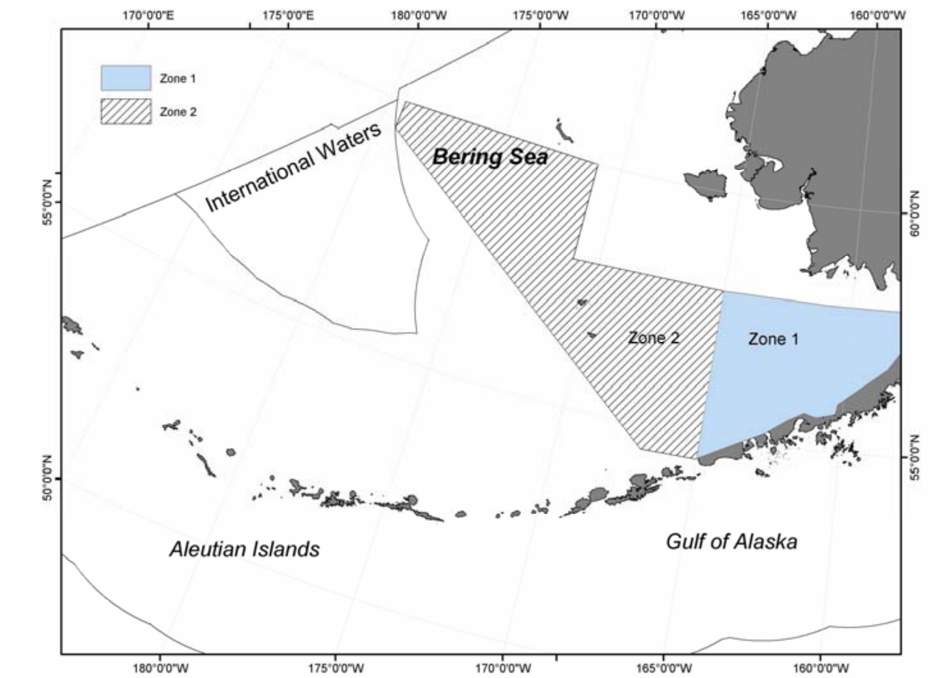


Figure 3-13 Chinoecetes opilio Bycatch Limitation Zone.

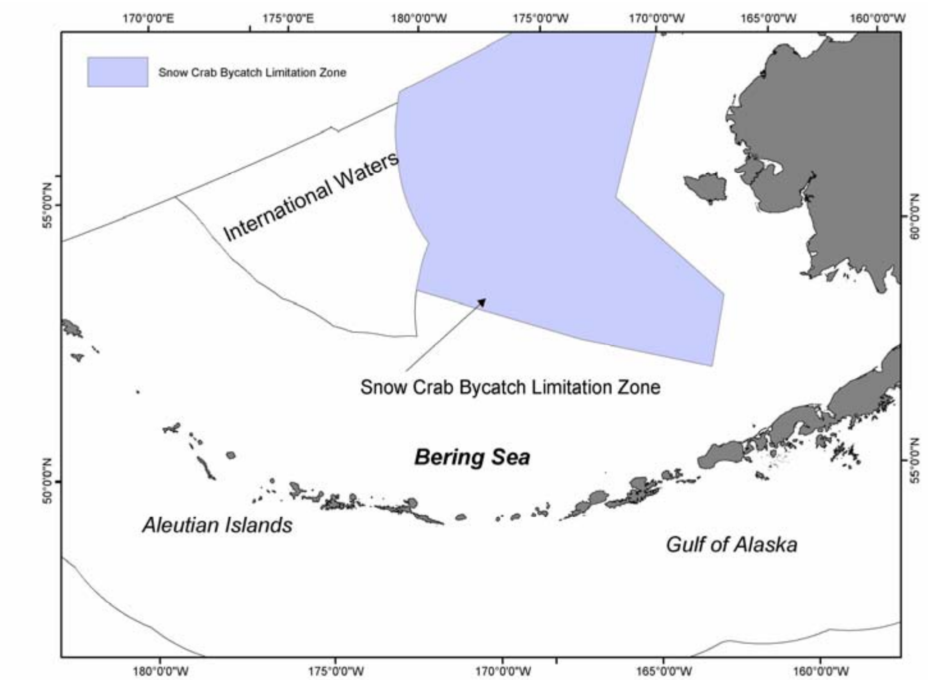


Figure 3-14 Herring Savings Areas.

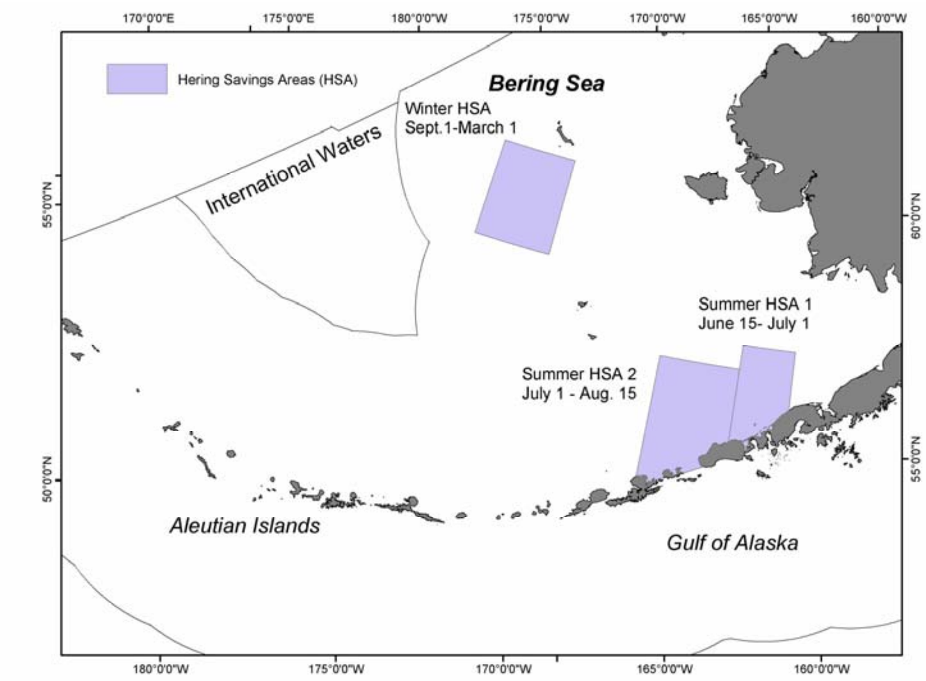


Figure 3-15 Chinook Salmon Savings Areas.

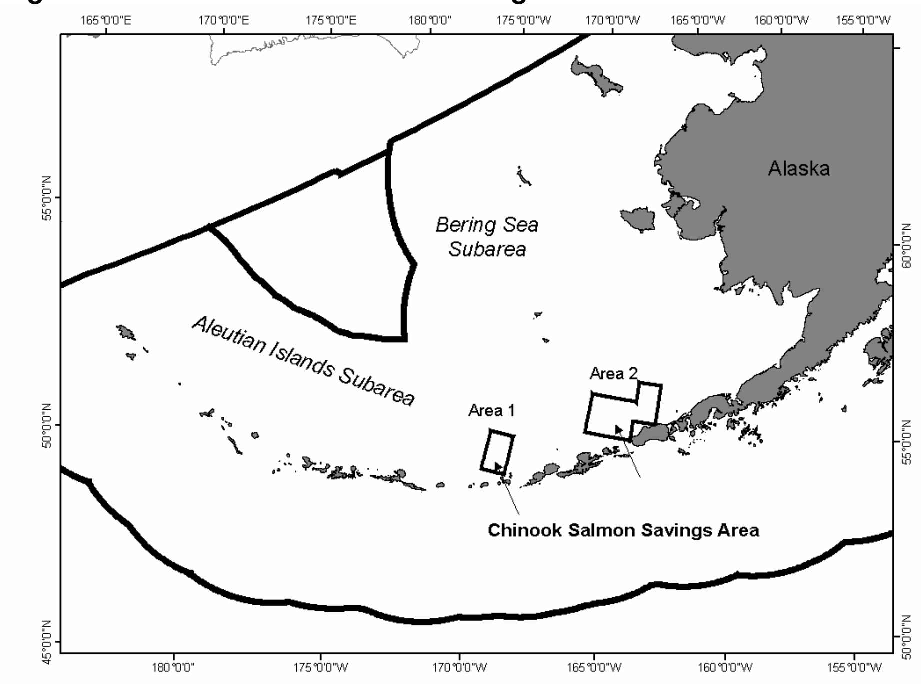


Figure 3-16 Bering Sea Habitat Conservation Area

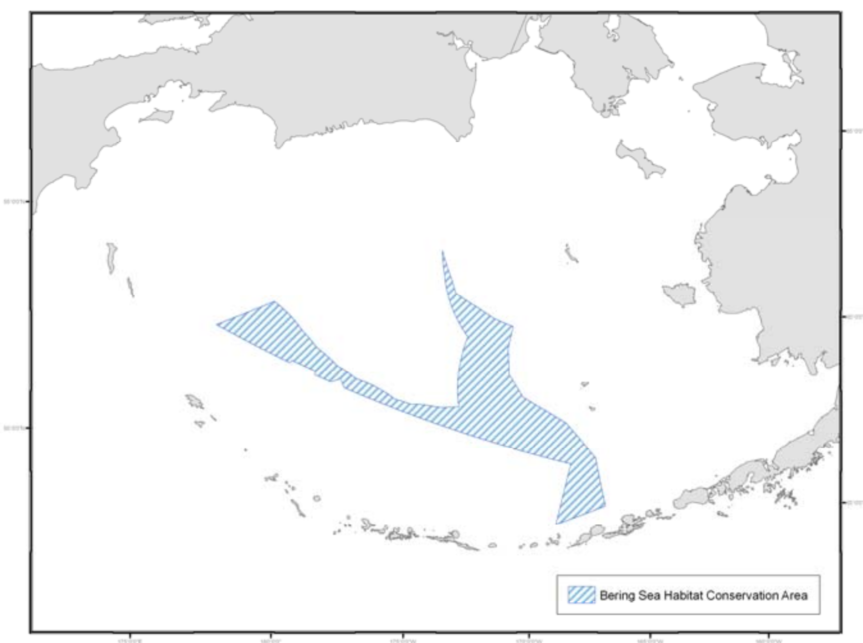


Figure 3-17 St. Matthew Island Habitat Conservation Area

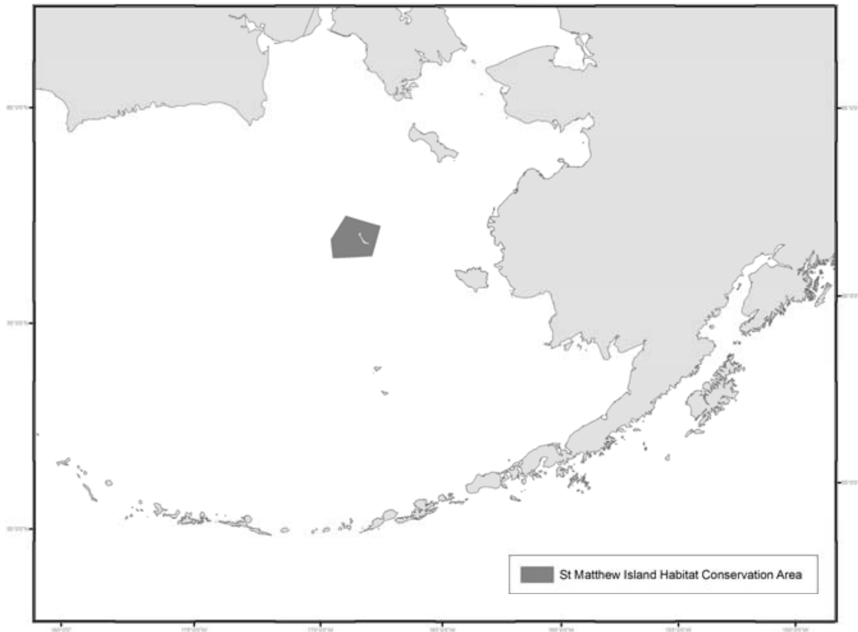


Figure 3-18 St. Lawrence Island Habitat Conservation Area

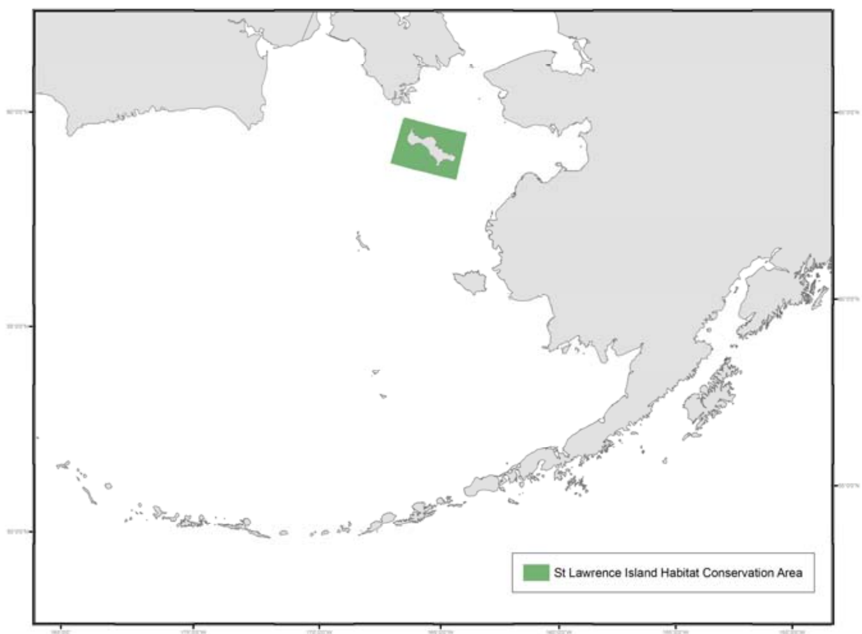


Figure 3-19 Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area

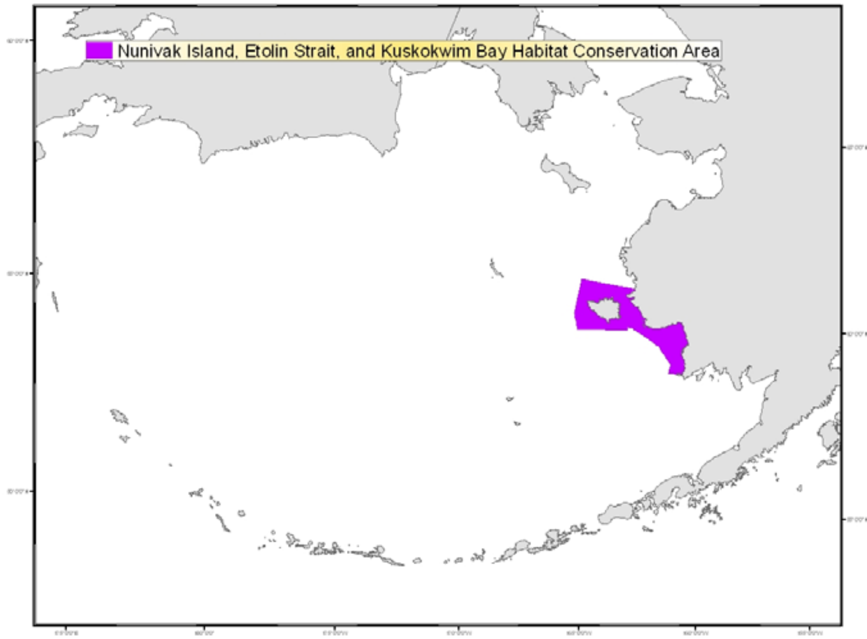
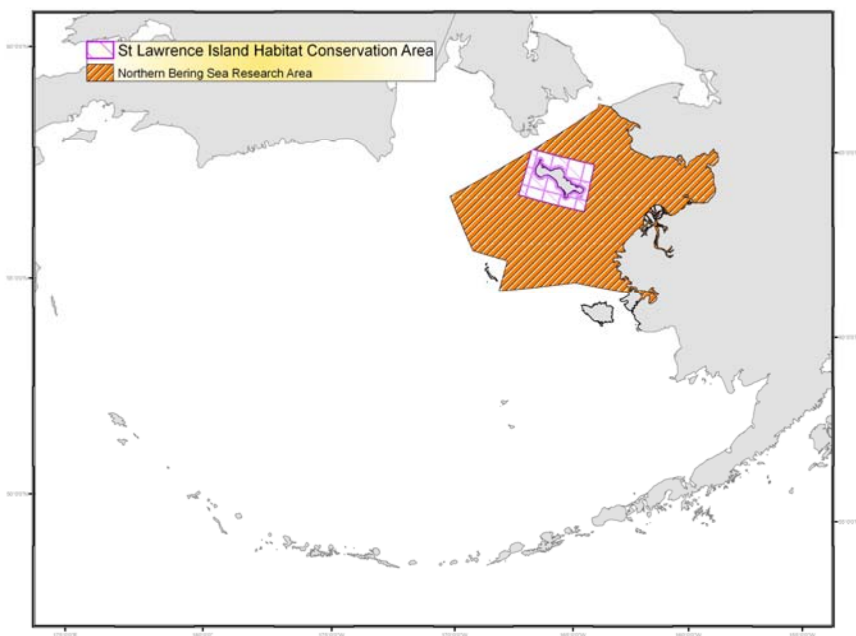


Figure 3-20 Northern Bering Sea Research Area



3.6.2.3 Apportionment of Prohibited Species Catch Limits

3.6.2.3.1 Target Fishery Categories

Trawl fisheries: The Pacific halibut PSC limit for trawl gear and the PSC limits for *C. bairdi* crab, *C. opilio* crab, red king crab, and herring apply to trawl fisheries for groundfish that are categorized by target species or species groups.

Non-trawl fisheries: The Pacific halibut PSC limit for non-trawl gear applies to non-trawl groundfish fisheries that may be categorized by target species or species groups, gear type, and area.

Fishery categories will be implemented by regulations that implement the goals and objectives of the FMP, the Magnuson-Stevens Act, and other applicable law. Fishery categories will remain in effect unless amended by regulations implementing the FMP. When recommending a regulatory amendment to revise fishery categories, the Council will consider the best information available on whether recommended fishery categories would best optimize groundfish harvests under the PSC limits established under Section 3.6.2.

3.6.2.3.2 Apportionments and Seasonal Allocations

Apportionments of PSC limits to target fishery categories established in Section 3.6.2.3.1 and seasonal allocations of those apportionments may be determined annually by the Secretary of Commerce, after consultation with the Council, using the following procedure:

1. Prior to the October Council meeting. The Plan Team will provide the Council the best available information on estimated prohibited species bycatch and mortality rates in the target groundfish fisheries, and estimates of seasonal and annual bycatch rates and amounts.

2. October Council meeting. While recommending proposed groundfish harvest levels under Section 3.2.3, the Council will also review the need to control the bycatch of prohibited species and will recommend appropriate apportionments of PSC limits to fishery categories as bycatch allowances. Fishery bycatch allowances are intended to optimize total groundfish harvest under established PSC limits, taking into consideration the anticipated amounts of incidental catch of prohibited species in each fishery category. The Council may recommend exempting specified non-trawl fishery categories from the non-trawl halibut bycatch mortality limit restrictions after considering the same factors (1) through (8) set forth under Section 3.6.2.1.4. The Council will also review the need for seasonal apportionments of fishery bycatch allowances.

   The Council will consider the best available information when recommending fishery apportionments of PSC limits and seasonal allocation of those apportionments. Types of information that the Council will consider relevant to seasonal allocation of fishery bycatch quotas include:

   a. seasonal distribution of prohibited species;
   b. seasonal distribution of target groundfish species relative to prohibited species distribution;
   c. expected prohibited species bycatch needs on a seasonal basis relevant to changes in prohibited species biomass and expected catches of target groundfish species;
   d. expected bycatch rates on a seasonal basis;
   e. expected changes in directed groundfish fishing seasons;
   f. expected start of fishing effort; and
   g. economic effects of establishing seasonal halibut allocations on segments of the target groundfish industry.

3. As soon as practicable after the Council's October meeting, the Secretary will publish the Council's recommendations as a notice in the *Federal Register*. Information on which the recommendations are based will also be published in the *Federal Register* or otherwise made

available by the Council. Public comments will be invited by means specified in regulations implementing the FMP.

4. Prior to the December Council meeting. The Plan Team will prepare for the Council a final SAFE report under Section 3.2.3 which provides the best available information on estimated prohibited species bycatch rates in the target groundfish fisheries, recommendations for halibut PSC limits and apportionments thereof among the target fisheries and gear types, and also may include an economic analysis of effects of the apportionments.

5. December Council meeting. While recommending final groundfish harvest levels, the Council reviews public comments, takes public testimony, and makes final decisions on apportionments of PSC limits among fisheries and seasons, using the factors (a) through (g) set forth under (2) above. The Council also makes final decisions on the exemption of any non-trawl fishery category from halibut bycatch mortality restrictions using the factors (1) through (8) set forth under Section 3.6.2.1.4.

6. As soon as practicable after the Council's December meeting, the Secretary will publish the Council's final decisions as a notice in the *Federal Register*. Information on which the final recommendations are based will also be published in the *Federal Register* or otherwise made available by the Council.

3.6.3 Retention and Utilization Requirements

3.6.3.1 Utilization of Pollock

Roe-stripping of pollock is prohibited, and the Regional Administrator is authorized to issue regulations to limit this practice to the maximum extent practicable. It is the Council's policy that the pollock harvest shall be utilized to the maximum extent possible for human consumption.

3.6.3.2 Improved Retention/Improved Utilization Program

Minimum retention requirements

All vessels participating in the groundfish fisheries are required to retain all catch of Improved Retention/ Improved Utilization Program (IR/IU) species, pollock and Pacific cod, when directed fishing for those species is open, regardless of gear type employed and target fishery. When directed fishing for an IR/IU species is prohibited, retention of that species is required only up to any maximum retainable amount in effect for that species, and these retention requirements are superseded if retention of an IR/IU species is prohibited by other regulations.

No discarding of whole fish of these species is allowed, either prior to or subsequent to that species being brought on board the vessel except as permitted in the regulations. At-sea discarding of any processed product from any IR/IU species is also prohibited, unless required by other regulations.

Minimum utilization requirements

All IR/IU species caught in the BSAI must be either 1) processed at sea subject to minimum product recovery rates and/or other requirements established by regulations implementing the FMP, or 2) delivered in their entirety to onshore processing plants for which similar processing requirements are implemented by State regulations.

3.6.4 Bycatch Reduction Incentive Programs

3.6.4.1 Prohibited Species Catch

The Secretary of Commerce, after consultation with the Council, may implement by regulation measures that provide incentives to individual vessels to reduce bycatch rates of prohibited species for which PSC limits are established under Section 3.6.2. The intended effect of such measures is to increase the opportunity to harvest groundfish TACs before established PSC limits are reached.

3.7 Share-based Programs

This section describes the share-based programs that are in place for specific target fisheries in the Bering Sea and Aleutian Islands groundfish fisheries.

3.7.1 Fixed Gear Sablefish Fishery

The directed fixed gear sablefish fishery is managed under an Individual Fishing Quota (IFQ) program, implemented in 1994-1995. This form of limited entry replaced the open access fisheries for sablefish in the BSAI management area.

3.7.1.1 Definitions

For purposes of Section 3.7.1, the following definitions of terms apply:

Person means any individual who is a citizen of the United States or any corporation, partnership, association, or other entity (whether or not organized or existing under the laws of any state) that meets the requirements set forth in 46 CFR Part 67.03, as applicable.

An Individual means a natural person who is not a corporation, partnership, association, or other entity.

Quota shares (QS) are equal to a person's fixed gear landings (qualifying pounds) for each area fished.

The Quota Share Pool is the total amount of quota share in each management area. The quota share pool may change over time due to appeals, enforcement, or other management actions.

Individual Fishing Quota (IFQ) means the annual poundage of fish derived by dividing a person's quota share into the quota share pool and multiplying that ratio by the annual fixed gear TAC for each management area.

Fixed Gear is defined to include all hook and line fishing gears (longlines, jigs, handlines, troll gear, and pot gear).

Catcher boat or catcher vessel means any vessel that delivers catch or landing in an unfrozen state.

Freezer longliner means any vessel engaged in fishing in the fixed gear fishery which, during a given trip, utilizes freezer capacity and delivers some or all of its groundfish catch in a frozen state.

Qualified crewmember is defined as any person that has acquired commercial fish harvesting time at sea (i.e. fish harvesting crew) equal to 5 months of any commercial fish harvesting activity in a fishery in state or federally managed waters of the U.S.. Additionally, any individual who receives an initial allocation of quota share will be considered a bona fide crew member.

3.7.1.2 Management Areas

Quota shares and IFQs are made available for the Bering Sea and Aleutian Islands management sub-areas identified in this FMP.

3.7.1.3 Initial Allocation of Quota Shares

3.7.1.3.1 Initial Recipients

1. Initial assignments of quota shares are made to:
   a. a qualified person who is a vessel owner who meets the requirements in this section; or
   b. a qualified person who meets the requirements of this section engaged in a lease of a fishing vessel (written or verbal) or other "bare-boat charter" arrangement in order to participate in the fishery. (For instances identified under this section, the qualified person shall receive full credit for deliveries made while conducting the fishery under such a lease or arrangement.)

2. Initial quota shares for sablefish are assigned only to persons who meet all other requirements of this section and who have landed those species in any one of the following years: 1988, 1989, or 1990. These three years shall be known as the quota share qualifying years.

3. Quota shares are assigned initially for each management subarea to qualified persons based on recorded landings, as documented through fish tickets or other documentation for fixed gear landings. Historical catch of sablefish is counted from 1985 through 1990. This historical period is known as the quota share base period. For each management subarea, NMFS will select a person's best five (5) years (subject to approval of the person involved) from the quota share base period to calculate their quota shares.

4. The sum of the catch in each person's five (5) selected years for each area shall equal that person's quota shares for that area. All quota share in any area are added together to form the "Quota Share Pool" for that area.

3.7.1.3.2 Vessel Categories

Quota shares and IFQs shall be assigned by vessel category as follows:

1. Freezer Longliner Shares:

   A vessel is determined to be a freezer longliner in any year, if during that year it processed (froze) fixed gear (as defined above) caught groundfish. If a vessel is determined to be a freezer longliner and that vessel was used in the most recent calendar year of participation by the owner through September 25, 1991, then all qualifying pounds landed by that vessel owner during the qualifying years shall be assigned as freezer longliner shares, unless the owner also participated in the most recent year through September 25, 1991, operating only as a catcher vessel, then shares will be assigned to separate categories, in proportion to the catch made aboard each of the vessels.

2. Catcher Vessel Shares:

   a. All landings made during the quota share base period by a vessel owner, whose last vessel that participated in a fixed gear fishery through September 25, 1991, is determined to be a catcher vessel, shall be allocated catcher vessel quota shares.

   b. There are two categories of catcher vessel shares for the sablefish QS/IFQ fishery:

      i. vessels less than or equal to 60 ft in length overall, and

      ii. vessels greater than 60 ft in length overall.

   c. For initial allocation of catcher vessel quota shares:

      i. if, during the last year of participation in a fixed gear fishery through September 25, 1991, a quota share recipient simultaneously owned or leased two or more vessels on which sablefish were landed, and those vessels were in different vessel categories, then the quota share allocation is for each vessel category and may not be combined into a single category.

      ii. if a quota share recipient bought or sold vessels in succession during the qualifying period, and to the extent the quota share recipient operations were in one vessel category during one year and the next vessel owned was in another vessel category, the quota share is combined and applied to the latest vessel category of ownership as of September 25, 1991.

3. Community Development Quota (CDQ) Compensation Quota Share:

   All CDQ compensation quota share initially issued to a person in an IFQ regulatory area in which that person does not hold quota share is designated as uncategorized catcher vessel quota share, except if the CDQ compensation quota share initially issued to a person in an IFQ regulatory area in which that person does not hold quota share is issued as compensation for quota share foregone in the freezer vessel category, in which case it is designated as freezer vessel quota share. The

IFQ resulting from uncategorized catcher vessel quota share can be fished on a vessel of any length. CDQ compensation quota share will remain uncategorized until it is transferred; upon transfer the CDQ compensation quota share must be designated in a specific catcher vessel category.

3.7.1.3.3 Quota Share Blocks

1. All initial allocations of sablefish quota share and all CDQ compensation quota share initially issued to a person in an IFQ regulatory area that would result in less than 20,000 lbs of IFQ based on the 1994 TAC for the fixed gear sablefish fishery in that area are issued as a quota share block.
2. All initial allocations of sablefish quota share that would result in at least 20,000 lbs of IFQ based on the 1994 TAC for the fixed gear sablefish fishery in that area, and all CDQ compensation quota share initially issued to a persons in an IFQ regulatory area in which that person does not hold quota share, are issued as unblocked quota share.

3.7.1.4 Transfer Provisions

1. Any person owning freezer longliner quota shares may sell or lease those quota shares to any other qualified person for use in the freezer longliner category.
2. Any person owning catcher vessel quota shares may sell those quota shares to any person meeting the provisions outlined in this section. Ten percent of a person's catcher vessel quota shares may be leased during the first three years following implementation.
3. In order to purchase or lease quota share, the purchaser must be an individual who is a U.S. citizen and a bona fide fixed gear crew member. Additionally, persons who received an initial allocation of catcher vessel quota shares may purchase catcher vessel quota shares and/or IFQs.
4. Quota shares, or IFQs arising from those quota shares, for any management area may not be transferred to any other management area or between the catcher vessel and the freezer vessel categories. Quota shares, or IFQs arising from those quota shares, initially issued to Category B vessels may be used on Category C vessels.
5. The Secretary may, by regulation, designate exceptions to this section to be employed in case of personal injury or extreme personal emergency which allow the transfer of catcher vessel quota shares or IFQs for limited periods of time.
6. Quota share designated as a "block" may only be traded in its entirety and may not be divided into smaller quota share units. Blocks of quota share representing IFQs of less than 5,000 lbs in the initial allocation may be combined or "swept-up", to form larger blocks, as long as the consolidated block does not result in IFQs greater than 5,000 lbs.

3.7.1.5 Use and Ownership Provisions

1. Fish caught with freezer longliner IFQs may be delivered frozen or unfrozen.
2. Fish caught with catcher vessel quota shares may not be frozen aboard the vessel utilizing those quota shares.
3. Sablefish IFQ resulting from quota share assigned to vessel categories B and C may be used on a vessel with processing capacity as long as processed sablefish or halibut is not on the vessel during that same trip. Further, non-IFQ species may be processed on a vessel using sablefish IFQ resulting from quota share assigned to vessel categories B and C.
4. In order to use catcher boat IFQs the user must: 1) own or lease the quota share, 2) be a U.S. citizen, 3) be a bona fide crew member, 4) be aboard the vessel during fishing operations, and 5) sign the fish ticket upon landing except as noted in (5) below, or in emergency situations.
5. Persons, as defined in Section 3.7.1.1, who receive initial catcher vessel quota share may utilize a hired skipper to fish their quota providing the person owns the vessel upon which the quota share

will be used, or the vessel is owned by a person with whom the quota share holder is affiliated through membership in a corporation or partnership. These initial recipients may purchase up to the total share allowed for the area. There shall be no leasing of such catcher vessel quota share other than as provided for in Section 3.7.1.4 above.

This provision will cease upon the sale or transfer of quota share or upon any change in the identity of the corporation, partnership, or estate as defined below:

a. Corporation: Any corporation that has no change in membership, except a change caused by the death of a corporate member providing the death did not result in any new corporate member. Additionally, corporate membership is not deemed to change if a corporate member becomes legally incapacitated and a trustee is appointed to act on his behalf, nor is corporate membership deemed to have changed if the ownership shares among existing members change, nor is corporate membership deemed to have changed if a member leaves the corporation.

b. Partnership: Any partnership that has no change in membership, except a change caused by the death of a partner providing the death did not result in any new partners. Additionally, a partnership is not deemed to have changed if a partner becomes legally incapacitated and a trustee is appointed to act on his behalf, nor is a partnership deemed to have changed if the ownership shares among existing partners change, nor is a partnership deemed to have changed if a partner leaves the partnership.

c. Estate: Any estate that has not been disposed to a legal heir.

d. Individual: Any individual as defined in Section 3.7.1.1.

6. For sablefish, each qualified person or individual may own, hold, or otherwise control, individually or collectively, but may not exceed, 3,229,721 units of quota share for the GOA and BSAI.

7. Any person who receives an initial assignment of quota shares in excess of the limits set forth in (6) of this section shall:

a. be prohibited from purchasing, leasing, holding or otherwise controlling additional quota shares until that person's quota share falls below the limits set forth in (6) above, at which time each such person shall be subject to the limitations of paragraph (6) above; and

b. be prohibited from selling, trading, leasing or otherwise transferring any interest, in whole or in part, of an initial assignment of quota share to any other person in excess of the limitations set forth in (6) above.

8. For sablefish, no more than 1 percent of the combined GOA and BSAI quota may be taken on any one vessel.

9. Persons must control IFQs for the amount to be caught before a trip begins, with the exception that limited overages will be allowed as specified in an overage program approved by NMFS and the International Pacific Halibut Commission.

10. Quota Share Block Provisions

a. A person may own and use up to two blocks in each management area.

b. Persons owning two blocks in a given management area may not use unblocked quota share in that area.

c. Persons who own less than two blocks in an area may own and use unblocked quota share up to the limits specified under this program, noting that the limit applies to both unblocked quota share and quota share embedded in blocks.

3.7.1.6 Annual Allocation of Quota Share/Individual Fishing Quota

Individual fishing quotas are determined for each calendar year for each person by applying the ratio of a person's quota share to the quota share pool for an area to the annual fixed gear total allowable catch for each management area, after adjusting for the CDQ program. In mathematical terms:

IFQs = (QS / QS pool) x fixed gear TAC.

3.7.1.7 General Provisions

1. For IFQ accounting purposes:
   a. The sale of catcher vessel caught sablefish or halibut to other than a legally registered buyer is illegal, except that direct sale to dockside customers is allowed provided the fisher is a registered buyer and proper documentation of such sales is provided to NMFS.
   b. Frozen product may only be off-loaded at sites designated by NMFS for monitoring purposes;
   c. Persons holding IFQs and wishing to fish must check-in with NMFS or their agents prior to entering any relevant management area, additionally any person transporting IFQ caught fish between relevant management areas must first contact NMFS or their agents.
2. Quota shares and IFQs arising from those quota shares may not be applied to trawl-caught sablefish.
3. Quota shares are a harvest privilege, and good indefinitely. However, they constitute a use privilege which may be modified or revoked by the Council and the Secretary at any time without compensation.
4. Discarding of sablefish is prohibited by persons holding sablefish IFQs and those fishing under the CDQ program.
5. Any person retaining sablefish or halibut with commercial fixed gear must own or otherwise control IFQs.
6. Persons holding IFQs may utilize those privileges at any time during designated seasons. Retention of fixed-gear caught sablefish or any halibut is prohibited during closed seasons. Seasons will be identified by the Council and the International Pacific Halibut Commission on an annual basis.
7. Those persons that would otherwise have received a full complement of sablefish quota share in the BSAI management area, but would receive less due to the provisions of CDQs, will be partially compensated and the cost of the compensation will be borne equally by all initial sablefish QS/IFQ recipients. In general this compensation plan will issue incremental amounts of quota share in each non-CDQ area to each disadvantaged person.

3.7.2 American Fisheries Act Pollock Fishery

Subtitle II of the American Fisheries Act (AFA) of 1998, entitled *Bering Sea Pollock Fishery*, directed the Council and NMFS to develop and implement four general categories of management measures: 1) regulations that limit access into the fishing and processing sectors of the BSAI pollock fishery and that allocate pollock to such sectors, 2) regulations governing the formation and operation of fishery cooperatives, 3) regulations that institute sideboard measures to protect other fisheries from spillover effects from the AFA, and 4) regulations governing catch measurement and monitoring in the BSAI pollock fishery. Key provisions are summarized in Appendix C. This entire subtitle of the AFA is incorporated into the FMP by reference and all management measures that are consistent with the provisions of Subtitle II of the AFA will be issued through regulations. The subtitle is reprinted in Appendix C. Certain provisions of the AFA pertaining to the Aleutian Islands directed pollock fishery were superseded by the Consolidated Appropriations Act of 2004, as further described in Section 3.7.3.

Subsection 213(c) of the AFA (Appendix C) provides the Council with the authority to recommend management measures to supersede certain provisions of the AFA. Any measure recommended by the

Council that supersedes a specific provision of the AFA must be implemented by FMP amendment in accordance with the Magnuson-Stevens Act. Under the authority set out in subsection 213(c) of the AFA, the Council has recommended the following management measures to supersede specific provisions of sections 210 and 211 of the AFA. These measures shall be implemented by NMFS through regulation.

3.7.2.1 Inshore Cooperative Allocation Formula

(supersedes the inshore cooperative allocation formula set out in subparagraph 210(b)(1)(B) of the AFA)

An inshore catcher vessel cooperative that applies for and receives an AFA inshore cooperative fishing permit will receive a sub-allocation of the annual Bering Sea subarea inshore sector directed fishing allowance.

Each inshore cooperative's annual allocation amount(s) is determined using the following procedure:

1. Calculation of individual vessel catch histories. The Regional Administrator will calculate an official AFA inshore cooperative catch history for every inshore-sector endorsed AFA catcher vessel according to the following steps:
    a. Determination of annual landings. For each year from 1995 through 1997 the Regional Administrator will determine each vessel's total inshore landings; from the Bering Sea subarea and Aleutian Islands subarea separately.
    b. Offshore compensation. If a catcher vessel made a total of 500 or more mt of landings of Bering Sea subarea pollock or Aleutian Islands subarea pollock to catcher/processors or offshore motherships other than the EXCELLENCE (USCG documentation number 967502); GOLDEN ALASKA (USCG documentation number 651041); or OCEAN PHOENIX (USCG documentation number 296779) over the 3-year period from 1995 through 1997, then all offshore pollock landings made by that vessel during from 1995 through 1997 will be added to the vessel's inshore catch history by year and subarea.
    c. Best two out of three years. After steps (a) and (b) are completed, the 2 years with the highest landings will be selected for each subarea and added together to generate the vessel's official AFA inshore cooperative catch history for each subarea. A vessel's best 2 years may be different for the Bering Sea subarea and the Aleutian Islands subarea.
2. Calculation of annual quota share percentage. Each inshore pollock cooperative that applies for and receives an AFA inshore pollock cooperative fishing permit will receive an annual quota share percentage of pollock for the BS subarea that is equal to the sum of each member vessel's official AFA inshore cooperative catch history divided by the sum of the official AFA inshore cooperative catch histories of all inshore sector-endorsed AFA catcher vessels. The cooperative's quota share percentage will be listed on the cooperative's AFA pollock cooperative permit.
3. Conversion of quota share to annual TAC allocation. Each inshore pollock cooperative that receives a quota share percentage for a fishing year will receive an annual allocation of Bering Sea pollock that is equal to the cooperative's quota share percentage multiplied by the annual inshore pollock allocation. Each cooperative's annual pollock TAC allocation may be published in the final BSAI TAC specifications notices.

3.7.2.2 Definition of Qualified Catcher Vessel

(supersedes AFA paragraph 210(b)(3) that has the effect of requiring a qualified catcher vessel to have actually fished for BSAI pollock in the year prior to the year in which the cooperative will be in effect)

A catcher vessel is qualified to join an inshore catcher vessel cooperative under paragraph 210(b)(3) of the AFA, if:

1. Active vessels. The vessel delivered more pollock harvested in the BS inshore directed pollock fishery to the inshore cooperative's designated AFA inshore processor than to any other shoreside processor or stationary floating processor during the year prior to the year in which the cooperative fishing permit will be in effect; or

2. Inactive vessels. The vessel delivered more pollock harvested in the BS inshore directed pollock fishery to the inshore cooperative's designated AFA inshore processor than to any other shoreside processor or stationary floating processor during the last year in which the vessel harvested BS pollock in the directed fishery for delivery to an AFA inshore processor.

3.7.2.3 Crab Processing Sideboard Limits

(supersedes the 1995-1997 formula set out in subparagraph 211(c)(2)(A) of the AFA)

Upon receipt of an application for a cooperative processing endorsement from the owners of an AFA mothership or AFA inshore processor, the Regional Administrator will calculate a crab processing cap percentage for the associated AFA inshore or mothership entity. The crab processing cap percentage for each BSAI king or Tanner crab species is equal to the percentage of the total catch of each BSAI king or Tanner crab species that the AFA crab facilities associated with the AFA inshore or mothership entity processed in the aggregate, on average, in 1995, 1996, 1997, and 1998 with 1998 given double-weight (counted twice).

3.7.2.4 Inshore Cooperative Contract Fishing by non-Member Vessels

(supersedes subparagraph 210(b)(1)(B) of the AFA that prohibits inshore cooperative vessels from fishing in excess of their cooperative allocation, and paragraph 210(b)(5) of the AFA that prohibits inshore cooperative vessels from fishing for any BSAI pollock that is not allocated to the cooperative under 210(b)(1)(B))

An inshore catcher vessel cooperative may contract with a non-member vessel to harvest a portion of its inshore pollock allocation provided that the non-member vessel holds an AFA catcher/vessel permit with an inshore processing endorsement and is a member of another inshore cooperative. Procedures for entering into and fishing under such contracts will be established in regulations.

3.7.3 Aleutian Islands Directed Pollock Fishery

Section 803 of the Consolidated Appropriations Act of 2004 (Pub. L. 108-199) established the Aleutian Islands directed pollock fishery allocation to the Aleut Corporation. This act supersedes the AFA provisions for the directed pollock fishery in the Aleutian Islands subarea. Beginning in 2004, the non-CDQ directed pollock fishery in the Aleutian Islands is fully allocated to the Aleut Corporation for the purpose of economic development in Adak, Alaska. NMFS, in consultation with the Council, will manage the Aleutian Islands directed pollock fishery to ensure compliance with the implementing statute (Pub. L. 108-199) and with the annual harvest specifications. Management provisions and considerations may include but are not limited to: prohibitions on having pollock from more than one management area on board the vessel, catch monitoring control plan requirements for shoreside and stationary floating processors, Aleut Corporation responsibilities for vessel and processor approval and quota management, observer requirements, and economic development reporting.

The harvest specifications for the Aleutian Islands directed pollock fishery include the following provisions:

1. When the combined BSAI groundfish fishery recommended TACs, without the Aleutian Islands pollock recommended TAC, are equal to the 2 million mt OY specified at §679.20(a)(1)(i), the Aleutian Islands pollock fishery recommended TAC would be funded by reducing the Bering Sea pollock fishery recommended TAC. When the sum of other BSAI groundfish fishery recommended TACs is below the 2 million mt BSAI OY, the allocation to the Aleutian Islands pollock fishery recommended TAC would be funded from the difference between the sum of all other BSAI groundfish fishery recommended TACs and the OY, to the extent possible in whole or in part. If the difference is only large enough to fund part of the allocation, the remainder of the funding would come from the Bering Sea pollock fishery recommended TAC.
2. The annual Aleutian Islands pollock TAC will equal the limit on the Aleutian Islands pollock TAC specified in regulations when the Aleutian Islands pollock ABC is equal to or more than the limit on the Aleutian Islands pollock TAC specified in regulations. When the Aleutian Islands

pollock ABC is less than the limit on the Aleutian Islands pollock TAC specified in regulations, the annual Aleutian Islands pollock TAC will not exceed the annual Aleutian Islands pollock ABC.

3. The CDQ direct fishery allowance and the incidental catch allowance for pollock in the Aleutian Islands will be deducted from the Aleutian Islands annual pollock TAC.

4. The “A” season apportionment will be no greater than the lesser of the annual TAC or 40 percent of the Aleutian Islands pollock ABC. The “A” season pollock harvest (Aleutian Islands directed pollock fishery, any “A” season CDQ fishery, and incidental catch allowance) shall be no more than 40 percent of the Aleutian Islands pollock ABC.

   The directed pollock fishery allocation to the Aleut Corporation for the “B” season will be equal to the annual Aleutian Islands pollock initial TAC minus the incidental catch allowance and minus the “A” season directed pollock fishery allocation. The “B” season allocation may be further adjusted by rollover of unharvested “A” season pollock.

5. Any unharvested pollock initial TAC from the Aleutian Islands fishery that is not expected to be harvested during the fishing year may be reallocated as soon as practicable to the Bering Sea subarea pollock fishery in accordance with regulations.

6. The harvest of the Aleutian Islands directed pollock fishery allocation is limited to vessels eligible to harvest pollock under Section 208 of Title II, Division C of Pub. L. 105-277 and vessels 60 feet or less in length over all. During 2005 through 2008, no more than 25 percent of the directed pollock fishery may be allocated to vessels 60 feet or less in length overall. During 2009 through 2012, no more than 50 percent of the directed pollock fishery may be allocated to vessels 60 feet or less in length overall. Beginning in 2013, 50 percent of the directed pollock fishery will be allocated to vessels 60 feet or less in length overall.

3.7.4 Community Development Quota Multispecies Fishery

The western Alaska Community Development Quota (CDQ) Program (hereinafter the CDQ Program) was established to provide fishermen who reside in western Alaska communities a fair and reasonable opportunity to participate in the Bering Sea and Aleutian Islands groundfish fisheries; to expand their participation in salmon, herring, and other nearshore fisheries; and to help alleviate the growing social and economic crisis within these communities. Residents of western Alaska communities are predominantly Alaska Natives who have traditionally depended upon the marine resources of the Bering Sea for their economic and cultural well-being. The CDQ program is a joint program of the Secretary and the Governor of the State of Alaska. Through the creation and implementation of community development plans, western Alaska communities will be able to diversify their local economies, provide community residents with new opportunities to obtain stable, long-term employment, and participate in the BSAI fisheries which have been foreclosed to them because of the high capital investment needed to enter the fishery.

The NMFS Regional Administrator shall hold the designated percent of the annual total allowable catch of groundfish for each management subarea in the BSAI for the western Alaska community quota as noted below. These amounts shall be released to eligible Alaska communities who submit a plan, approved by the Governor of Alaska, for their wise and appropriate use.

The CDQ program is structured such that the Governor of Alaska is authorized to recommend to the Secretary that a Bering Sea rim community be designated as an eligible fishing community to receive a portion of the reserve. To be eligible a community must meet specified criteria and have developed a fisheries development plan approved by the Governor of Alaska. The Governor shall develop such recommendations in consultation with the Council. The Governor shall forward any such recommendations to the Secretary, following consultation with the Council. Upon receipt of such recommendations, the Secretary may designate a community as an eligible fishing community and, under the plan, may release appropriate portions of the reserve.

Not more than 33 percent of the total western Alaska community quota for any single species category may be designated for a single CDQ applicant, except that if portions of the total quota are not designated by the end of the second quarter, applicants may apply for any portion of the remaining quota for the remainder of that year only.

3.7.4.1 Eligible Western Alaska Communities

The Governor of Alaska is authorized to recommend to the Secretary that a community within western Alaska which meets all of the following criteria be eligible for the CDQ program:

1. be located on or proximate to the Bering Sea coast from the Bering Strait to the western most of the Aleutian Islands or a community located on an island within the Bering Sea, which the Secretary of the Interior has certified pursuant to Section 11(b)(2) or (3) of Pub. L. No. 92-203 as Native villages are defined in Section 3(c) of Pub. L. No. 92-203;
2. be unlikely to be able to attract and develop economic activity other than commercial fishing that would provide a substantial source of employment;
3. its residents have traditionally engaged in and depended upon fishing in the waters of the Bering Sea coast;
4. has not previously developed harvesting or processing capability sufficient to support substantial participation in the commercial groundfish fisheries of the BSAI because of a lack of sufficient funds for investing in harvesting or processing equipment; and
5. has developed a community development plan approved by the Governor, after consultation with the Council.

Also, Akutan is included in the list of eligible CDQ communities.

3.7.4.2 Fixed Gear Sablefish Allocation

The NMFS Regional Administrator shall hold 20 percent of the annual fixed-gear total allowable catch of sablefish for each management subarea in the BSAI for the western Alaska sablefish community quota. The portions of fixed-gear sablefish TACs for each management area not designated to CDQ fisheries will be allocated as quota share and IFQs and shall be used pursuant to the program outlined in Section 3.7.1.

3.7.4.3 Pollock Allocation

Ten percent of the pollock TAC in the BSAI management area shall be allocated as a directed fishing allowance to the CDQ program. This quota shall be released to communities on the Bering Sea coast which submit a plan, approved by the Governor of Alaska, for the wise and appropriate use of the quota.

3.7.4.4 Pacific cod Allocation

Pacific cod TAC in the BSAI management area shall be allocated to the CDQ Program.

3.7.4.5 Other Groundfish Allocations

Section 305(i)(1)(B) of the Magnuson-Stevens Act governs allocations of groundfish to the CDQ Program. The Magnuson-Stevens Act requires that 10.7 percent of the TAC for each species in a directed groundfish fishery in the BSAI, except pollock and sablefish, shall be allocated to the CDQ Program. The Magnuson-Stevens Act also requires that 7.5 percent of the trawl allocation of the sablefish TAC shall be allocated to the CDQ Program.

3.7.4.6 Prohibited Species Allocations

The following allocations of the PSC limits will be made to the CDQ Program:

Halibut:	In 2008 and 2009, 343 mt of mortality. In 2010 and thereafter, 393 mt of mortality.

Crab:	10.7 percent of each crab PSC limit in the BSAI.
Chinook salmon:	7.5 percent of the Chinook salmon PSC limit in the BSAI.
Non-Chinook salmon:	10.7 percent of the non-Chinook salmon PSC limit in the BSAI.

PSC allocations to the CDQ Program are not allocated by gear or target fishery.

3.7.5 Amendment 80

Allocate certain specific non-pollock groundfish, crab PSC, and halibut PSC among trawl sectors and establish a limited access privilege program (LAPP) for the non-AFA trawl catcher/processor sector.

3.7.5.1 Allocation of BSAI Non-Pollock Groundfish in the Trawl Fisheries.

3.7.5.1.1 *General*

Allocate a portion of yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod TAC between the non-AFA trawl catcher/processor sector as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447), and all other BSAI trawl vessels (BSAI trawl limited access sector) after deductions for CDQ Program allocations, incidental catch amounts (except for Pacific cod), and other existing fishery allocations, (i.e., Atka mackerel jig). The amount of groundfish allocated between trawl sectors after deductions for the CDQ Program and incidental catch allowance is the initial TAC (ITAC). Additional non-pollock groundfish species could be added or deleted through an amendment process.

3.7.5.1.2 *Allocation Formula*

The following percentage of the ITAC would be assigned to the non-AFA trawl catcher/processor and BSAI trawl limited access sector. For purpose of allocation to the non-AFA trawl CP sector, each species allocation is:

1. Yellowfin Sole: A percentage of the ITAC is allocated among the trawl sectors, as shown below. The total ITAC allocated to a sector is determined by adding the sum of the percentage of ITAC allocations.

If the ITAC is …(mt)	Non-AFA trawl C/P Sector	BSAI Trawl Limited Access Sector
< = 87,500 +	93%	7%
87,500 – 95,000 +	87.5%	12.5%
95,000 – 102,500 +	82%	18%
102,500 – 110,000 +	76.5%	23.5%
110,000 – 117,500 +	71%	29%
117,500 – 125,000 +	65.5%	34.5%
>125,000	60%	40%

2. Rock Sole: 100% to the non-AFA trawl CP sector
3. Flathead Sole: 100% to the non-AFA trawl CP sector
4. Atka Mackerel: Non-AFA trawl CP sector: 98% of the ITAC in Area BS/541 and Area 542, in the first year of the program, decreasing by 2% increments over a four year period to 90%. 100% of the ITAC in Area 543.
   BSAI trawl limited access sector: The amount of ITAC remaining after allocation to the non-AFA trawl C/P sector.
5. AI POP: Non-AFA trawl C/P sector: 95% of the ITAC in Area 541 and Area 542 in the first year of the program, decreasing to 90% in the second year of the program. 98% of the ITAC in Area 543.
   BSAI trawl limited access sector: The amount of ITAC remaining after allocation to the non-AFA trawl CP sector.
6. Pacific cod: See Section 3.2.6.3.1.

3.7.5.2 PSC Allowance for the Non-AFA Trawl Catcher Processor Sector and the CDQ Program

3.7.5.2.1 *Allocation Formula*

The trawl PSC limit for halibut, Zone 1 red king crab, C. opilio crab PSC (COBLZ), Zone 1 C. bairdi crab PSC, and Zone 2 C. bairdi crab PSC is apportioned between the non-AFA trawl CP and the BSAI trawl limited access sector as follows:

Sector	Year after implementation.	Halibut PSC limit in the BSAI (mt)	Zone 1 Red king crab PSC limit...	C. opilio crab PSC limit (COBLZ)...	Zone 1 C. bairdi crab PSC limit...	Zone 2 C. bairdi crab PSC limit...
			as a percentage of the total BSAI trawl PSC limit after allocation as PSQ			
Amendment 80 sector	Year 1	2,525 mt	62.48	61.44	52.64	29.59
	Year 2	2,475 mt	59.36	58.37	50.01	28.11
	Year 3	2,425 mt	56.23	55.30	47.38	26.63
	Year 4	2,375 mt	53.11	52.22	44.74	25.15
	Year 5 and all future years	2,325 mt	49.98	49.15	42.11	23.67
BSAI trawl limited access	All years	875 mt	30.58	32.14	46.99	46.81

3.7.5.3 Rollover of ITAC, PSC, and ICA

3.7.5.3.1 Target species ITAC, ICA, and PSC rollover:

1. Any unharvested portion of the yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod ITAC or ICA or unused portion of PSC in the BSAI trawl limited access fishery that is projected to remain unused may be rolled over to non-AFA trawl catcher/processor cooperatives. The distribution of any rollover to a cooperative shall be proportional to the amount of CQ initially issued to that cooperative for that year.
2. Any rollover of halibut PSC to non-AFA Trawl CP cooperatives shall be discounted by 5%. Once the initial allocation has been determined, the non-AFA trawl CP cooperatives may re-allocate the PSC among the target species.
3. NMFS shall evaluate the possibility of rolling over unused ITAC, ICA, or PSC as it deems appropriate. In making its determination, NMFS shall consider current catch and PSC usage, historic catch and PSC usage, harvest capacity and stated harvest intent, as well as other relevant information.

3.7.5.4 Allocation of quota share (QS) to the non-AFA trawl catcher/processor sector:

3.7.5.4.1 Eligibility to receive QS.

Any person who is qualified under the definition of the non-AFA trawl catcher/processor sector as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447) may apply for and receive QS that represents a portion of the total catch of a non-AFA trawl catcher/processor during 1998 through 2004.

3.7.5.4.2 Allocation Formula

The amount of QS that is attributable to a specific non-AFA trawl catcher/processor is calculated as follows:

1. Select the five calendar years from 1998 through 2004 that yield the highest amount of yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod legal landings, including zero metric tons if necessary.
2. Sum the legal landings of the highest five years for yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod. This yields the Highest Five Years for that species.
3. Divide the Highest Five Years for a yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod in paragraph (2) by the sum of all Highest Five Years for all non-AFA trawl catcher/processors for yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod based on the Amendment 80 official record for yellowfin sole, rock sole, flathead sole, Atka mackerel, and Aleutian Islands Pacific ocean perch, and Pacific cod as presented in the following equation:

Highest Five / All Highest Five Years = Percentage of the Total

4. The result (quotient) of this equation is the Percentage of the Total for that vessel for that species.
5. This Percentage of the Total is then multiplied by the initial QS pool established by NMFS to yield the number of QS units.
6. If a non-AFA trawl catcher/processor received less than 2 percent of the total Atka mackerel legal landings and is less than 200 ft (38.1 m) length overall, QS will be allocated in each management area in proportion to the legal landings made by that vessel by area. Other vessels will be allocated Atka mackerel QS equally in each management area.
7. If a non-AFA trawl catcher/processor as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447) did not fish from 1998 through 2004, that non-AFA trawl catcher/processor will receive an allocation of QS no less than:
   - 0.5 percent of the yellowfin sole legal landings
   - 0.5 percent of the rock sole legal landings
   - 0.1 percent of the flathead sole legal landings
8. The legal landings assigned to other non-AFA trawl catcher/processor vessels will be adjusted to meet this requirement.
9. Legal landing means, for the purpose of initial allocation of QS, fish caught during the qualifying years specified and landed in compliance with state and Federal permitting, landing, and reporting regulations in effect at the time of the landing. Legal landings exclude any test fishing, fishing conducted under an experimental, exploratory, or scientific activity permit, or the fishery conducted under the Western Alaska CDQ program.
10. Each eligible vessel will generate one QS permit. QS permits are not separable or divisible. The catch history credited to an eligible vessel will be the legal landings of that vessel. In the event of the actual total loss or constructive total loss of a vessel, or permanent inability of a vessel to be used either before or after the qualifying period, the vessel owner may transfer the legal landings, or QS permit to the LLP license that was originally issued for that vessel. Once the catch history has been assigned to the license, that license must be used on an eligible Non-AFA Trawl CP vessel.

3.7.5.5 Cooperative Formation for the Non-AFA Trawl Catcher Processor Sector

3.7.5.5.1 *Cooperative Formation*

1. Prior to the start of a fishing year, the holder of a QS permit can choose to join a cooperative with other QS permit holders and receive a quantity of fish expressed as CQ units which represents a portion of the ITAC of yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod held for the exclusive use by that cooperative.

2. QS permit holders must meet at least the following requirements to form a cooperative:
   - Include at least three separate QS permit holding entities not linked through direct or indirect ownership or control.

- Include at least 30% of the QS permits issued.

3.7.5.5.2 *Cooperative quota (CQ) allocations.*

1. Each cooperative will receive an amount of yellowfin sole, rock sole, flathead sole, Atka mackerel, Aleutian Islands Pacific ocean perch, and Pacific cod ITAC equal to the sum of the QS held by the members of a cooperative divided by the total QS held by all persons and multiplied by the ITAC assigned to the non-AFA trawl catcher/processor sector for that year.

2. The cooperative will receive an amount of crab and halibut PSC based on:
    - The amount of PSC assigned to the non-AFA trawl catcher/processor sector in a year is based on the amount of PSC that has historically been used during the target fishery for each Amendment 80 species from 1998-2004.
    - The amount of PSC assigned to a cooperative is based on the proportion of CQ for each species held by the cooperative.

3. Once PSC is assigned to a cooperative it may be used while fishing for any groundfish species in the BSAI. PSC assigned to a cooperative is not subject to seasonal apportionment.

3.7.5.6 Use Caps

3.7.5.6.1 Person Use Caps

1. No single person can collectively hold or use more than 30% of the QS.
2. Persons that exceed this cap in the initial allocation would be exempted from this cap (i.e., grandfathered) based on the amount of legal landings held by that person the time of final Council action.

3.7.5.6.2 Vessel Use Caps

No vessel shall catch more than 20% of the aggregate ITAC assigned to the non-AFA trawl CP sector in a year.

3.7.5.7 GOA Sideboard Limits

Sideboard limits maintain relative amounts of non-allocated species until such time that fisheries for these species are further rationalized in a manner that would supersede a need for these sideboard provisions. Sideboards shall apply to all eligible licenses and associated non-AFA trawl catcher/processors from which the catch history arose.

3.7.5.7.1 GOA sideboard provisions

GOA pollock, Pacific cod, and directed rockfish species (Pacific ocean perch, northern rockfish and pelagic shelf rockfish) sideboards for the non-AFA trawl CP sector are established based on retained catch by regulatory areas from 1998 through 2004 as a percentage of total retained catch of all sectors in that regulatory area.

GOA flatfish prohibitions

- Vessels that have GOA weekly participation of greater than 10 weeks in the flatfish fishery during 1998 through 2004 will be eligible to participate in the GOA flatfish fisheries

GOA halibut PSC limits

- GOA-wide halibut sideboard limits for the deep-water and shallow-water complex fisheries are established by season based on the actual usage of the non-AFA trawl sector during 1998 through 2004.

Exemption from GOA halibut sideboard limit

- Non-AFA trawl CP vessel(s) that fished 80% of their weeks in the GOA flatfish fisheries from January 1, 2000 through December 31, 2003, will be exempt from GOA halibut sideboards in the GOA**.** Vessel(s) exempted from Amendment 80 halibut sideboards in the GOA may participate fully in the GOA open-access flatfish fisheries. Exempt vessel(s) will be prohibited from directed fishing for all other sideboarded species in the GOA (rockfish, Pacific cod, and pollock). The history of exempt vessels will not contribute to the non-AFA trawl CP sideboards and their catch will not be subtracted from these sideboards.

3.7.5.8 Other Elements of Amendment 80

3.7.5.8.1 Transfers of QS

1. Permanent transfers of an eligible vessel, its associated catch history, and its permit would be allowed.

2. In the event of the actual total loss or constructive total loss of a vessel, or permanent inability of a vessel to be used in the Program, catch history would be attached to the license that arose from the vessel and would not be separable or divisible.

3. All transfers of QS must be approved by NMFS.

3.7.5.8.2 Transfers of CQ

1. Annual allocations to the cooperative will be transferable among non-AFA trawl CP cooperatives. Inter-cooperative transfers must be approved by NMFS.

2. Specific requirements for reporting, monitoring and enforcement, and observer protocols will be developed in regulations for participants in the non-AFA trawl CP sector.

3.7.5.9 Economic Data Report

A socioeconomic data collection program will be implemented for the non-AFA trawl CP sector. Data will be collected on a periodic basis. The purpose of the data collection program is to understand the economic effects of the Amendment 80 program on vessels or entities regulated by this action, and to inform future management actions.

3.8 Flexible Management Authority

3.8.1 Inseason Adjustments

Harvest levels for each groundfish species or species group that are set by the Council for a new fishing year are based on the best biological, ecological, and socioeconomic information available. The Council finds, however, that new information and data relating to stock status may become available to the Regional Administrator and/or the Council during the course of a fishing year which warrants inseason adjustments to a fishery.

Such changes in stock status might not have been anticipated or were not sufficiently understood at the time harvest levels were being set. Changes may become known from events within the fishery as it proceeds, or they may become known from new scientific survey data. Certain changes warrant swift action by the Regional Administrator to protect the resource from biological harm by instituting gear modifications or adjustments through closures or restrictions. Other changes warrant action to provide greater fishing opportunities for the industry by instituting time or area adjustments through openings or extension of a season beyond a scheduled closure.

Other inseason actions may be necessary to promulgate interim fishery closures in portions of the Bering Sea and the Aleutian Islands management subareas to reduce prohibited species bycatch rates and the probability of premature attainment of PSC limits and allowances. The intent of such interim closures would be to provide fishermen with a greater opportunity to harvest groundfish quota amounts by guaranteeing a longer fishing period before PSC limits or allowances are reached and bycatch zones or areas are closed to specified fisheries or gear types.

Ideally, the need to implement interim closures of areas to limit fishery operations that exhibit unexpectedly high bycatch rates would be identified through an examination of bycatch data collected inseason by observers. At times, however, data on bycatch rates may not be timely enough for effective implementation of season closures. Alternatively, the fishery bycatch rates may vary so much from week to week that the Regional Administrator may have difficultly determining whether bycatch rates in a fishery or area are intrinsically high, are an exhibition of "dirty fishing", or simply reflect natural variability in an otherwise "clean" fishery or area. Historical data could be used, therefore, to determine whether consistent "hot spots" occur. Historical information may then be compared with variable inseason data to help determine whether an inseason closure is warranted to reduce overall bycatch rates.

The need for inseason action for conservation purposes may be related to several circumstances. For instance, certain target or bycatch species may have decreased in abundance. When new information indicates that a species has decreased in abundance, allowing a fishery to continue to a harvest level now known to be too high could increase the risk of overfishing that species. Conservation measures limited to establishing prohibited species catch limits for such prohibited species may be necessary during the course of the fishery to prevent jeopardizing the well-being of prohibited species stocks.

When current information demonstrates a harvest level to have been set too low, closing a fishery at the annually specified harvest level would result in under-harvesting that species, which also results in the fishery unnecessarily foregoing economic benefits during that year unless the total allowable catch were increased and the fishery allowed to continue.

Similarly, current information may indicate that a prohibited species is more abundant than was anticipated when limits were set. Closing a fishery on the basis of the preseason PSC limit that is proven to be too low would impose unnecessary costs on the fishery. Increasing the PSC limits may be appropriate if such additional mortality inflicted on the prohibited species of concern would not impose detrimental effects on the stock or unreasonable costs on a fishery that utilize the prohibited species. However, adjustments to target quotas or PSC limits that are not initially specified on the basis of biological stock status is not appropriate.

The Council finds that inseason adjustments are accomplished most effectively by management personnel who are monitoring the fishery and communicating with those in the fishing industry who would be directly affected by such adjustments. Therefore, the Council authorizes the Secretary, by means of his or her delegation to the Regional Administrator of NMFS, to make inseason adjustments to conserve fishery resources on the basis of all relevant information. Using all available information, he or she may extend, open, or close fisheries in all or part of a regulatory area, or restrict the use of any type of fishing gear as a means of conserving the resource. He or she may also change any previously specified TAC or PSC limit if such are proven to be incorrectly specified on the basis of the best available scientific information or biological stock status. Such inseason adjustments must be necessary to prevent one of the following occurrences:

a. the overfishing of any species or stock of fish, including those for which PSC limits have been set; and/or
b. the harvest of a TAC for any groundfish, the taking of a PSC limit for any prohibited species, or the closure of any fishery based on a TAC or PSC limit that, on the basis of currently available information, is found by the Secretary to be incorrectly specified.

The Regional Administrator may also promulgate an inseason closure of an area to reduce prohibited species bycatch rates provided the closure period extends no longer than the time period specified in regulations. Interim closures must be based upon a determination that such closures are necessary to prevent:

a. a continuation of relatively high bycatch rates in a statistical areas, or portion thereof;
b. the take of an excessive share of PSC limits or allowances established under Section 3.6.2 by vessels fishing in an area;

c. the closure of one or more directed groundfish fisheries due to excessive prohibited species bycatch rates occurring in a specified target fishery; and

d. the premature attainment of established PSC limits or allowances and associated loss of opportunity to vessels to harvest the groundfish optimum yield.

The types of information that the Regional Administrator will consider in determining whether conditions exist that require an inseason adjustment or action are described as follows, although he or she is not precluded from using information not described but determined to be relevant to the issue:

a. the effect of overall fishing effort within an area;

b. catch per unit of effort and rate of harvest;

c. relative distribution and abundance of stocks of target groundfish species and prohibited species within an area;

d. the condition of a stock in all or part of an area;

e. inseason prohibited species bycatch rates observed in target groundfish fisheries in all or part of a statistical area;

f. historical prohibited species bycatch rates observed in target groundfish fisheries in all or part of a statistical area;

g. economic impacts of fishing businesses being affected; or

h. any other factor relevant to the conservation and management of groundfish species or any incidentally-caught species that are designated as a prohibited species or for which a PSC limit has been specified.

The Regional Administrator is constrained, however, in his or her choice of management responses to prevent potential overfishing by having to first consider the least restrictive adjustments to conserve the resource. The order in which the Regional Administrator must consider inseason adjustments to prevent overfishing are specified as: 1) any gear modification that would protect the species in need of conservation protection, but that would still allow fisheries to continue for other species; 2) a time or area closure that would allow fisheries for other species to continue in non-critical areas and time periods; and 3) total closure of the management area and season.

The procedure that the Secretary must follow requires that the Secretary publish a notice of proposed adjustments in the *Federal Register* before they are made final, unless the Secretary finds for good cause that such notice is impracticable or contrary to the public interest. If the Secretary determines that the prior comment period should be waived, he or she is still required to request comments for 15 days after the notice is made effective, and respond to any comments by publishing in the *Federal Register* either notice of continued effectiveness or a notice modifying or rescinding the adjustment.

To effectively manage each groundfish resource throughout its range, the Regional Administrator must coordinate inseason adjustments, when appropriate, with the State of Alaska to assure uniformity of management in both State and Federal waters.

Any inseason time or area adjustments made by the Regional Administrator will be carried out within the authority of this FMP. Such action is not considered to constitute an emergency that would warrant a plan amendment within the scope of Section 305(e) of the Magnuson-Stevens Act. Any adjustments will be made by the Regional Administrator by such procedures provided under existing law. Any inseason adjustments that are beyond the scope of the above authority will be accomplished by emergency regulations as provided for under Section 305(e) of the Magnuson-Stevens Act.

3.8.2 Measures to Address Identified Habitat Problems

An FMP may contain only those conservation and management measures that pertain to fishing or to fishing vessels. The Secretary, upon the recommendation of the Council, may adopt regulations of the kinds and for the purposes set forth below:

a. regulations establishing gear, timing, or area restrictions for purposes of protecting particular habitats of species in the BSAI groundfish fishery;

b. regulations establishing area or timing restrictions to prevent the harvest of fish in contaminated areas; and/or

c. regulations restricting disposal of fishing gear by vessels.

3.8.3 Vessel Safety

The Council will consider, and may provide for, temporary adjustments regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of the vessels, after consultation with the U.S. Coast Guard and persons utilizing the fishery.

3.9 Monitoring and Reporting

3.9.1 Recordkeeping and Reporting

The Council and NMFS must have the best available biological and socioeconomic information with which to carry out their responsibilities for conserving and managing groundfish resources, as well as other fish resources, such as crab, halibut, and salmon, that are incidentally caught in the groundfish fishery. This information is used for making inseason and inter-season management decisions that affect these resources as well as the fishing industry that utilize them. This information is also used to judge the effectiveness of regulations guiding these decisions. The Council will recommend changes to regulations when necessary on the basis of such information.

The need for the Council and NMFS to consider the best available information is explicit in the goals and objectives as established by the Council and contained in the FMP. They are also explicit in the Magnuson-Stevens Act, Executive Order 12866, the Regulatory Flexibility Act, the National Environmental Policy Act, and other applicable law. The Secretary, therefore, will require segments of the fishing industry to keep and report certain records as necessary to provide the Council and NMFS with the needed information to accomplish these goals and objectives. The Secretary may implement and amend regulations at times to carry out these requirements after receiving Council recommendations to do so, or at other times as necessary to accomplish these goals and objectives. Regulations will be proposed and implemented in accordance with the Administrative Procedure Act, the Magnuson-Stevens Act, and other applicable law.

Information on catch and production, effort, and price

In consultation with the Council, the Secretary may require recordkeeping that is necessary and appropriate to determine catch, production, effort, price, and other information necessary for conservation and management of the fisheries. Such requirements may include the use of catch and/or product logs, product transfer logs, effort logs, or other records. The Secretary may require the industry to submit periodic reports or surveys of catch and fishery performance information derived from the logs or other recordkeeping requirements.

Recordkeeping and reporting is required of operators of catcher vessels, catcher/processor vessels, mothership processor vessels, and by responsible officers of shoreside processor plants.

3.9.1.1 Processor Reports

All processors of groundfish shall report information necessary for the management of groundfish resources. The regulations implementing this plan specify the information to be reported and the time schedule for reporting.

3.9.1.2 At-Sea Processor Vessels

1. <u>Reporting requirements</u>

Vessels that catch and process groundfish at sea (catcher/processors) and vessels that receive catch from other vessels for processing (mothership/processors) have the ability to operate for extended periods without landing. To avoid delay in monitoring catches, catcher/processors and mothership/processors are required to report to the Regional Administrator of NMFS at regular intervals as specified in the regulations.

2. Check-in and check-out report

Catcher/processors are required to check in and check out of any fishing area for which TAC is established within a time period prescribed by regulation. This report may be by radio through the U.S. Coast Guard to the Regional Administrator of NMFS. The Council intends that this requirement will enhance the ability of NMFS to monitor the timeliness of the written catch reports described in (1) above and to assess the total harvest capacity in a fishing area for purposes of projecting dates when a TAC, or apportionment of TAC, will be reached.

3. Catch/receipt and product transfer report

Operators of catcher/processor and mothership/processor vessels must submit a weekly catch/receipt and product transfer report. This report will be required after notification of starting fishing by a vessel and continuing until that vessel's entire catch or cargo of fish has been off-loaded for each weekly period, Sunday through Saturday, or for each portion of such a period. This report must be sent to the Regional Administrator within one week of the end of the reporting period through such means as the Regional Administrator will prescribe by regulations and must contain the following information:

a. name and radio call sign of the vessel;

b. federal permit number for the BSAI groundfish fisheries;

c. month and days fished or during which fish were received at sea;

d. the estimated round weight of all fish caught or received at sea by that vessel during the reporting period by species or species group, rounded to the nearest one-tenth of a metric ton (0.1 mt), whether retained, discarded, or off-loaded;

e. the number of cartons of product and the unit net weight, in kilograms or pounds, of each carton of processed fish by species or species group produced by that vessel during the reporting period;

f. the area in which each species or species group was caught;

g. if any species or species groups were caught in more than one area during a reporting period, the estimated round weight of each, rounded to the nearest 0.1 mt by area; and

h. the product weight, rounded to the nearest 0.1 mt, and the number of cartons transferred or off-loaded by product type and by species or species group.

4. Cargo transfer/off-loading log

Operators of catcher/processor and mothership/processor vessels must record certain information in a separate transfer log. He or she must record the following information, within a time specified by regulations, for each transfer or off-loading of any fishery product in the EEZ, as well as quantities transferred or off-loaded outside the EEZ, within any state's territorial waters, or within the internal waters of any state:

a. the time and date (GMT) and location (in geographic coordinates or if within a port, the name of the port) the transfer began and was completed;

b. the product weight and product type, by species or species group, of all fish products transferred or off-loaded rounded to the nearest tenth of a metric ton (0.1 mt);

c. the name and permit number of the vessel off-loading to or, if to a shoreside facility, the name of the commercial facility receiving the product; and

d. the intended port of destination of the receiving vessel if off-loaded to another vessel.

3.9.2 Observer Program

The Council and NMFS must have the best available biological and socioeconomic information with which to carry out their responsibilities for conserving and managing groundfish resources. To address management and scientific information needs, NMFS, in consultation with the Council, will require U.S. fishing vessels that catch groundfish from the EEZ or receive groundfish from the EEZ, and shoreside processors that receive groundfish caught in the EEZ, to accommodate observers certified by NMFS. Provisions of the North Pacific Groundfish Observer Program will be developed in consultation with the Council and established in regulations. The purpose of the groundfish observer program is to verify catch composition and quantity, including those discarded at sea, and collect biological information on marine resources.

3.10 Council Review of the Fishery Management Plan

3.10.1 Procedures for Evaluation

The Council will maintain a continuing review of the fisheries managed under this FMP through the following methods:

1. Maintain close liaison with the management agencies involved, usually the Alaska Department of Fish and Game and NMFS, to monitor the development of the fisheries and the activity in the fisheries.
2. Promote research to increase their knowledge of the fishery and the resource, either through Council funding or by recommending research projects to other agencies.
3. Conduct public hearings at appropriate times and in appropriate locations to hear testimony on the effectiveness of the management plans and requests for changes.
4. Consider all information gained from the above activities and develop, if necessary, amendments to the FMP. The Council will also hold public hearings on proposed amendments prior to forwarding them to the Secretary for possible adoption.

3.10.2 Schedule for Review

Adaptive management requires regular and periodic review. Unless specified below, all critical components of the FMP will be reviewed by the Council at such time as a supplement to the programmatic environmental impact statement on the groundfish fisheries is anticipated, or as otherwise warranted. Following the Council's review, components of the FMP may be identified that should be further examined in the programmatic analysis.

Management Approach

Objectives identified in the management policy statement (Section 2.2) 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 the management policy.

Essential Fish Habitat Components

To incorporate the regulatory guidelines for review and revision of essential fish habitat (EFH) FMP components, the Council will conduct a complete review of all the EFH components of each FMP once every 5 years and will amend those EFH components as appropriate to include new information.

Additionally, the Council may use the FMP amendment cycle every three years to solicit proposals for habitat areas of particular concern and/or conservation and enhancement measures to minimize the potential adverse effects from fishing. Those proposals that the Council endorses would be implemented through FMP amendments.

An annual review of existing and new EFH information will be conducted and this information will be provided to the BSAI Groundfish Plan Team for their review during the annual SAFE report process. This information could be included in the "Ecosystems Considerations" chapter of the SAFE report.

Chapter 4 Description of Stocks and Fishery

A description of the stocks that are managed as part of the Fishery Management Plan (FMP) for the Bering Sea/Aleutian Islands (BSAI) groundfish is contained in Section 4.1, and includes a discussion of stock units and the status and trends of groundfish species. Section 4.2 describes the habitat of the BSAI management area, defines essential fish habitat (EFH) for each of the managed species and provides recommendations, and describes habitat areas of particular concern. Fishing activities that affect the groundfish stocks are addressed in Section 4.3, including the history of exploitation in the BSAI, and a description of the commercial and subsistence fisheries for groundfish. Section 4.4 examines the economic and socioeconomic characteristics of the groundfish fisheries, and Section 4.5 describes fishing communities.

4.1 Stocks

The Bering Sea supports about 300 species of fishes, the majority of which are found near or on the bottom (Wilimovsky 1974). The fish groups of primary concern in this plan are the bottom or near-bottom dwelling forms – the flatfish, rockfish, sablefish, Pacific cod, pollock, and Atka mackerel. Although not bottom-dwelling, squids (*Cephalopoda*), sharks, and octopus are also included in the FMP.

There is a general simplification in the diversity of groundfish species in the Bering Sea compared to the more southern regions of the Gulf of Alaska (GOA) and Washington to California. As a result, certain species inhabiting the Bering Sea are some of the largest groundfish resources found anywhere in the world. Relatively few groundfish species in the eastern Bering Sea and the Aleutian Islands are large enough to attract target fisheries: walleye pollock, Pacific cod, Pacific ocean perch, sablefish, Atka mackerel, several species of rockfish and flatfish. Since the 1960s, pollock catches have accounted for the majority of the Bering Sea groundfish harvest. Yellowfin sole and rock sole currently dominate the flatfish group and have the longest history of intense exploitation by foreign fisheries. Other flatfish species that are known to occur in aggregations large enough to form target species are Greenland turbot, flathead sole, Alaska plaice, and arrowtooth flounder.

4.1.1 Stock Units

The groundfish and squid resources considered in this FMP consist of species that are wide ranging in their general distribution, occurring in the eastern Bering Sea, Aleutian Islands waters, the Gulf of Alaska, and in some cases further south. For the most part, groundfish species are managed as a single stock in the BSAI management area. This section contains a summary of distribution and known stock structure information for the target species. Further information on species stock structure can be found in the annual *Stock Assessment and Fishery Evaluation* (SAFE) report; the information in this section is summarized from the 2003 SAFE report (NPFMC 2003).

For pollock, there are currently three stocks identified for management purposes, although there is undoubtedly some degree of exchange between them. The eastern Bering Sea stock is the largest. There is also an Aleutian Island region stock, and a central Bering Sea-Bogoslof Island pollock stock, which is a mixture of pollock that migrate from the U.S. and Russian shelves to the Aleutian Basin.

Pacific cod is distributed widely over the eastern Bering Sea and the Aleutian Islands area, and in the BSAI is managed as a single unit. Tagging studies (e.g., Shimada and Kimura 1994) have demonstrated significant migration both within and between the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska, and genetic studies (e.g., Grant et al. 1987) have failed to show significant evidence of stock structure within these areas.

Adult sablefish live mainly in offshore waters at bottom depths of 200 meters and greater, from northern Mexico to the Bering Sea (Wolotira et al. 1993). Sablefish appear to form two populations, the northern of which inhabits Alaska and northern British Columbia waters. Northern sablefish appear to be highly migratory, with substantial movement between the BSAI and the GOA (Heifitz and Fujioka 1991, Kimura et al. 1998). As a result, sablefish in Alaska waters are assessed as a single population, although for management purposes discrete regions are identified to distribute exploitation throughout their wide geographical range. In the BSAI, the management areas distinguish the eastern Bering Sea and the Aleutian Islands region.

Flatfish in the BSAI are predominately found on the eastern Bering Sea continental shelf and slope, with lower abundance in the Aleutian Islands for those species whose range extends to that area. Each of the flatfish species is assessed as a single unit in the BSAI.

Yellowfin sole is one of the most abundant flatfish species in the eastern Bering Sea. They inhabit the continental shelf, and abundance in the Aleutian Islands region is negligible. Greenland turbot are distributed throughout the BSAI management area. The absence of juveniles in the Aleutian Islands region suggests that the population originates from the eastern Bering Sea or elsewhere, and the annual stock assessment assumes that Greenland turbot in the two regions represent a single stock. Arrowtooth flounder is most abundant in the eastern Bering Sea but which ranges into the Aleutian Islands region.

Although two species of rock sole are known to occur in the North Pacific ocean, the northern rock sole predominates in the BSAI. Flathead sole consist of two species of *Hippoglossoides* whose ranges overlap in the BSAI (Walters and Wildebuer 1997). Alaska plaice is mainly distributed on the eastern Bering Sea continental shelf, with a summer distribution at depths less than 110 m.

Rockfish are primarily assessed at the BSAI level, although some species are assigned separate harvest quotas in the eastern Bering Sea and the Aleutian Islands region. Many rockfish are not thought to exhibit large-scale movements as adults. Analysis of genetic material from north Pacific rockfish, with a view to determining evidence of stock structure, is an active area of research.

Pacific ocean perch (POP) inhabit the outer continental shelf and upper slope regions of the north Pacific Ocean and Bering Sea. An earlier study of POP in Alaska analyzed differences in biological features (e.g., growth rate) between eastern Bering Sea and Aleutian Islands fish and suggested that each of these areas has its own unique stock (Chikuni 1975). Further research has posed uncertainty as to whether the eastern Bering Sea POP represent a discrete stock (Spencer and Ianelli 2001), and since 2001, POP in the BSAI have been assessed and managed as a single stock.

Northern rockfish are patchily distributed in the BSAI, with the majority of harvest occurring as incidental catch in the Aleutian Islands Atka mackerel fishery. Initial genetic analysis has revealed no evidence of population structure (Gharrett 2003), although sample sizes were small. Shortraker rockfish in the BSAI appear to be a separate stock from those in the GOA. Rougheye rockfish also show evidence of two distinct species, with overlapping ranges in the GOA. The two most abundant species in the 'other rockfish' complex are the light dusky rockfish and the shortspine thornyhead, however distributions for these species are not well documented.

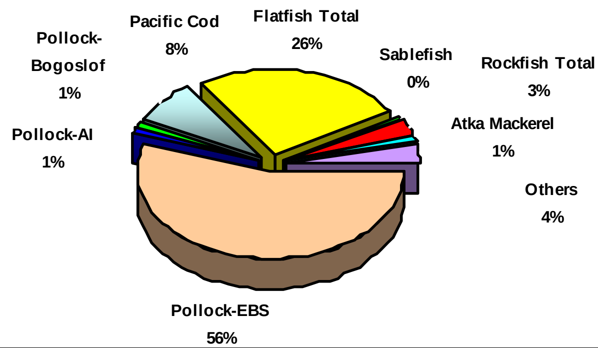
Atka mackerel center of abundance is the Aleutian Islands region, with a geographical range extending to the waters off Kamchatka, the eastern Bering Sea, and the Gulf of Alaska. Tag capture information from Alaska suggests that Atka mackerel populations are localized and do not travel long distances. Atka mackerel are not targeted in the eastern Bering Sea.

The predominant species of squid in commercial catches in the eastern Bering Sea is believed to be the red squid, *Berryteuthis magister*, while *Onychoteuthis borealijaponicus*, the boreal clubhook squid, is likely the principal species encountered in the Aleutian Islands region. Squid are generally migratory pelagic schooling species, with a lifespan thought to be 1-2 years.

4.1.2 Status of Stocks

This section summarizes the status of the various groundfish stocks of commercial importance in the BSAI. More detailed assessments and current estimates of biomass and acceptable biological catches can be found in the *Stock Assessment and Fishery Evaluation* (SAFE) report, that is produced annually (or biennially for some stocks) by the Bering Sea and Aleutian Islands Groundfish Plan Team (available at www.fakr.noaa.gov/npfmc). The information in this section comes from the November 2003 SAFE report (NPFMC 2003). The SAFE report contains further details on fishery statistics, resource assessment surveys, and the analytical techniques applied to the assessment of the various species.

Figure 4-1 2003 Exploitable Biomass of BSAI Groundfish by species, 19,869 million mt total

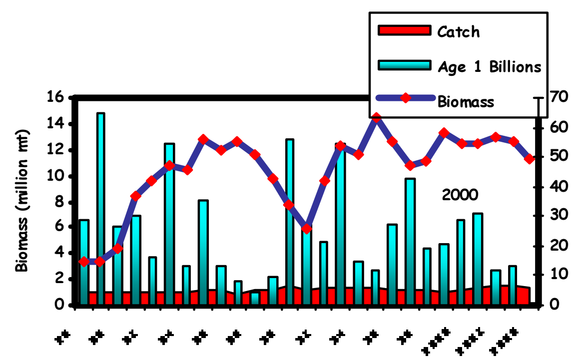


4.1.2.1 Pollock

Three stocks of pollock inhabit the BSAI area: the eastern Bering Sea, Aleutian Islands, and Aleutian Basin stocks. Exploitation and abundance of these stocks are very different.

The eastern Bering Sea pollock stock peaked in 1985, and declined to about 6 million mt by 1991. The age 3 and older biomass increased again in 1995 and has been variable around 12 million mt since. For 2004, spawning biomass of eastern Bering Sea pollock (3,525,000 mt) was estimated to be well above the biomass level that produces maximum sustainable yield (2,468,000 mt).

Figure 4-2 Eastern Bering Sea Pollock Abundance and Recruitment Trends



The Aleutian Islands pollock stock is considerably smaller than the eastern Bering Sea and Aleutian Basin stock. Age 3+ biomass in the Aleutian Island area is estimated at about 330,000 mt in 2004, and an ABC of 27,400 mt. Between 1999 and 2003, the Council recommended that no directed fishing for pollock occur in the Aleutian Islands area given current low abundance and the importance of pollock as prey for Steller sea lions. In 2004 Congress legislated that the Council would apportion the Aleutian Island pollock TAC to the Aleut Corporation to provide economic development in Adak.

Table 4-1 Projected age 3+ biomass and ABC (mt) of eastern Bering Sea walleye pollock.

Year	Biomass	ABC
2002	9,800,000	2,110,000
2003	11,100,000	2,330,000
2004	11,000,000	2,560,000

The Aleutian Basin pollock stock is at low levels. Biomass in the Aleutian Basin area is estimated by the hydroacoustic survey in the Bogoslof area. Biomass in the Bogoslof area declined from 2,400,000 mt in 1988 to only 54,000 mt in 1994. The projected 2004 exploitable biomass was 227,000 mt. This stock has historically contributed to the fishery in the international waters of the central Bering Sea (the Donut Hole fishery), which provided catches of 1.0 to 1.4 million mt during the years 1986 through 1989. No directed fishing has occurred on this stock since 1991.

The BSAI pollock TAC has been allocated between inshore and offshore trawl fishing sectors since 1992. The American Fisheries Act (AFA) of 1998 established specific allocations for the pollock TAC: 10 percent to the community development quota program, with the remainder allocated 50 percent to catcher vessels delivering inshore, 40 percent to catcher processors processing offshore, and 10 percent to catcher vessels delivering to motherships. The Act also established the authority and mechanisms for pollock fishery cooperatives (for further information, see Appendix C). The Consolidated Appropriations Act of 2004 allocated all of the Aleutian Islands directed pollock fishery to the Aleut Corporation.

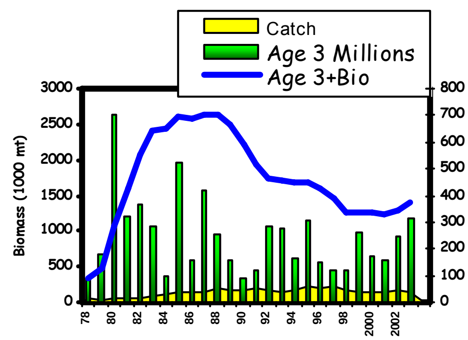
In 1990, roe-stripping of pollock was prohibited, and the Bering Sea pollock fishery was divided into roe and non-roe fishing seasons. The pollock fishery has also been affected by management measures designed to protect Steller sea lions since 1992. Temporal and spatial dispersion of the fleet has been accomplished through fishery exclusion zones around rookeries or haulout sites, phased in reduction in the seasonal proportions of TAC that can be taken in Steller sea lion critical habitat, and additional seasonal TAC allocations.

Measures have also been implemented to reduce bycatch in the pollock fishery. Bycatch limits for chum salmon (42,000 fish), Chinook salmon (29,000 fish in the Bering Sea subarea and 700 fish in the Aleutian Islands subarea), and herring (1 percent of total BSAI herring biomass) trigger area closures for the pollock fisheries in particular (see Section 3.6). Beginning in 1998, 100 percent retention was required for pollock under the improved retention/improved utilization (IR/IU) program. In 1999, the use of bottom trawl gear for directed pollock fishing was prohibited, to reduce bycatch of halibut and crabs.

4.1.2.2 Pacific Cod

The BSAI Pacific cod stock increased to high levels in the mid 1990s, then declined. The 2000 year class was above average, with recruits into the fishery beginning in 2003. Significant uncertainty surrounds the maximum permissible ABC computed in the stock assessment model. Between 1998 and 2002, the ABC was set below the maximum permissible ABC from the model. In 2003 and 2004, the Council, with advice from the Groundfish Plan Team and the SSC, instead selected an ABC through an alternative 'constant catch' approach, as the resulting ABC is at least as conservative as under the previous approach.

Figure 4-3 Pacific Cod Abundance and Recruitment Trends



The BSAI Pacific cod TAC is not apportioned by area, but is currently allocated after subtraction of the CDQ allowance: 1.4% to vessels using jig gear; 2.3% to catcher processors using trawl gear listed in Section 208(e)(1)-(20) of the AFA; 13.4% to catcher processors using trawl gear as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (P.L. 108-447); 22.1% to catcher vessels using trawl gear; 48.7% to catcher processors using hook-and-line gear; 0.2% to catcher vessels ≥60' LOA using hook-and-line gear; 1.5% to catcher processors using pot gear; 8.4% to catcher vessels ≥60' LOA using pot gear; and 2.0% to catcher vessels <60' LOA that use either hook-and-line gear or pot gear.

Table 4-2 Projected age 3+ biomass and ABC (mt) of BSAI Pacific cod.

Year	Biomass	ABC
2002	1,540,000	223,000
2003	1,680,000	223,000
2004	1,660,000	223,000

The hook-and-line, pot, and jig gear allocations are seasonally apportioned through regulations, with the exception of catcher vessels <60' LOA that use either hook-and-line gear or pot gear. The trawl gear allocations are also seasonally apportioned through regulations. Beginning in 1998, 100 percent retention was required for Pacific cod under the IR/IU program.

4.1.2.3 Sablefish

Sablefish in the Bering Sea, Aleutian Islands, and Gulf of Alaska are considered to be of one stock. The resource is managed by region in order to distribute exploitation throughout its range. Large catches of sablefish (up to 26,000 mt) were made in the Bering Sea during the 1960s, but have declined considerably. Since 1991, catch has rarely exceed 1,000 mt. Catch in the Aleutian Islands has never exceeded 3,600 mt, and in the early 2000s has hovered at around 1,000 mt. Biomass of the sablefish stock off Alaska has increased from recent lows during 1998 and 2000, and now appears to be at a moderate level.

Figure 4-4 Alaska Sablefish Abundance and Recruitment Trends

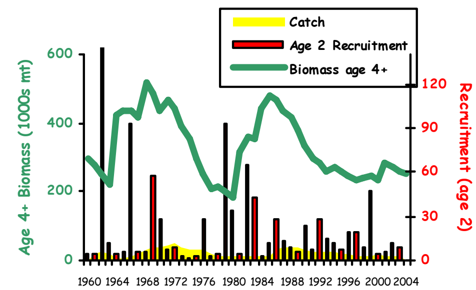


Table 4-3 Projected age 4+ biomass and ABC (mt) of BSAI sablefish.

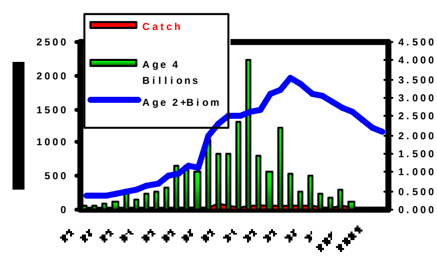
Year	Biomass	ABC
2002	67,000	4,480
2003	70,000	6,000
2004	71,000	6,460

The TAC for sablefish is apportioned among gear types. Sablefish in the Bering Sea is allocated 50 percent to fixed gear and 50 percent to trawl gear. In the Aleutian Islands, the sablefish TAC is allocated 75 percent to fixed gear and 25 percent to trawl gear. Twenty percent of the fixed gear allocations is reserved for use by community development quota program participants. The remaining fixed gear apportionment of the sablefish TAC is managed under an individual fishing quota (IFQ) program, which began in 1995. Important, although small, state water open access sablefish fisheries occur in the Aleutian Islands.

4.1.2.4 Flatfish

After pollock, flatfish species comprise a large proportion of groundfish exploitable biomass in the BSAI. Dominant species are yellowfin sole and rock sole. Other abundant or commercially important BSAI flatfish species are Greenland turbot, arrowtooth flounder, flathead sole, and Alaska plaice.

Figure 4-5 Eastern Bering Sea Rock Sole Abundance and Recruitment Trends



As of 2004, the biomass of most BSAI flatfish stocks remains relatively high. For many flatfish species, recruitment in more recent years has been low; consequently, stock declines are expected in coming years. The yellowfin sole stock has been declining since the mid-1980s, however the possibility of the 1995 year class being above average suggests that the stock may be more stable in the near future. Although biomass of rock sole increased from 2002 to 2003, it is expected to decline over the next few years. Recruitment of Alaska plaice has been stable since the late 1970s. The eastern Bering Sea bottom trawl survey for 2003 estimated a decrease in biomass for the ‘other flatfish’ stocks of 8 percent over 2002.

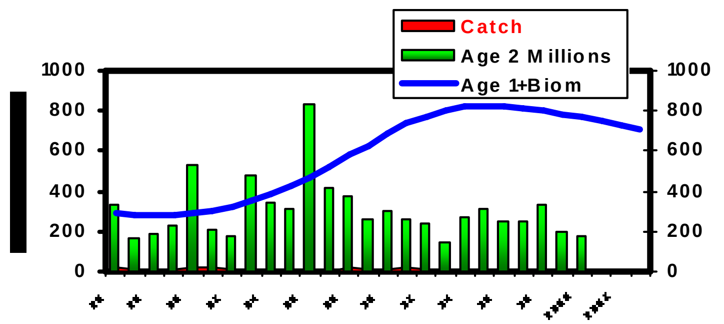
Table 4-4 Projected biomass and ABC (mt) of BSAI flatfish, 2004.

Species	Biomass	ABC
yellowfin sole	1,560,000 [1]	114,000
Greenland turbot	132,000 [2]	[3]
arrowtooth flounder	696,000 [2]	115,000
rock sole	1,160,000 [1]	139,000
flathead sole	505,000 [4]	61,900
Alaska plaice	1,050,000 [2]	203,000
other flatfish	90,300 [2]	13,500

[1] age 2+ biomass
[2] age 1+ biomass
[3] Greenland turbot ABC is apportioned by subarea.
[4] age 3+ biomass

Yellowfin sole and arrowtooth flounder are caught primarily with bottom trawl gear. Rock sole are important as the target of a high value roe fishery in February and March that accounts for the majority of the annual catch. Arrowtooth flounder has a low perceived commercial value, despite research in the early 1990s on their commercial utilization (Hiatt et al. 2003). This results in high discard rates. Alaska plaice is also a little utilized species, with a retention rate in 2002 of only 3 percent. The principle species of the 'other flatfish' group are starry flounder and rex sole; these species contributed 85 percent of the 'other flatfish' harvest in 2003.

Figure 4-6 Arrowtooth Flounder Abundance and Recruitment Trends



Other than yellowfin sole, flatfish species as a whole are lightly harvested. This is due primarily to halibut and crab bycatch limits, which frequently close down the fisheries prior to the achievement of TAC. Additionally, the Council frequently sets conservative quotas for these fisheries, at levels significantly less than their ABCs, because they are unlikely to achieve their TACs and that OY quota can instead be set for more highly valued species such as pollock, Pacific cod, and yellowfin sole.

Unlike biomass of other BSAI flatfish species, biomass of Greenland turbot is at low levels and declining. Biomass has declined due to poor year classes from 1981-1997. Catch has also declined from a peak of 57,000 mt in 1981. Since the 1990s, the Council has set low TACs (7,000 mt or lower) for Greenland turbot as an added conservation measure due to concerns about low recruitment. Biomass is projected to continue declining despite conservative management. The ABC for Greenland turbot is allocated by subarea, based on the proportion of biomass in each area.

Figure 4-7 Flathead Sole Abundance and Recruitment Trends

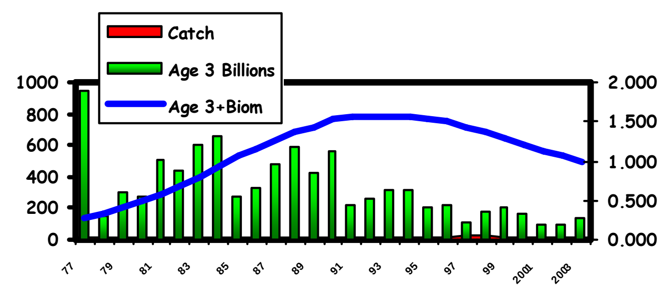
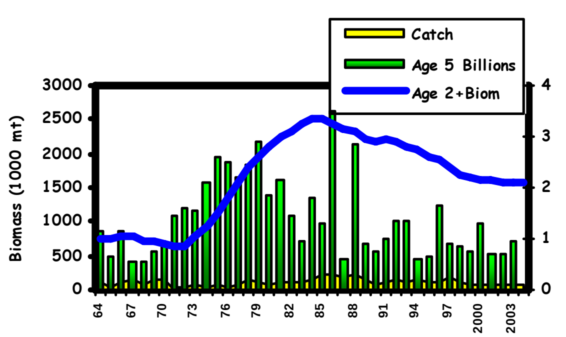
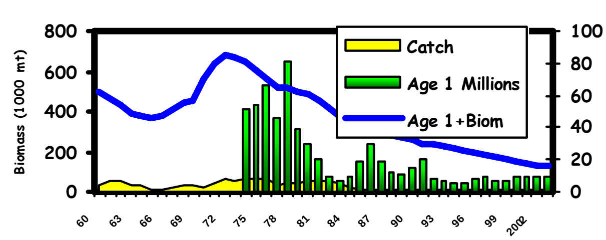


Figure 4-8 Yellowfin Sole Abundance and Recruitment Trends



In 2004, the ABC for the Aleutian Islands was 1,578 mt (33 percent of the total) , and for the Bering Sea was 3,162 mt. Greenland turbot were harvested almost exclusively (greater than 90 percent) by trawl gear until the early 1990s when longlines became the dominant gear type for this species. No halibut bycatch has been apportioned for a directed trawl fishery since 1996, effectively prohibiting this gear type from targeting turbot.

Figure 4-9 Greenland Turbot Abundance and Recruitment



4.1.2.5 Pacific Ocean Perch

Pacific ocean perch (commonly referred to by its acronym POP) are the dominant red rockfish species in the north Pacific. They are caught primarily along the Aleutian Islands, and to a lesser extent in the eastern Bering Sea and Gulf of Alaska. Heavy exploitation by foreign fleets resulted in peak catches of 47,000 mt in the eastern Bering Sea in 1961, and 109,100 mt in 1965 in the Aleutian Islands, and subsequent biomass declines. Above average year classes in the early 1980s has boosted biomass levels, which have remained relatively stable since 1995.

Figure 4-10 BSAI Pacific Ocean Perch Abundance and Recruitment Trends

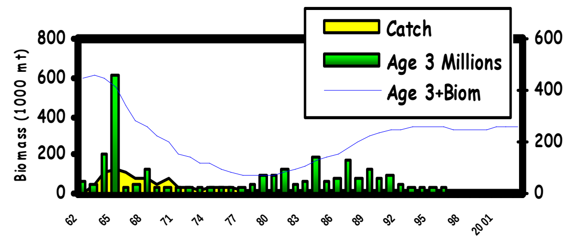


Table 4-5 Projected age 3+ biomass (mt) of Pacific ocean perch in the BSAI.

Year	Biomass
2002	337,000
2003	375,000
2004	349,000

ABCs and TACs for POP are apportioned by subarea, and for the Aleutian Islands, are further allocated by district. In 2004, the ABC for POP was 2,128 mt in the Bering Sea, 3,059 mt in the eastern Aleutian Islands, 2,926 in the central Aleutian Islands, and 5,187 in the western Aleutian Islands.

4.1.2.6 Other Rockfish

Rockfish other than Pacific ocean perch were divided into two complexes, the other red rockfish complex and the other rockfish complex, through 2000. Since 2001, northern, shortraker and rougheye rockfish have been managed as separate species in order to manage them more consistently.

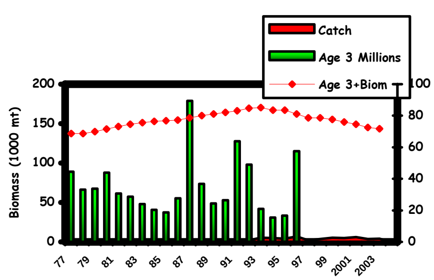
Table 4-6 Survey biomass and ABC (mt) of BSAI rockfish, 2004.

Species	Biomass	ABC
northern rockfish	142,000	6,880
shortraker rockfish	23,400	526
rougheye rockfish	10,400	195
eastern Bering Sea 'other rockfish'	18,300	960
Aleutian Islands 'other rockfish'	12,100	634

[1]ABC is apportioned by subarea

In the early 2000s, approximately 90 percent of northern rockfish were harvested in the Atka mackerel bottom trawl fishery, mainly in the Western Aleutian Islands district. Compared to northern rockfish, shortraker rockfish, and rougheye rockfish are a relatively high valued species, and consequently are less frequently discarded.

Figure 4-11 BSAI Northern Rockfish Abundance and Recruitment Trends



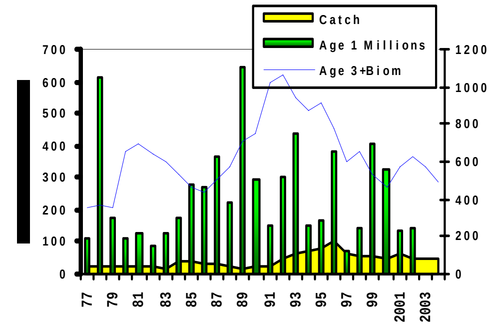
Since 1998, the Aleutian Islands TAC for shortraker/rougheye rockfish is allocated between trawl and fixed gear fisheries. Since 2001, shortraker and rougheye rockfish have been allocated separate TACs. Thirty percent of the TAC is allocated to fixed gear and 70 percent to vessels using trawl gear.

The "other rockfish" category contains eight rockfish species; the most abundant members are shortspine thornyhead and light dusky. Shortspine thornyheads are a higher priced species, and are caught mainly by fixed gear rather than trawl fisheries. The ABCs for the complex are listed in the box above.

4.1.2.7 Atka Mackerel

Atka mackerel are found along the Aleutian Islands, and to a lesser extent in the western Gulf of Alaska. Biomass increased from 1977 to a peak in 1992, declined over the 1990s, and has since increased. Catches have been relatively high since 1992, in response to evidence of a large exploitable biomass in the central and western Aleutian Islands; a record 103,000 mt was harvested in 1996. The Atka mackerel fishery takes place primarily with bottom trawl gear at depths of less than 200 m. The fishery is highly localized and takes place in the same few locations each year.

Figure 4-12 Aleutian Islands Atka Mackerel Abundance and Recruitment Trends



In 1993, TAC allocations in the Aleutian Islands subarea was divided into districts, in part to allows localized management. In 2004, the ABCs for Atka mackerel were 11,240 mt in the combined Eastern Aleutian Islands/Bering Sea subarea, 31,100 in the Central Aleutian Islands, and 24,360 in the Western Aleutian Islands.

Table 4-7 Projected age 3+ biomass (mt) of BSAI Atka mackerel.

Year	Biomass
2002	440,000
2003	358,000
2004	286,000

Since 1998, Atka mackerel have also been allocated by gear. A total of 1 percent of the combined Eastern Aleutian Islands/Bering Sea subarea TAC is allocated to jig gear. Once the jig fleet takes its 1 percent allocation, its allocation will increase to 2 percent for future years.

Atka mackerel are an important prey for Steller sea lions, and management measures have been taken to reduce the impacts of an Atka mackerel fishery on Steller sea lions. Since June 1998, the Atka mackerel fishery has been dispersed, both temporally and spatially, to reduce localized depletions of Atka mackerel. The TAC is now being equally split into two seasons, and the amount taken within sea lion critical habitat is limited.

4.1.2.8 Squid

There is no reliable estimate of squid abundance in the eastern Bering Sea. As a result, squid is managed in Tier 6 of the overfishing definitions, such that the overfishing level and ABC is based on catch history between 1978 and 1995. The BSAI ABC for squid is set at 1,970 mt.

Squid were a target fishery in the late 1970s and early 1980s for Japanese and Korean trawl vessels. Catches peaked at 6,886 mt in the eastern Bering Sea and 2,332 mt in the Aleutian Islands during this time. While not a target of the domestic fisheries, squid are taken incidentally in the target fisheries for pollock. Between 2001 and 2003, total catch averaged about 1,400 mt in the eastern Bering Sea, and was negligible in the Aleutian Islands. Discard rates of squid in the other target groundfish fisheries ranged between 40 and 85 percent during 1992-1998.

4.2 Habitat

4.2.1 Habitat Types

4.2.1.1 Bering Sea

The Bering Sea is a semi-enclosed, high-latitude sea. Of its total area of 2.3 million sq. km, 44 percent is continental shelf, 13 percent is continental slope, and 43 percent is deep-water basin (Figure 4-13). Its broad continental shelf is one of the most biologically productive areas of the world. In contrast, the Aleutian Island shelf is very narrow. The EBS contains approximately 300 species of fish, 150 species of crustaceans and mollusks, 50 species of seabirds, and 26 species of marine mammals (Livingston and Tjelmeland 2000). However, commercial fish species diversity is lower in the EBS than in the GOA.

A special feature of the EBS is the pack ice that covers most of its eastern and northern continental shelf during winter and spring. The dominant circulation of the water begins with the passage of North Pacific water (the Alaska Stream) into the EBS through the major passes in the AI (Favorite et al. 1976) (Figure 4-14). There is net water transport eastward along the north side of the AI and a turn northward at the continental shelf break and at the eastern perimeter of Bristol Bay. Eventually EBS water exits northward through the Bering Strait, or westward and south along the Russian coast, entering the western North Pacific via the Kamchatka Strait. Some resident water joins new North Pacific water entering Near Strait, which sustains a permanent cyclonic gyre around the deep basin in the central BS.

The EBS sediments are a mixture of the major grades representing the full range of potential grain sizes of mud (subgrades clay and silt), sand, and gravel. The relative composition of such constituents determines the type of sediment at any one location (Smith and McConnaughey 1999). Sand and silt are the primary components over most of the seafloor, with sand predominating the sediment in waters with a depth less than 60 m. Overall, there is often a tendency of the fraction of finer-grade sediments to increase (and average grain size to decrease) with increasing depth and distance from shore. This grading is particularly noticeable on the southeastern BS continental shelf in Bristol Bay and immediately westward. The condition occurs because settling velocity of particles decreases with particle size (Stokes Law), as does the minimum energy necessary to resuspend or tumble them. Since the kinetic energy of sea waves reaching the bottom decreases with increasing depth, terrigenous grains entering coastal shallows drift with water movement until they are deposited, according to size, at the depth at which water speed can no longer transport them. However, there is considerable fine-scale deviation from the graded pattern, especially in shallower coastal waters and offshore of major rivers, due to local variations in the effects of waves, currents, and river input (Johnson 1983).

The distribution of benthic sediment types in the EBS shelf is related to depth (Figure 4-15). Considerable local variability is indicated in areas along the shore of Bristol Bay and the north coast of the Alaska Peninsula, as well as west and north of Bristol Bay, especially near the Pribilof Islands. Nonetheless, there is a general pattern whereby nearshore sediments in the east and southeast on the inner shelf (0 to 50 m depth) often are sandy gravel and gravelly sand. These give way to plain sand farther offshore and west. On the middle shelf (50 to 100 m), sand gives way to muddy sand and sandy mud, which continue over much of the outer shelf (100 to 200 m) to the start of the continental slope. Sediments on the central and northeastern shelf (including Norton Sound) have not been so extensively sampled, but Sharma (1979) reports that, while sand is dominant in places here, as it is in the southeast, there are concentrations of silt both in shallow nearshore waters and in deep areas near the shelf slope. In addition, there are areas of exposed relic gravel, possibly resulting from glacial deposits. These departures from a classic seaward decrease in grain size are attributed to the large input of fluvial silt from the Yukon River and to flushing and scouring of sediment through the Bering Strait by the net northerly current.

McConnaughey and Smith (2000) and Smith and McConnaughey (1999) describe the available sediment data for the EBS shelf. These data were used to describe four habitat types. The first, situated around the shallow eastern and southern perimeter and near the Pribilof Islands, has primarily sand substrates with a little gravel. The second, across the central shelf out to the 100 m contour, has mixtures of sand and mud. A third, west of a line between St. Matthew and St. Lawrence islands, has primarily mud (silt) substrates, with some mixing with sand (Figure 4-16). Finally, the areas north and east of St. Lawrence Island, including Norton Sound, have a complex mixture of substrates.

Important water column properties over the EBS include temperature, salinity, and density. These properties remain constant with depth in the near-surface mixed-layer, which varies from approximately 10 to 30 m in summer to approximately 30 to 60 m in winter (Reed 1984). The inner shelf (less than 50 m) is, therefore, one layer and is well mixed most of the time. On the middle shelf (50 to 100 m), a two-layer temperature and salinity structure exists because of downward mixing of wind and upward mixing due to relatively strong tidal currents (Kinder and Schumacher 1981). On the outer shelf (100 to 200 m), a three-layer temperature and salinity structure exists due to downward mixing by wind, horizontal mixing with oceanic water, and upward mixing from the bottom friction due to relatively strong tidal currents. Oceanic water structure is present year-round beyond the 200-m isobath.

Three fronts, the outer shelf, mid-shelf, and inner shelf, follow along the 200-, 100-, and 50-m bathymetric contours, respectively; thus, four separate oceanographic domains appear as bands along the broad EBS shelf. The oceanographic domains are the deep water (more than 200 m), the outer shelf (200 to 100 m), the mid-shelf (100 to 50 m), and the inner shelf (less than 50 m).

The vertical physical system also regulates the biological processes that lead to separate cycles of nutrient regeneration. The source of nutrients for the outer shelf is the deep oceanic water; for the mid-shelf, it is the shelf-bottom water. Starting in winter, surface waters across the shelf are high in nutrients. Spring surface heating stabilizes the water column, then the spring bloom begins and consumes the nutrients. Steep seasonal thermoclines over the deep EBS (30 to 50 m), the outer shelf (20 to 50 m), and the mid-shelf (10 to 50 m) restrict vertical mixing of water between the upper and lower layers. Below these seasonal thermoclines, nutrient concentrations in the outer shelf water invariably are higher than those in the deep EBS water with the same salinity. Winter values for nitrate-N/phosphate-P are similar to the summer ratios, which suggests that, even in winter, the mixing of water between the mid-shelf and the outer shelf domains is substantially restricted (Hattori and Goering 1986).

Effects of a global warming climate should be greater in the EBS than in the GOA. Located further north than the GOA, the seasonal ice cover of the EBS lowers albedo effects. Atmospheric changes that drive the speculated changes in the ocean include increases in air temperature, storm intensity, storm frequency, southerly wind, humidity, and precipitation. The increased precipitation, plus snow and ice melt, leads to an increase in freshwater runoff. The only decrease is in sea level pressure, which is associated with the northward shift in the storm track. Although the location of the maximum in the mean wind stress curl will probably shift poleward, how the curl is likely to change is unknown. The net effect of the storms is what largely determines the curl, and there is likely to be compensation between changes in storm frequency and intensity.

Ocean circulation decreases are likely to occur in the major current systems: the Alaska Stream, Near Strait Inflow, Bering Slope Current, and Kamchatka Current. Competing effects make changes in the Unimak Pass inflow, the shelf coastal current, and the Bering Strait outflow unknown. Changes in hydrography should include increases in sea level, sea surface temperature, shelf bottom temperature, and basin stratification. Decreases should occur in mixing energy and shelf break nutrient supply, while competing effects make changes in shelf stratification and eddy activity unknown. Ice extent, thickness, and brine rejection are all expected to decrease.

Temperature anomalies in the EBS illustrate a relatively warm period in the late 1950s, followed by cooling (especially in the early 1970s), and then by a rapid temperature increase in the latter part of that decade. For more information on the physical environment of the EBS, refer to the programmatic groundfish SEIS (NMFS 2004).

Characteristic features of the EBS are described in Table 4-8.

4.2.1.2 Aleutian Islands

The Aleutian Islands lie in an arc that forms a partial geographic barrier to the exchange of northern Pacific marine waters with EBS waters. The AI continental shelf is narrow compared with the EBS shelf, ranging in width on the north and south sides of the islands from about 4 km or less to 42 to 46 km; the shelf broadens in the eastern portion of the AI arc. The AI comprises approximately 150 islands and extends about 2,260 km in length.

Bowers Ridge in the AI is a submerged geographic structure forming a ridge arc off the west-central AI. Bowers Ridge is about 550 km long and 75 to 110 km wide. The summit of the ridge lies in water approximately 150 to 200 m deep in the southern portion deepening northward to about 800 to 1,000 m at its northern edge.

The AI region has complicated mixes of substrates, including a significant proportion of hard substrates (pebbles, cobbles, boulders, and rock), but data are not available to describe the spatial distribution of these substrates.

The patterns of water density, salinity, and temperature are very similar to the GOA. Along the edge of the shelf in the Alaska Stream, a low salinity (less than 32.0 ppt) tongue-like feature protrudes westward. On the south side of the central AI, nearshore surface salinities can reach as high as 33.3 ppt, as the higher salinity EBS surface water occasionally mixes southward through the AI. Proceeding southward, a minimum of approximately 32.2 ppt is usually present over the slope in the Alaska Stream; values then rise to above 32.6 ppt in the oceanic water offshore. Whereas surface salinity increases toward the west as the source of fresh water from the land decreases, salinity values near 1,500 m decrease very slightly. Temperature values at all depths decrease toward the west.

Climate change effects on the AI area are similar to the effects described for climate change in the EBS. For more information on the physical environment of the AI, refer to the programmatic groundfish SEIS (NMFS 2004).

Table 4-8 Characteristic Features of the Eastern Bering Sea Shelf Ecosystem

Characteristic Features	Consequences
Physical Features	
Large Continental Shelf	• High standing stocks of biota • High fish production • Large food resources for mammals
High latitude area	• Nutrient replenishment with seasonal turnover • Environmental distribution limits for many species • Large seasonal changes • Seasonal presence of ice • Accumulation of generations
Large seasonal changes	• Seasonally changing growth • Seasonal migrations • Possibility of large anomalies
Ice	• Presence of ice-related mammals • Migration of biota (in and out) caused by ice • Limited production in winter
Cold bottom water	• Out migration of biota • Higher mortalities and lower growth of benthic and demersal biota • Accumulation of generations
High runoff	• Low salinities (near coasts) • High turbidities • Presence of euryhaline fauna
Sluggish circulation	• Local biological production • Local pelagic spawning
Biological Features	
High production and slow turnover	• High standing stocks
Fewer species than in lower latitudes	• Few species quantitatively very dominant
High amounts of marine mammals and birds	• High predation by apex predators
Pronounced seasonal migrations	• Great local space and time changes of abundance
Fisheries Resource Features	
Pollock dominate semidemersal species	• Flexible feeding and breeding habits, especially environmental adaptation
Yellowfin sole dominate demersal species	• Abundant benthos food supply
Herring and capelin dominate pelagic species	• Important forage species in the ecosystem
Abundant crab resources	• Large, relatively shallow shelf. Few predators on adults, especially environmental adaptation.
Abundant marine mammals	• Abundant food supply, no enemies, insignificant hunting. Competes with man on fishery resources
Man-related Features	
Fisheries development rather recent	• Ecosystem in near-natural state, not yet fully adjusted to effects of extensive fishery
Little inhabited coasts	• Ample space for breeding colonies for mammals and birds. Very limited local fisheries.

(Favorite and Laevastu 1981)

Figure 4-13 Bathymetric map of the Bering Sea

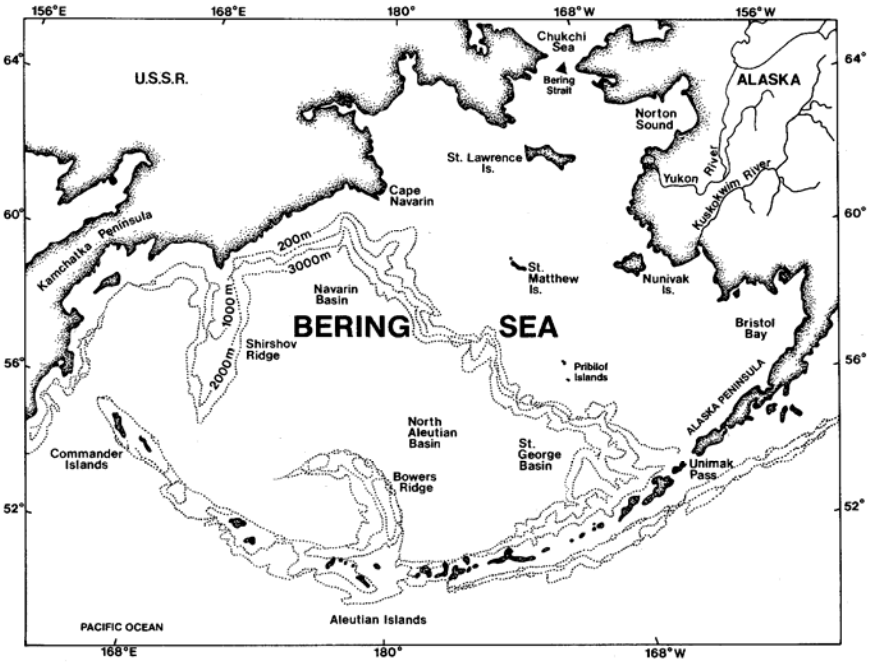
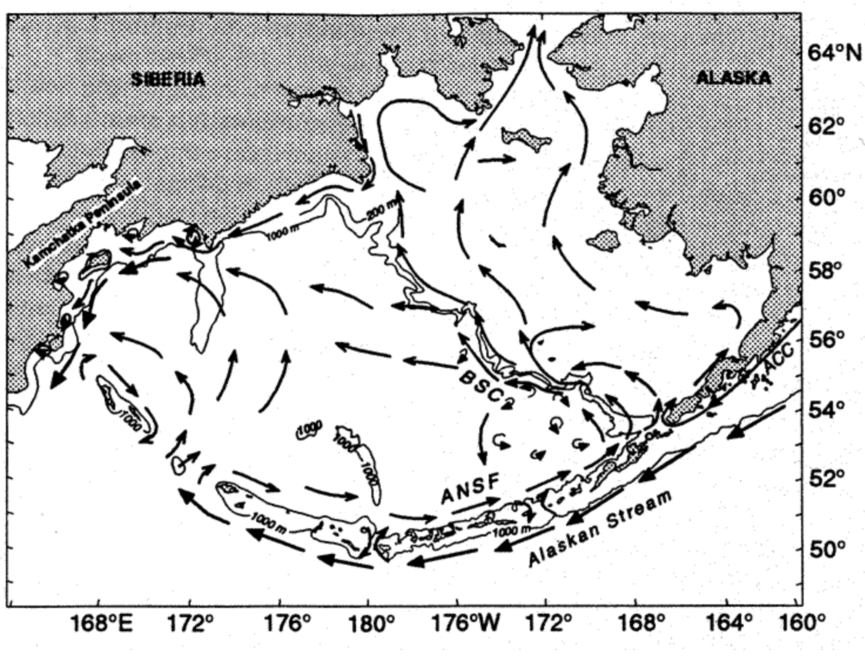


FIG. 1. The Bering Sea (from Sayles et al. 1979).

(Sayles 1979).

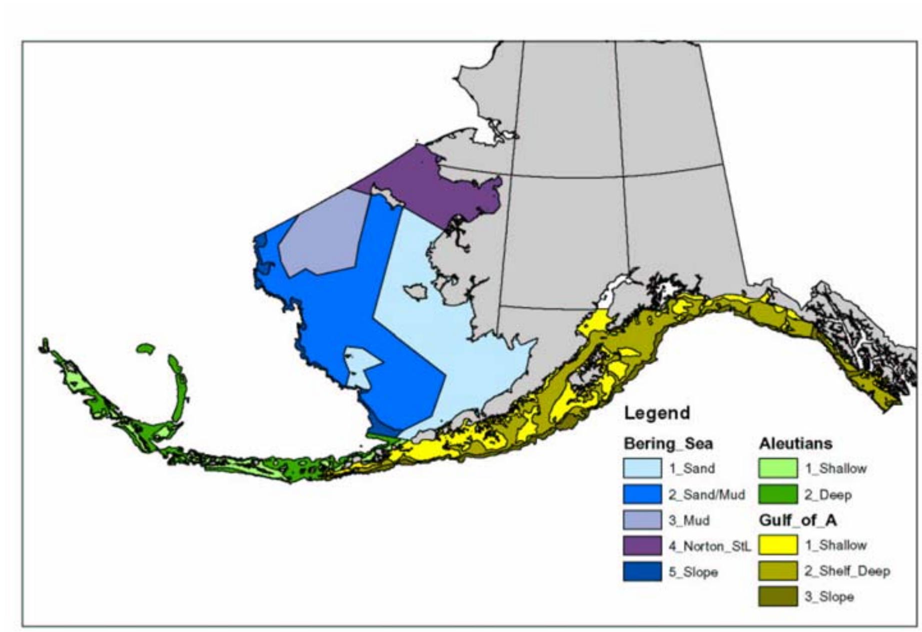
Figure 4-14 Currents in the Bering Sea



(Stabeno et al. 1993).

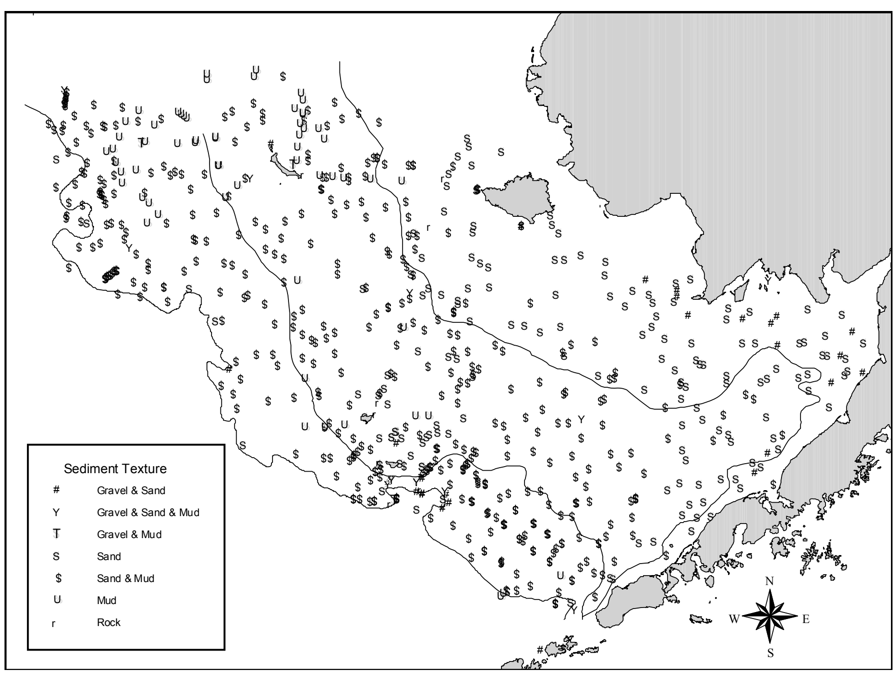
Note: Schematic of mean circulation in the upper 40 m of the Bering Sea water column over the basin and shelf (after Stabeno and Reed 1994, Schumacher and Stabeno 1998). The arrows with solid heads represent currents with mean speeds typically >50 cm/s. The Alaskan Stream, Kamchatka Current, Bering Slope Current (BSC), and Aleutian North Slope Current (ANSF) are each indicated. The 100-m flow and 1,000-m isobath are indicated.

Figure 4-15 Surficial sediment textural characteristics for the portion of the continental shelf which is the focus of the EBSSED database.



(Appendix B, NMFS 2005)

Figure 4-16 Distribution of Bering Sea sediments.



Source: Smith and McConnaughey 1999.

4.2.2 Essential Fish Habitat Definitions

EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH for groundfish species is the general distribution of a species described by life stage. General distribution is a subset of a species population and is 95 percent of the population for a particular life stage, if life history data are available for the species. Where information is insufficient and a suitable proxy cannot be inferred, EFH is not described. General distribution is used to describe EFH for all stock conditions whether or not higher levels of information exist, because the available higher level data are not sufficiently comprehensive to account for changes in stock distribution (and thus habitat use) over time.

EFH is described for FMP-managed species by life stage as general distribution using new guidance from the EFH Final Rule (50 CFR 600.815), such as the updated EFH Level of Information definitions. New analytical tools are used and recent scientific information is incorporated for each life history stage from updated scientific habitat assessment reports (see Appendix F to the NMFS 2005). EFH descriptions include both text (Section 4.2.2.2) and maps (Section 4.2.2.3 and Appendix E), if information is available for a species' particular life stage. These descriptions are risk averse, supported by scientific rationale, and accounts for changing oceanographic conditions, regime shifts, and the seasonality of migrating fish stocks.

EFH descriptions are interpretations of the best scientific information. In support of this information, a thorough review of FMP species in the Environmental Impact Statement for Essential Fish Habitat Identification and Conservation (NMFS 2005) (EFH EIS) is contained in Section 3.2.1, Biology, Habitat Usage, and Status of Magnuson-Stevens Act Managed Species and detailed by life history stage in Appendix F: EFH Habitat Assessment Reports.

4.2.2.1 Essential Fish Habitat Information Levels

A summary of the habitat information levels for each species is listed in Table 4-9.

Table 4-9 Levels of essential fish habitat information currently available for BSAI groundfish, by life history stage.

Species	Eggs	Larvae	Early Juveniles	Late Juveniles	Adults
Pollock	1	1	x	1	1
Pacific cod	x	1	x	1	1
Sablefish	x	1	x	1	1
Yellowfin sole	x	x	x	1	1
Greenland turbot	1	1	x	1	1
Arrowtooth flounder	x	x	x	1	1
Rock sole	x	1	x	1	1
Alaska plaice	1	x	x	1	1
Rex sole	x	x	x	1	1
Dover sole	x	x	x	1	1
Flathead sole	1	1	x	1	1
Pacific ocean perch	x	1	x	1	1
Northern rockfish	x	1	x	x	1
Shortraker/rougheye rockfish	x	1	x	x	1
Yelloweye rockfish	x	1	x	1	1
Dusky rockfish	x	1	x	x	1
Thornyhead rockfish	x	1	x	1	1
Atka mackerel	x	1	x	x	1
Squid	x	x	x	1	1
Sculpins	x	x	x	1	1
Skates	x	x	x	x	1
Sharks	x	x	x	x	x
Octopus	x	x	x	x	x
Forage fish complex	x	x	x	x	x

Juveniles were subdivided into early and late juvenile stages based on survey selectivity curves

Note: "1" indicates that there is sufficient information available to describe EFH; "x" indicates that there is insufficient information available to describe EFH.

4.2.2.2 Essential Fish Habitat Text Descriptions for BSAI Groundfish

4.2.2.2.1 Walleye Pollock

Eggs: EFH for walleye pollock eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure E-1.

Larvae: EFH for larval walleye pollock is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure E-2.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile walleye pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI, as depicted in Figure E-3. No known preference for substrates exist.

Adults: EFH for adult walleye pollock is the general distribution area for this life stage, located in the lower and middle portion of the water column along the entire shelf (0 to 200 m) and slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure E-3. No known preference for substrates exist.

4.2.2.2.2 Pacific Cod

Eggs: No EFH Description Determined. Scientific information notes the rare occurrence of Pacific cod eggs in the BSAI.

Larvae: EFH for larval Pacific Cod is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure E-4.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting of sand, mud, sandy mud, and muddy sand, as depicted in Figure E-5.

Adults: EFH for adult Pacific cod is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting of sand, mud, sandy mud, muddy sand, and gravel, as depicted in Figure E-5.

4.2.2.2.3 Sablefish

Eggs: No EFH Description Determined. Scientific information notes the rare occurrence of sablefish eggs in the BSAI.

Larvae: EFH for larval sablefish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E- 20.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure E-21.

Adults: EFH for adult sablefish is the general distribution area for this life stage, located in the lower portion of the water column, varied habitats, generally softer substrates, and deep shelf gulleys along the slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure E-21.

4.2.2.2.4 Yellowfin Sole

Eggs: No EFH Description Determined .Scientific information notes the rare occurrence of yellowfin sole eggs in the BSAI.

Larvae: No EFH Description Determined. Scientific information notes the rare occurrence of larval yellowfin sole in the BSAI.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand, as depicted in Figure E-6.

Adults: EFH for adult yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand, as depicted in Figure E-6.

4.2.2.2.5 Greenland Turbot

Eggs: EFH for Greenland turbot eggs is the general distribution area for this life stage, located principally in benthypelagic waters along the outer shelf (100 to 200 m) and slope (200 to 3,000 m) throughout the BSAI in the fall, as depicted in Figure E-7.

Larvae: EFH for larval Greenland turbot is the general distribution area for this life stage, located principally in benthypelagic waters along the outer shelf (100 to 200 m) and slope (200 to 3,000 m) throughout the BSAI and seasonally abundant in the spring, as depicted in Figure E-8.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile Greenland turbot is the general distribution area for this life stage, located in the lower and middle portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of mud and sandy mud, as depicted in Figure E-9.

Adults: EFH for late adult Greenland turbot is the general distribution area for this life stage, located in the lower and middle portion of the water column along the outer shelf (100 to 200 m), upper slope (200 to 500 m), and lower slope (500 to 1,000 m) throughout the BSAI wherever there are softer substrates consisting of mud and sandy mud, as depicted in Figure E-9.

4.2.2.2.6 Arrowtooth Flounder

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: No EFH Description Determined. Scientific information notes the rare occurrence of larval arrowtooth flounder in the BSAI.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of gravel, sand, and mud, as depicted in Figure E-10.

Adults: EFH for adult arrowtooth flounder is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of gravel, sand, and mud, as depicted in Figure E-10.

4.2.2.2.7 Rock Sole

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval rock sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 1,000 m) throughout the BSAI, as depicted in Figure E-11.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble, as depicted in Figure E-12.

Adults: EFH for adult rock sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble, as depicted in Figure E-12.

4.2.2.2.8 Alaska Plaice

Eggs: EFH for Alaska plaice eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout the BSAI in the spring, as depicted in Figure E-13.

Larvae: No EFH Description Determined. Scientific information notes the rare occurrence of larval Alaska plaice in the BSAI.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure E-14.

Adults: EFH for adult Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure E-14.

4.2.2.2.9 Rex Sole

Eggs: No EFH Description Determined. Scientific information notes the rare occurrence of rex sole eggs in the BSAI.

Larvae: No EFH Description Determined. Scientific information notes the rare occurrence of larval rex sole in the BSAI.

Late Juveniles: EFH for juvenile rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are substrates consisting of gravel, sand, and mud, as depicted in Figure E-15.

Adults: EFH for adult rex sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are substrates consisting of gravel, sand, and mud, as depicted in Figure E-15.

4.2.2.2.10 Dover Sole

Eggs: No EFH Description Determined. Scientific information notes the rare occurrence of Dover sole eggs in the BSAI.

Larvae: No EFH Description Determined. Scientific information notes the rare occurrence of larval Dover sole in the BSAI.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of sand and mud, as depicted in Figure E-16.

Adults: EFH for adult Dover sole is the general distribution area for this life stage, located in the lower portion of the water column along the middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of sand and mud, as depicted in Figure E-16.

4.2.2.2.11 Flathead Sole

Eggs: EFH for flathead sole eggs is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI in the spring, as depicted in Figure E-17.

Larvae: EFH for larval flathead sole is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E-18.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for juvenile flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure E-19

Adults: EFH for adult flathead sole is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud, as depicted in Figure E-19.

4.2.2.2.12 Pacific Ocean Perch

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval Pacific ocean perch is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E-22, General Distribution of Rockfish Larvae.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile Pacific ocean perch is the general distribution area for this life stage, located in the middle to lower portion of the water column along the inner shelf (1 to 50 m), middle shelf (50 to 100 m), outer shelf (100 to 200 m), and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand, as depicted in Figure E-23.

Adults: EFH for adult Pacific ocean perch is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates consisting of cobble, gravel, mud, sandy mud, or muddy sand; depicted in Figure E-23.

4.2.2.2.13 Northern Rockfish

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval northern rockfish is the general distribution area for this life stage, located in pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E-22, General Distribution of Rockfish Larvae.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: EFH for adult northern rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer slope (100 to 200 m) and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of cobble and rock, as depicted in Figure E-25.

4.2.2.2.14 Shortraker and Rougheye Rockfish

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval shortraker and rougheye rockfish is the general distribution area for this life stage, located in epipelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E-22, General Distribution of Rockfish Larvae.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: The adult stage of Shortraker and Rougheye are very difficult to distinguish and data are not available for the individual species. Because both species share the same habitat and depth strata, they are grouped for purposes of describing EFH. EFH for adult shortraker and rougheye rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) regions throughout the BSAI wherever there are substrates consisting of mud, sand, sandy mud, muddy sand, rock, cobble, and gravel, as depicted in Figure E-24.

4.2.2.2.15 Yelloweye Rockfish

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval yelloweye rockfish is the general distribution area for this life stage, located in the epipelagic waters along the entire shelf (0 to 200 m) and slope (200 to

3,000 m) throughout the BSAI, as depicted in Figure E-22, General Distribution of Rockfish Larvae.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates of rock and in areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges, as depicted in Figure E-27.

Adults: EFH for adult yelloweye rockfish is the general distribution area for this life stage, located in the lower portion of the water column within bays and island passages and along the inner shelf (0 to 50 m), outer shelf (100 to 100 m), and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of rock and in vegetated areas of vertical relief, such as crevices, overhangs, vertical walls, coral, and larger sponges, as depicted in Figure E-27.

4.2.2.2.16 Dusky Rockfish

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval dusky rockfish is the general distribution area for this life stage, located in the pelagic waters along the entire shelf (0 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E-22, General Distribution of Rockfish Larvae.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: EFH for adult dusky rockfish is the general distribution area for this life stage, located in the middle and lower portions of the water column along the outer shelf (100 to 200 m) and upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of cobble, rock, and gravel, as depicted in Figure E-28.

4.2.2.2.17 Thornyhead Rockfish

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval thornyhead rockfish is the general distribution area for this life stage, located in epipelagic waters along the outer shelf (100 to 200 m) and slope (200 to 3,000 m) throughout the BSAI, as depicted in Figure E-22, General Distribution of Rockfish Larvae.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for late juvenile Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 m) and upper to lower slope (200 to 1,000 m) throughout the BSAI wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel, as depicted in Figure E-26.

Adults: EFH for adult Thornyhead rockfish is the general distribution area for this life stage, located in the lower portion of the water column along the middle and outer shelf (50 to 200 m) and upper to lower slope (200 to 1,000 m) throughout the BSAI wherever there are substrates of mud, sand, rock, sandy mud, muddy sand, cobble, and gravel, as depicted in Figure E-26.

4.2.2.2.18 Atka Mackerel

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: EFH for larval atka mackerel is the general distribution area for this life stage, located in epipelagic waters along the shelf (0 to 200 m), upper slope (200 to 500 m), and intermediate slope (500-1000 m) throughout the BSAI, as depicted in Figure E-29.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: EFH for adult Atka mackerel is the general distribution area for this life stage, located in the entire water column, from sea surface to the sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates of gravel and rock and in vegetated areas of kelp, as depicted in Figure E-30.

4.2.2.2.19 Squid

Eggs: No EFH Description Determined. Insufficient information is available.

EarlyJuveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: EFH for older juvenile squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer (200 to 500 m) shelf and the entire slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure E-33.

Adults: EFH for adult squid is the general distribution area for this life stage, located in the entire water column, from the sea surface to sea floor, along the inner (0 to 50 m), middle (50 to 100 m), and outer (200 to 500 m) shelf and the entire slope (500 to 1,000 m) throughout the BSAI, as depicted in Figure E-33.

4.2.2.2.20 Sculpins

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: No EFH Description Determined. Insufficient information is available.

Juveniles: EFH for juvenile sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), outer shelf (100 to 200 m) and portions of the upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of rock, sand, mud, cobble, and sandy mud, as depicted in Figure E-32.

Adults: EFH for adult sculpins is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m, outer shelf (100 to 200 m) and portions of the upper slope (200 to 500 m) throughout the BSAI wherever there are substrates of rock, sand, mud, cobble, and sandy mud, as depicted in Figure E-32.

4.2.2.2.21 Skates

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: No EFH Description Determined. Insufficient information is available.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: EFH for adult skates is the general distribution area for this life stage, located in the lower portion of the water column on the shelf (0 to 200 m) and the upper slope (200 to

500 m) throughout the BSAI wherever there are of substrates of mud, sand, gravel, and rock, as depicted in Figure E-31.

4.2.2.2.22 Sharks

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: No EFH Description Determined. Insufficient information is available.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: No EFH Description Determined. Insufficient information is available.

4.2.2.2.23 Octopus

Eggs: No EFH Description Determined. Insufficient information is available.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: No EFH Description Determined. Insufficient information is available.

4.2.2.2.24 Forage Fish Complex

The forage fish complex consists of species including eulachon, capelin, sand lance, sand fish, euphausiids, myctophids, pholids, gonostomatids.

Eggs: No EFH Description Determined. Insufficient information is available.

Larvae: No EFH Description Determined. Insufficient information is available.

Early Juveniles: No EFH Description Determined. Insufficient information is available.

Late Juveniles: No EFH Description Determined. Insufficient information is available.

Adults: No EFH Description Determined. Insufficient information is available.

4.2.2.3 EFH Map Descriptions

Figures E-1 through E-33 in Appendix E show EFH distribution for the BSAI groundfish species.

4.2.2.4 Essential Fish Habitat Conservation

In order to protect EFH, certain EFH habitat conservation areas have been designated. A habitat conservation area is an area where fishing restrictions are implemented for the purposes of habitat conservation.

The following area has been designated in the BSAI management area:

- Aleutian Islands Habitat Conservation Area

The coordinates of this area are described in Appendix B; management measures associated with this area are described in Section 3.5.2.

4.2.3 Habitat Areas of Particular Concern

Habitat areas of particular concern (HAPCs) are specific sites within EFH that are of particular ecological importance to the long-term sustainability of managed species, are of a rare type, or are especially susceptible to degradation or development. HAPCs are meant to provide for greater focus of conservation and management efforts and may require additional protection from adverse effects. 50 CFR 600.815(a)(8) provides guidance to the Councils in identifying HAPCs.

FMPs should identify specific types or areas of habitat within EFH as habitat areas of particular concern based on one or more of the following considerations:

(i) The importance of the ecological function provided by the habitat.

(ii) The extent to which the habitat is sensitive to human-induced environmental degradation.

(iii) Whether, and to what extent, development activities are, or will be, stressing the habitat type.

(iv) The rarity of the habitat type.

4.2.3.1 HAPC Process

The Council may designate specific sites as HAPCs and may develop management measures to protect habitat features within HAPCs.

50 CFR 600.815(a)(8) provides guidance to the Councils in identifying HAPCs. FMPs should identify specific types or areas of habitat within EFH as habitat areas of particular concern based on one or more of the following considerations:

(i) The importance of the ecological function provided by the habitat.

(ii) The extent to which the habitat is sensitive to human-induced environmental degradation.

(iii) Whether, and to what extent, development activities are, or will be, stressing the habitat type.

(iv) The rarity of the habitat type.

Proposed HAPCs, identified on a map, must meet at least two of the four considerations established in 50 CFR 600.815(a)(8), and rarity of the habitat is a mandatory criterion. HAPCs may be developed to address identified problems for FMP species, and they must meet clear, specific, adaptive management objectives.

The Council will initiate the HAPC process by setting priorities and issuing a request for HAPC proposals. Any member of the public may submit a HAPC proposal. HAPC proposals may be solicited every 3 years or on a schedule established by the Council. The Council may periodically review existing HAPCs for efficacy and considerations based on new scientific research.

Criteria to evaluate the HAPC proposals will be reviewed by the Council and the Scientific and Statistical Committee prior to the request for proposals. The Council will establish a process to review the proposals and may establish HAPCs and conservation measures (NPFMC 2005).

4.2.3.2 HAPC Designation

In order to protect HAPCs, certain habitat protection areas and habitat conservation zones have been designated. A habitat protection area is an area of special, rare habitat features where fishing activities that may adversely affect the habitat are restricted. A habitat conservation zone is a subset of a habitat conservation area (used to protect EFH, see Section 4.2.2.4, above), in which additional restrictions are imposed on fishing beyond those established for the conservation area, in order to protect specific habitat features.

The following areas have been designated in the BSAI management area:

- Bowers Ridge Habitat Conservation Zone (Bowers Ridge and Ulm Plateau)
- Alaska Seamount Habitat Protection Area (Bowers Seamount)

The coordinates of these areas are described in Appendix B; management measures associated with these areas are described in Section 3.5.2.

4.2.4 Habitat Conservation and Enhancement Recommendations for Fishing and Non-fishing Threats to Essential Fish Habitat and Habitat Areas of Particular Concern

Conservation and enhancement of EFH and HAPC areas have been recommended and adopted by the designation of EFH habitat conservation areas and HAPC habitat conservation zones and protection areas. The restrictions for these areas are described in Section 3.5.2. Conservation recommendations for non-fishing threats to EFH and HAPCs are located in Appendix F.

4.3 Fishing Activities Affecting the Stocks

The Bering Sea and Aleutian Islands management area is utilized primarily by commercial fisheries. The groundfish fisheries have been entirely domestic since 1991 (a history of exploitation is addressed in Section 4.3.1). The commercial fleet is described in Section 4.3.2. There is also subsistence fishing for groundfish species (Section 4.3.3) in the BSAI, although most of this activity takes place within state waters (0-3 nm). Recreational fisheries are addressed in Section 4.3.4. There are no Indian treaty fishing rights for groundfish in the BSAI exclusive economic zone (EEZ).

4.3.1 History of Exploitation

The earliest fisheries for groundfish in the BSAI were the native subsistence fisheries. The fish and other marine resources remain an important part of the life of native people, and dependence on demersal species of fish may have been critical to their survival in periods of the year when other sources of food were scarce or lacking. Fishing was primarily in nearshore waters utilizing such species as cod, halibut, rockfish, and other species. These small-scale subsistence fisheries have continued to the present time.

The first commercial venture for groundfish occurred in 1864 when a single schooner fished for Pacific cod in the Bering Sea. This domestic fishery continued until 1950 when demand for cod declined and economic conditions caused the fishery to be discontinued. Fishing areas in the eastern Bering Sea were from north of Unimak Island and the Alaska Peninsula to Bristol Bay. Vessels operated from home ports in Washington and California and from shore stations in the eastern Aleutian Islands. The cod fishery reached its peak during World War I when the demand for cod was high. Numbers of schooners operating in the fishery ranged between 1 and 16 up to 1914 and increased to between 13 and 24 in the period 1915-20. Estimated catches during the peak of the fishery ranged annually between 12,000-14,000 mt.

Another early fishery targeted Pacific halibut. Halibut were reported as being present in the Bering Sea by United States cod vessels as early as the 1800s. However, halibut from the Bering Sea did not reach North American markets until 1928. Small and infrequent landings of halibut were made by United States and Canadian vessels between 1928 and 1950, but catches were not landed every year until 1952. The catch by North American setline vessels increased sharply between 1958 and 1963 and then declined steadily until 1972.

Several foreign countries conducted large scale groundfish fisheries in the BSAI prior to 1991. Vessels from Japan, the USSR (Russia), Canada, Korea, Taiwan, and Poland all plied the waters of the North Pacific for groundfish. In the mid 1950s, vessels from Japan and Russia targeted yellowfin sole, and catches peaked at over 550,000 mt in 1961. In the 1960s, Japanese vessels, and to a lesser extent Russian vessels, developed a fishery for Pacific ocean perch (POP), pollock, Greenland turbot, sablefish, and other groundfish. By the early 1970s, over 1.7 million mt of pollock was being caught by these two countries in the eastern Bering Sea annually. Korean vessels began to target pollock in 1968. Polish vessels fished briefly in the Bering Sea in 1973. Taiwanese vessels entered the fishery in 1977. For more information on foreign fisheries in the BSAI, refer to NPFMC (1995), Megrey and Wespestad (1990), and Fredin (1987).

The foreign fleets were phased out in the 1980s. The transition period from foreign to fully domestic groundfish fisheries was stimulated by a quick increase in joint-venture operations. The American Fisheries Promotion Act (the so-called "fish and chips" policy) required that allocations of fish quotas to foreign nations be based on the nation's contributions to the development of the U.S. fishing industry. This provided incentive for development of joint-venture operations, with U.S. catcher vessels delivering their catches directly to foreign processing vessels. Joint-venture operations peaked in 1987, giving way to a rapidly developing domestic fleet. By 1991, the entire BSAI groundfish harvest (1,765,397 mt, worth

$351 million ex-vessel) was taken by only 391 U.S. vessels. Groundfish harvest has been entirely domestic since that time.

Catch History

Catch statistics since 1954 are shown for the eastern Bering Sea subarea in Table 4-10. The initial target species was yellowfin sole. During the early period of these fisheries, total catches of groundfish reached a peak of 674,000 mt in 1961. Following a decline in abundance of yellowfin sole, other species (principally walleye pollock) were targeted upon, and total catches rose to 2.2 million mt in 1972. Catches have since varied from 1 to 2 million mt as catch restrictions and other management measures were placed on the fishery.

Catches in the Aleutian Islands subarea have always been much smaller than those in the eastern Bering Sea. Target species have also been different (Table 4-11): in the Aleutians, POP was the initial target species. During the early years of exploitation, overall catches of Aleutian groundfish reached a peak of 112,000 mt in 1965. As POP abundance declined, the fishery diversified to other species. Total catches from the Aleutians in recent years have been about 100,000 mt annually.

Table 4-10a Groundfish and squid catches in the eastern Bering Sea, 1954-2004 (pollock, Pacific cod, sablefish, flatfish), in metric tons.

Year	Pollock	Pacific Cod	Sablefish	Yellowfin Sole	Greenland Turbot	Arrowtooth flounder	Rock sole[a]	"Other Flatfish"[a]
1954				12,562				
1955				14,690				
1956				24,697				
1957				24,145				
1958	6,924	171	6	44,153				
1959	32,793	2,864	289	185,321				
1960			1,861	456,103	36,843	b		
1961			15,627	553,742	57,348	b		
1962			25,989	420,703	58,226	b		
1963			13,706	85,810	31,565	b		35,643
1964	174,792	13,408	3,545	111,177	33,729	b		30,604
1965	230,551	14,719	4,838	53,810	9,747	b		11,686
1966	261,678	18,200	9,505	102,353	13,042	b		24,864
1967	550,362	32,064	11,698	162,228	23,869	b		32,109
1968	702,181	57,902	4,374	84,189	35,232	b		29,647
1969	862,789	50,351	16,009	167,134	36,029	b		34,749
1970	1,256,565	70,094	11,737	133,079	19,691	12,598		64,690
1971	1,743,763	43,054	15,106	160,399	40,464	18,792		92,452
1972	1,874,534	42,905	12,758	47,856	64,510	13,123		76,813
1973	1,758,919	53,386	5,957	78,240	55,280	9,217		43,919
1974	1,588,390	62,462	4,258	42,235	69,654	21,473		37,357
1975	1,356,736	51,551	2,766	64,690	64,819	20,832		20,393
1976	1,177,822	50,481	2,923	56,221	60,523	17,806		21,746
1977	978,370	33,335	2,718	58,373	27,708	9,454		14,393
1978	979,431	42,543	1,192	138,433	37,423	8,358		21,040
1979	913,881	33,761	1,376	99,017	34,998	7,921		19,724
1980	958,279	45,861	2,206	87,391	48,856	13,761		20,406
1981	973,505	51,996	2,604	97,301	52,921	13,473		23,428
1982	955,964	55,040	3,184	95,712	45,805	9,103		23,809
1983	982,363	83,212	2,695	108,385	43,443	10,216		30,454
1984	1,098,783	110,944	2,329	159,526	21,317	7,980		44,286
1985	1,179,759	132,736	2,348	227,107	14,698	7,288		71,179
1986	1,188,449	130,555	3,518	208,597	7,710	6,761		76,328
1987	1,237,597	144,539	4,178	181,429	6,533	4,380		50,372
1988	1,228,000	192,726	3,193	223,156	6,064	5,477		137,418
1989	1,230,000	164,800	1,252	153,165	4,061	3,024		63,452
1990	1,353,000	162,927	2,329	80,584	7,267	2,773		22,568
1991	1,268,360	165,444	1,128	94,755	3,704	12,748	46,681	30,401
1992	1,384,376	163,240	558	146,942	1,875	11,080	51,720	34,757
1993	1,301,574	133,156	669	105,809	6,330	7,950	63,942	28,812
1994	1,362,694	174,151	699	144,544	7,211	13,043	60,276	29,720
1995	1,264,578	228,496	929	124,746	5,855	8,282	54,672	34,861
1996	1,189,296	209,201	629	129,509	4,699	13,280	46,775	35,390
1997	1,115,268	209,475	547	166,681	6,589	8,580	67,249	42,374
1998	1,101,428	160,681	586	101,310	8,303	14,985	33,221	39,940
1999	889,589	134,647	646	67,307	5,205	9,827	39,934	33,042
2000	1,132,736	151,372	742	84,057	5,888	12,071	49,186	36,813
2001	1,387,452	142,452	863	63,563	4,252	12,836	28,949	27,693
2002	1,481,815	166,552	1,143	74,956	3,150	10,821	40,700	30,229
2003	1,341,352	162,827	898	74,781	2,467	12,022	35,192	26,343
2004	1,331,508	167,155	840	69,012	1,772	16,968	46,934	29,241

[a]Includes flathead sole, Alaska plaice, and "other flatfish"; also, rock sole prior to 1991 is included in catch statistics.
[b]Arrowtooth flounder is included in Greenland turbot catch statistics.
Note: Numbers do not include fish taken for research.

Table 4-10b Groundfish and squid catches in the eastern Bering Sea, 1954-2004
(rockfish, Atka mackerel, "other species", total of all species), in metric tons.

Year	Pacific ocean perch complex[a]	"Other rockfish"	Atka mackerel	Squid	"Other species"	Total (all species)
1954						12,562
1955						14,690
1956						24,697
1957						24,145
1958					147	51,401
1959					380	221,647
1960	6,100					500,907
1961	47,000					673,717
1962	19,900					524,818
1963	24,500					191,224
1964	25,900				736	393,891
1965	16,800				2,218	344,369
1966	20,200				2,239	452,081
1967	19,600				4,378	836,308
1968	31,500				22,058	967,083
1969	14,500				10,459	1,192,020
1970	9,900				15,295	1,593,649
1971	9,800				13,496	2,137,326
1972	5,700				10,893	2,149,092
1973	3,700				55,826	2,064,444
1974	14,000				60,263	1,900,092
1975	8,600				54,845	1,645,232
1976	14,900				26,143	1,428,565
1977	2,654	311		4,926	35,902	1,168,144
1978	2,221	2,614	831	6,886	61,537	1,302,509
1979	1,723	2,108	1,985	4,286	38,767	1,159,547
1980	1,097	459	4,955	4,040	34,633	1,221,944
1981	1,222	356	3,027	4,182	35,651	1,259,666
1982	224	276	328	3,838	18,200	1,211,483
1983	221	220	141	3,470	15,465	1,280,285
1984	1,569	176	57	2,824	8,508	1,458,299
1985	784	92	4	1,611	11,503	1,649,109
1986	560	102	12	848	10,471	1,633,911
1987	930	474	12	108	8,569	1,639,121
1988	1,047	341	428	414	12,206	1,810,470
1989	2,017	192	3,126	300	4,993	1,630,382
1990	5,639	384	480	460	5,698	1,644,109
1991	4,744	396	2,265	544	16,285	1,647,455
1992	3,309	675	2,610	819	29,993	1,831,954
1993	3,763	190	201	597	21,413	1,674,406
1994	1,907	261	190	502	23,430	1,818,628
1995	1,210	629	340	364	20,928	1,745,890
1996	2,635	364	780	1,080	19,717	1,653,355
1997	1,060	161	171	1,438	20,997	1,640,590
1998	1,134	203	901	891	23,156	1,486,739
1999	609	135	2,008	393	17,045	1,200,387
2000	704	239	239	375	23,098	1,497,520
2001	1,148	296	264	1,761	23,148	1,694,678
2002	858	401	572	1,334	26,639	1,839,169
2003	1,321	324	5,361	801	24,288	1,687,978
2004	966	311	7,053	1,004	24,307	1,697,702

[a]Includes Pacific ocean perch, and shortraker, rougheye, northern, and sharpchin rockfish.
Note: Numbers do not include fish taken for research.

Table 4-11a Groundfish and squid catches in the Aleutian Islands subarea, 1962-2004 (pollock, Pacific cod, sablefish, flatfish), in metric tons.

Year	Pollock	Pacific cod	Sablefish	Yellowfin sole	Greenland turbot	Arrowtooth flounder	Rock sole	"Other flatfish"[a]
1962								
1963			664		7	b		
1964		241	1,541		504	b		
1965		451	1,249		300	b		
1966		154	1,341		63	b		
1967		293	1,652		394	b		
1968		289	1,673		213	b		
1969		220	1,673		228	b		
1970		283	1,248		285	274		
1971		2,078	2,936		1,750	581		
1972		435	3,531		12,874	1,323		
1973		977	2,902		8,666	3,705		
1974		1,379	2,477		8,788	3,195		
1975		2,838	1,747		2,970	784		
1976		4,190	1,659		2,067	1,370		
1977	7,625	3,262	1,897		2,453	2,035		
1978	6,282	3,295	821		4,766	1,782		
1979	9,504	5,593	782		6,411	6,436		
1980	58,156	5,788	274		3,697	4,603		
1981	55,516	10,462	533		4,400	3,640		
1982	57,978	1,526	955		6,317	2,415		
1983	59,026	9,955	673		4,115	3,753		
1984	81,834	22,216	999		1,803	1,472		
1985	58,730	12,690	1,448		33	87		
1986	46,641	10,332	3,028		2,154	142		
1987	28,720	13,207	3,834		3,066	159		
1988	43,000	5,165	3,415		1,044	406		
1989	156,000	4,118	3,248		4,761	198		
1990	73,000	8,081	2,116		2,353	1,459		
1991	78,104	6,714	2,071	1,380	3,174	938	n/a	88
1992	54,036	42,889	1,546	4	895	900	236	68
1993	57,184	34,234	2,078	0	2,138	1,348	318	59
1994	58,708	22,421	1,771	0	3,168	1,334	308	55
1995	64,925	16,534	1,119	6	2,338	1,001	356	47
1996	28,933	31,389	720	654	1,677	1,330	371	61
1997	26,872	25,166	779	234	1,077	1,071	271	39
1998	23,821	34,964	595	5	821	694	446	54
1999	965	27,714	565	13	422	746	577	53
2000	1,244	39,684	1,048	13	1,086	1,157	480	113
2001	824	34,207	1,074	15	1,060	1,220	526	97
2002	1,177	30,801	1,118	29	485	1,032	1,165	150
2003	1,653	32,190	1,009	<1	965	913	964	76
2004	1,150	28,579	924	9	381	779	800	69

[a]Includes flathead sole, Alaska plaice, and "other flatfish".
[b]Arrowtooth flounder included in Greenland turbot catch statistics.
Note: Numbers do not include fish taken for research.

Table 4-11b Groundfish and squid catches in the Aleutian Islands subarea, 1962-2004 (pollock, Pacific cod, sablefish, flatfish), in metric tons.

Year	Pacific ocean perch complex[a]	"Other rockfish"	Atka mackerel	Squid	"Other species"	Total (all species)
1962	200					200
1963	20,800					21,471
1964	90,300				66	92,652
1965	109,100				768	111,868
1966	85,900				131	87,589
1967	55,900				8,542	66,781
1968	44,900				8,948	56,023
1969	38,800				3,088	44,009
1970	66,900		949		10,671	80,610
1971	21,800				2,973	32,118
1972	33,200		5,907		22,447	79,717
1973	11,800		1,712		4,244	34,006
1974	22,400		1,377		9,724	49,340
1975	16,600		13,326		8,288	46,553
1976	14,000		13,126		7,053	43,465
1977	8,080	3,043	20,975	1,808	16,170	67,348
1978	5,286	921	23,418	2,085	12,436	61,092
1979	5,487	4,517	21,279	2,252	12,934	75,195
1980	4,700	420	15,533	2,332	13,028	108,531
1981	3,622	328	16,661	1,763	7,274	104,199
1982	1,014	2,114	19,546	1,201	5,167	98,233
1983	280	1,045	11,585	510	3,675	94,617
1984	631	56	35,998	343	1,670	147,022
1985	308	99	37,856	9	2,050	113,310
1986	286	169	31,978	20	1,509	96,259
1987	1,004	147	30,049	23	1,155	81,364
1988	1,979	278	21,656	3	437	77,383
1989	2,706	481	14,868	6	108	186,494
1990	14,650	864	21,725	11	627	124,886
1991	2,545	549	22,258	30	91	117,942
1992	10,277	3,689	46,831	61	3,081	164,513
1993	13,375	495	65,805	85	2,540	179,659
1994	16,959	301	69,401	86	1,102	175,614
1995	14,734	220	81,214	95	1,273	183,862
1996	20,443	278	103,087	87	1,720	190,750
1997	15,687	307	65,668	323	1,555	139,049
1998	13,729	385	56,195	25	2,448	134,182
1999	17,619	630	51,636	9	1,633	102,582
2000	14,893	601	46,990	8	3,010	110,327
2001	15,588	610	61,296	5	4,029	120,551
2002	14,996	551	44,722	10	1,980	98,215
2003	17,574	401	48,918	34	1,345	106,042
2004	14,937	318	48,910	14	1,781	98,650

[a]Includes Pacific ocean perch, and shortraker, rougheye, northern and sharpchin rockfish.
Note: Numbers do not include fish taken for research.

4.3.2 Commercial Fishery

This section contains a general discussion of the commercial groundfish fisheries in the BSAI, including catch data for recent years. The information in this section comes from the annually updated *Stock Assessment and Fishery Evaluation* (SAFE) report (NPFMC 2003), in particular the *Economic Status of the Groundfish Fisheries off Alaska* appendix (Hiatt et al. 2003). This document is available on the Council website, or by request from the Council office. Additionally, catch data are also reported on the NMFS Alaska region website. Website addresses for the Council and NMFS are included in Chapter 6.

In 2002, 343 vessels participated in the groundfish fisheries in the BSAI. Of these, 163 were trawl vessels, 120 hook-and-line vessels, and 64 pot vessels. Total groundfish catch was 1.94 million mt, which represents approximately 92 percent of the total groundfish catch off Alaska. Total ex-vessel value of the

BSAI groundfish catch in 2002 was $428.8 million. Pollock accounts for the largest majority of the harvest in terms of both metric tons and ex-vessel value. The groundfish fisheries off Alaska accounted for 49 percent of the weight and 18 percent of the ex-vessel value of total U.S. domestic landings, as reported in Fisheries of the United States (2002).

Walleye (Alaska) pollock (*Theragra chalcogramma*) has been the dominant species in the BSAI commercial groundfish catch. The 2002, pollock catch of 1.48 million mt accounted for 77 percent of the total BSAI groundfish catch. The next major species, Pacific cod (*Gadus macrocephalus*), accounted for 196,700 mt or about 10 percent of the total 2002 catch. The 2002 catch of flatfish, which includes yellowfin sole (*Pleuronectes asper*), rock sole (*Pleuronectes bilineatus*), and arrowtooth flounder (*Atheresthes stomias*), was 162,400 mt. Pollock, Pacific cod, and flatfish comprised 95 percent of the total 2002 BSAI groundfish catch. Other important species are sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes and Sebastolobus* species), and Atka mackerel (*Pleurogrammus monopterygius*).

Trawl, hook-and-line (including longline and jigs), and pot gear account for virtually all the catch in the BSAI groundfish fisheries. There are catcher vessels and catcher processor vessels for each of these three gear groups. From 1998-2002, the trawl catch averaged about 91 percent of the total catch, while catch with hook-and-line gear accounted for 7.6 percent. During the same period, catcher vessels took 42 percent of the catch and catcher/processor vessels took the other 58 percent. Most species are harvested predominately by one type of gear, which typically accounts for 90 percent or more of the catch. The one exception is Pacific cod, where in 2002, 51 percent (103,000 mt) was taken by hook-and-line gear, 39 percent (79,000 mt) by trawl gear, and 10 percent (20,000 mt) by pots. The FMP allocates total allowable catch among gear types for pollock, sablefish, Pacific cod, Atka mackerel, and shortraker and rougheye rockfish (Section 3.6.2).

The discards of groundfish in the groundfish fishery have received increased attention in recent years by NMFS, the Council, Congress, and the public at large. The discard rate is the percent of total catch that is discarded. For the BSAI groundfish fisheries as a whole, the annual discard rate for groundfish decreased from 14.7 percent in 1994 (total discards, 286,200 mt) to 6.1 percent in 2002 (total discards, 118,900 mt) with the vast majority of the reduction occurring in 1998. The 41 percent reduction in the BSAI discard rate from 1997 to 1998 was the result of prohibiting pollock and Pacific cod discards in the BSAI groundfish fisheries beginning in 1998. Since 1998, the discard rate has been reduced from 8.1 percent to 6.1 percent.

The bycatch of Pacific halibut, crab, Pacific salmon, and Pacific herring has been an important management issue in the commercial fishery for more than twenty years. The retention of these species was first prohibited in the foreign groundfish fisheries, to ensure that groundfish fishers had no incentive to target on these species. Estimates of bycatch of these prohibited species are assessed annually in the *Stock Assessment and Fishery Evaluation* report. The FMP establishes catch limits for prohibited species that apply to some or all fisheries, seasons, or areas in the BSAI (Section 3.6.2). Attainment of the catch limit shuts down an area or a fishery for the remainder of the year or season. Other management measures that address prohibited species bycatch include seasonal closure areas, gear modifications, and the modification of fishing patterns as a result of share-based programs such as IFQs or cooperatives. The history of prohibited species bycatch management is reviewed in Witherell and Pautzke (1997).

An extensive at-sea observer program was developed for the foreign fleets and then extended to the domestic fishery once it had all but replaced foreign participation. The observer program resulted in fundamental changes in the nature of the bycatch program. First, by providing good estimates of total groundfish catch and non-groundfish bycatch by species, it eliminated much of the concern that total fishing mortality was being underestimated due to fish that were discarded at sea. Second, it made it possible to establish, monitor, and enforce the groundfish quotas in terms of total catch as opposed to only retained catch. For groundfish fisheries, this means that both retained catch and discarded catch are counted against TACs. Third, it made it possible to implement and enforce bycatch quotas for the non-groundfish species that by regulation had to be discarded at sea. Finally, it provided extensive information that managers and the industry could use to assess methods to reduce bycatch and bycatch mortality. In summary, the observer program provided fishery managers with the information and tools necessary to prevent bycatch from adversely affecting the stocks of the bycatch species. Therefore, bycatch in the groundfish fisheries is principally not a conservation problem, although it can be an allocation problem.

4.3.3 Subsistence Fishery

The earliest fisheries for groundfish in the BSAI were the native subsistence fisheries. Fish and other marine resources are an important part of the life of native people, and dependence on demersal species of fish may have been critical to their survival in periods of the year when other sources of food were scarce or lacking. 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. Although not well estimated, the total catch of groundfish in subsistence fisheries is thought to be minuscule relative to commercial fishery catches.

4.3.4 Recreational Fishery

At this time, there are essentially no recreational fisheries for groundfish species covered under this FMP. Recreational catch of groundfish in the BSAI would take place in state waters and likely fall under the classification of subsistence or personal use fisheries as regulated by Alaska state law.

4.4 Economic and Socioeconomic Characteristics of the Fishery

This section contains a general discussion of the economic and socioeconomic characteristics of the commercial groundfish fisheries in the BSAI. The information cited in this section is from the annually updated *Economic Status of the Groundfish Fisheries off Alaska* appendix to the SAFE (Hiatt et al. 2003). This document is available on the Council website, or by request from the Council office. The website address for the Council is included in Chapter 6.

Estimates of ex-vessel value by area, gear, type of vessel, and species, are included in the annual Economic Status appendix to the SAFE report. The ex-vessel value of the landings in the BSAI groundfish fisheries, excluding the value added by at-sea processing, increased from $280.1 million in 1998 to $428.8 million in 2002. The distribution of ex-vessel value by type of vessels differed by area, gear, and species. In 2002, trawl gear accounted for 86 percent of the ex-vessel value of the groundfish landings compared to 92 percent of the total catch because trawl vessels take larger percentages of lower priced species such as pollock, which was $0.12 per pound in 2002. Catcher vessels accounted for 48 percent of the total ex-vessel value compared to 45 percent of the catch.

Residents of Alaska and of other states, particularly Washington and Oregon, are active participants in the BSAI groundfish fisheries. For the BSAI groundfish fisheries as a whole, 97.6 percent of the 2002 catch was made by vessels with owners who indicated that they were not residents of Alaska, accounting for 96 percent of the 2002 ex-vessel value.

Employment data for at-sea processors (but not including inshore processors) indicate that in 2002, the crew weeks totaled 97,440. The months with the highest employment occurred in February (16,501), March (16,513), and September (15,569). Much of this was accounted for by the BSAI pollock fishery.

There are a variety of at least partially external factors that affect the economic performance of the BSAI groundfish fisheries. They include landing market prices in Japan, wholesale prices in Japan, U.S. imports of groundfish products, U.S. per capita consumption of seafood, U.S. consumer and producer price indexes, foreign exchange rates, and U.S. cold storage holdings of groundfish. Exchange rates and world supplies of fishery products play a major role in international trade. Exchange rates change rapidly and can significantly affect the economic status of the groundfish fisheries.

4.5 Fishing Communities

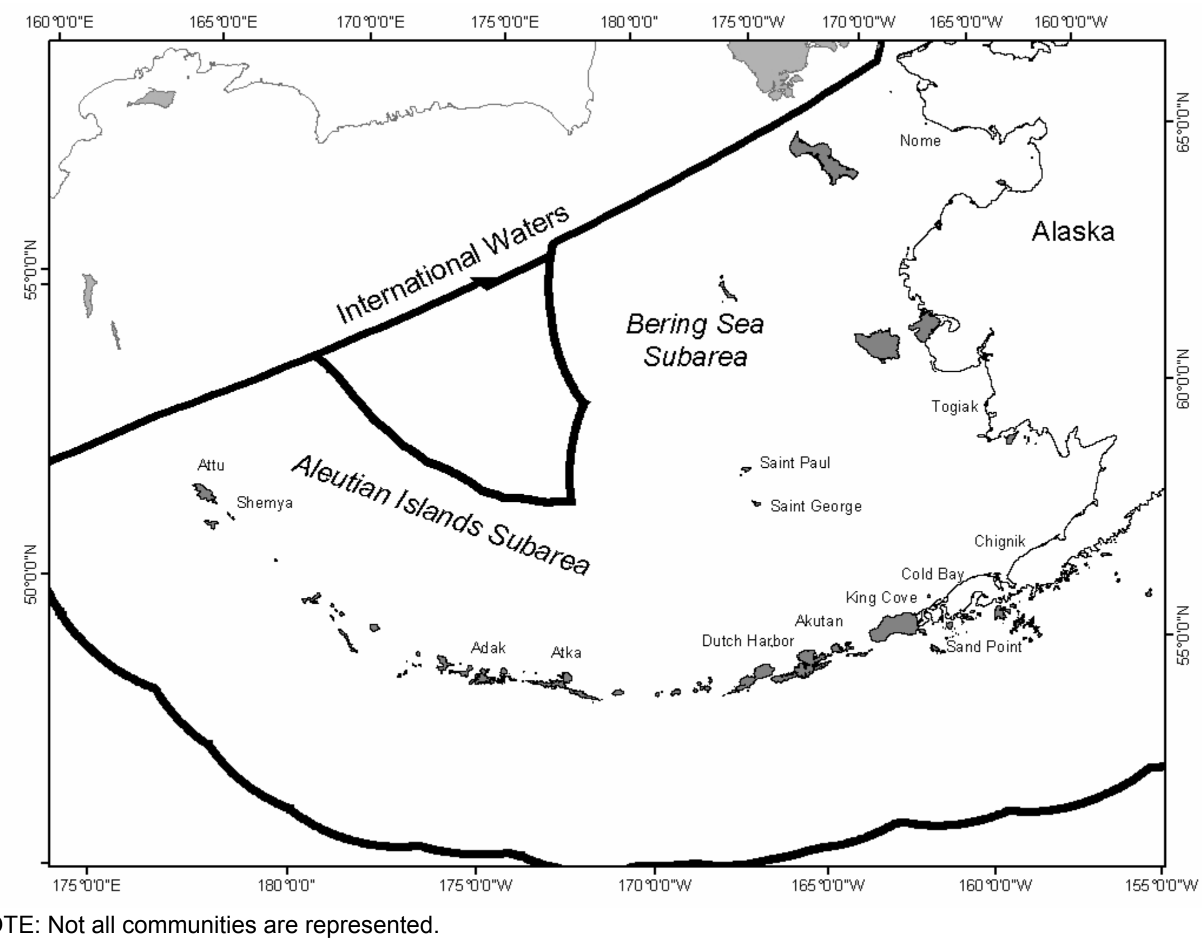
This section contains a general discussion of the fishing communities that depend on the commercial groundfish fisheries in the BSAI. The information in this section is drawn from the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries* (NMFS 2004). This document is available on the NMFS Alaska Region website, or by request from the NMFS Alaska Region office. Another source of information on BSAI fishing communities is *Faces of the Fisheries*, a publication of community profiles by the Council (NPFMC 1994).

Traditionally, the dependence of BSAI coastal communities on the groundfish fisheries and fisheries affected by the groundfish fisheries has resulted from these communities being one or more of the following: 1) the home ports of vessels that participate in these fisheries; 2) the residence of participants in the harvesting or processing sectors of these fisheries; 3) the port of landings for these fisheries; 4) the location of processing plants; and 5) a service or transportation center for the fisheries. BSAI coastal communities are shown in Figure 4-17.

Many of the participants in the BSAI groundfish fisheries are not from the communities adjacent to the management area. In the BSAI, adjacent communities are small and remote. Even in the case of Unalaska and Akutan, the two BSAI communities with large groundfish processing plants, a large part of the processing plant labor force is accounted for by individuals who are neither local nor Alaska residents.

The fishery dependence of coastal and western Alaska communities was addressed through the creation of the pollock, sablefish, and halibut community development quota (CDQ) programs for the BSAI in the early to mid-1990s and the expansion of those programs into the multispecies CDQ program with the addition of all other groundfish species by 1999. The CDQ program has provided the following for the CDQ communities: 1) additional employment in the harvesting and processing sectors of the groundfish fisheries; 2) training; and 3) income generated by fishing the CDQ allocations. In many cases, CDQ royalties have been used to increase the ability of the residents of the CDQ communities to participate in the regional commercial fisheries, or the CDQ has been fished by residents themselves. The CDQ program is discussed further in Section 4.5.4.

Figure 4-17 Bering Sea fishing communities



NOTE: Not all communities are represented.

4.5.1 Home Ports

Almost 100 Alaskan communities are listed as home ports. For the vast majority of the Alaska home ports, trawl vessels account for none or a very small part of the vessels and the mean length is less than 50 feet. Many of the Alaska home ports had fewer than 5 vessels. The Alaska home ports with typically more than 50 fishing vessels are as follows: Homer (100+), Juneau (200+), Kodiak (100+), Petersburg (50+), and Sitka (100+). For these five home ports, all but Kodiak had non-trawl vessels account for at least 90 percent of the vessels, and in Petersburg and Sitka almost 100 percent were non-trawl vessels. Sand Point, which typically had more than 30 vessels, was unique among Alaska home ports in that typically trawl vessels accounted for more than 50 percent of its vessels.

Vessels that participated in the BSAI and GOA groundfish fisheries had home ports in nine states other than Alaska. However, only three states had home ports for more than 2 vessels. They were: California with fewer than 20 vessels, Oregon with 42 to 75 vessels, and Washington with 310 to 423 vessels. Almost all of the non-Alaska home ports had fewer than 10 vessels and many had only a few. Seattle, with typically about 300 vessels, was the only non-Alaska port with more than 50 vessels.

4.5.2 Owner Residence

Less than 3 percent of the BSAI groundfish catch in 2002 was taken by vessels with owners who indicated that they were residents of Alaska (Hiatt et al. 2003). Residents of other states, particularly Washington and Oregon, are active participants in the BSAI groundfish fisheries.

4.5.3 Ports

When the fishing ports are ranked, from highest to lowest, on the basis of their 1997 groundfish landings and value, the first five ports account for in excess of 95 percent of the total Alaska (BSAI and GOA) groundfish landings. Table 4-12 shows the top five ports in rank order.

Table 4-12 Top Five Fishing Ports for total Alaska (BSAI and GOA) groundfish landings

Port & Ranking	Metric Tons*	Value	Number of Processors
1. Dutch Harbor/Unalaska	224,000	$59,774,500	6
2. Akutan	<120,000	NA	1
3. Kodiak	84,000	$33,488,800	9
4. Sand Point	<45,000	NA	1
5. King Cove	<25,000	NA	1

* estimated total groundfish landings

NA - data cannot be reported due to confidentiality constraints

The remaining 5 percent or so of total groundfish landings made to Alaska fishing ports is distributed over more than twenty different locations. Very few common characteristics are shared by all these remaining ports. Like virtually every settlement in Alaska (with the exception of Anchorage), these landing ports are all relatively small communities, varying from year-round resident populations of a few hundred people (St. Paul - population 739) to several thousands. The balance of this section will focus on the five primary groundfish ports. Dutch Harbor/Unalaska and Akutan are located on the Bering Sea side of the Alaska Peninsula/Aleutian Island chain, while Sand Point and King Cove are on the Gulf of Alaska side and Kodiak Island, where the port and City of Kodiak are located, is in the Gulf. Nonetheless, a substantial portion of the groundfish processed in Sand Point and King Cove is harvested in the Bering Sea, as is a somewhat lesser share of that landed in Kodiak. Historically, relatively small amounts of groundfish harvested in the GOA have been delivered for processing in Dutch Harbor/Unalaska and Akutan.

4.5.3.1 Dutch Harbor/Unalaska

Dutch Harbor/Unalaska is located approximately 800 miles southwest of Anchorage and 1,700 miles northwest of Seattle. Unalaska is the 11th largest city in Alaska, with a reported year-round population of 4,283 in 2000. The name Dutch Harbor is often applied to the portion of the City of Unalaska located on

Amaknak Island, which is connected to Unalaska Island by a bridge. Dutch Harbor is fully contained within the boundaries of the City of Unalaska, which encompasses 115.8 square miles of land and 98.6 square miles of water (Alaska Department of Community and Regional Affairs 1998).

Unalaska is primarily non-Native, although the community is culturally diverse. Subsistence activities remain important to the Aleut community and many long-time non-Native residents, as well. Salmon, Pacific cod, Dolly Varden, Pacific halibut, sea bass, pollock, and flounders are the most important marine species, according to Alaska Department of Fish and Game reports. Sea urchins, razor and butter clams, cockles, mussels, limpets, chiton, crabs, and shrimps make up the shellfish and invertebrates most commonly harvested by subsistence users. Marine mammals traditionally harvested include sea lions, harbor and fur seals, and porpoises. Local residents also harvested reindeer, ducks, geese, sea gull eggs and other bird eggs in great numbers in previous years (NPFMC 1994).

Dutch Harbor/Unalaska has been called the most prosperous stretch of coastline in Alaska. With 27 miles of ports and harbors, several hundred local businesses, most servicing, supporting, or relying on the seafood industry, this city is the center of the Bering Sea fisheries. Dutch Harbor is not only the top ranked fishing port in terms of landings in Alaska, but has held that distinction for the Nation, as a whole, each year since 1989. In addition, it ranked at or near the top in terms of the ex-vessel value of landings over the same period.

Virtually the entire local economic base in Dutch/Unalaska is fishery-related, including fishing, processing, and fishery support functions (e.g., fuel, supply, repairs and maintenance, transshipment, cold storage, etc.). Indeed, Dutch Harbor/Unalaska is unique among Alaska coastal communities in the degree to which it provides basic support services for a wide range of Bering Sea fisheries (Impact Assessment Incorporated 1998). It has been reported that over 90 percent of the population of this community considers itself directly dependent upon the fishing industry, in one form or another (NPFMC 1994).

Historically, Dutch Harbor/Unalaska was principally dependent upon non-groundfish (primarily king and Tanner crab) landings and processing for the bulk of its economic activity. These non-groundfish species continue to be important components of a diverse processing complex in Dutch Harbor/Unalaska. In 1997, for example, nearly 2 million pounds of salmon, more than 1.7 million pounds of herring, and 34 million pounds of crabs were reportedly processed in this port.

Nonetheless, since the mid-1980s, groundfish has accounted for the vast majority of total landings in Dutch Harbor/Unalaska. Again, utilizing 1997 catch data, over 93.5 percent of total pounds landed and processed in this port were groundfish.

While well over 90 percent of this total tonnage was groundfish, a significantly smaller percentage of the attributable ex-vessel value of the catch is comprised of groundfish. While equivalent processed product values for non-groundfish production are not readily available, Alaska fish ticket data indicate that the ex-vessel value of these species landed in Dutch Harbor/Unalaska was nearly $43 million, in 1997; or about 60 percent of the reported gross product value of the groundfish output. If the value added through processing of these non-groundfish species were fully accounted for, the total would obviously exceed the ex-vessel value of the raw catch.

As suggested, transshipping is an integral component of the local service-based economy of this community, as well. The port serves as a hub for movement of cargo throughout the Pacific Rim. Indeed, the Great Circle shipping route from major U.S. west coast ports to the Pacific Rim passes within 50 miles of Unalaska. The Port of Dutch Harbor is among the busiest ports on the west coast. The port reportedly serves more than 50 domestic and foreign transport ships per month. Seafood products, with an estimated first wholesale value substantially in excess of a billion dollars, cross the port’s docks each year and are carried to markets throughout the world.

The facilities and related infrastructure in Dutch Harbor/Unalaska support fishing operations in both the BSAI and GOA management areas. Processors in this port receive and process fish caught in both areas, and the wider community is linked to, and substantially dependent upon serving both the on-shore and at-sea sectors of the groundfish industry.

In a profile of regional fishing communities, published by the Council in 1994, the local economy of Unalaska was characterized in the following way:

> If it weren't for the seafood industry, Unalaska would not be what it is today ... In 1991, local processors handled 600 million lbs. of seafood onshore, and 3 billion lbs. of seafood were processed offshore aboard floating processors that use Dutch Harbor as a land base. Seven shore-based and many floating processors operate within municipal boundaries.

While these figures presumably include both groundfish and non-groundfish species, and current sources identify at least eight shore-based processing facilities, they are indicative of the scope of this community's involvement in, and dependence upon, seafood harvesting and processing.

Detailed data on costs, net earnings, capital investment and debt service for the harvesting, processing, and fisheries support sectors in Dutch Harbor/Unalaska are not available.

While Dutch Harbor has been characterized as one of the world's best natural harbors, it offers few alternative opportunities for economic activity beyond fisheries and fisheries support. Its remote location, limited and specialized infrastructure and transportation facilities, and high cost make attracting non-fishery related industrial and/or commercial investment doubtful (at least in the short-run). Sea floor minerals exploration, including oil drilling, in the region have been discussed. No such development seems likely in the short run, however. Unalaska reportedly also expected nearly 6,000 cruise ship visitors in 1996.

Without the present level of fishing and processing activities, it is probable that many of the current private sector jobs in this groundfish landings port could be lost, or at the very least, would revert to highly seasonal patterns, with the accompanying implications for community stability observed historically in this and other Alaska seafood processing locations dependent upon transient, seasonal work forces. It is likely, for example, that the number of permanent, year-round residents of Dutch Harbor/Unalaska would decline significantly. This would, in turn, alter the composition and character of the community and place new, and different, demands on local government.

The municipal government of the City of Unalaska is substantially dependent upon the tax revenues which are generated from fishing and support activities. Between the State of Alaska's Fisheries Business Tax and Fishery Resource Landings Tax revenues (both of which are shared on a 50/50 basis with the community of origin), local raw fish sales tax, real property tax (on fishery related property), and permits and fees revenues associated with fishing enterprises, the City of Unalaska derives a substantial portion of its operating, maintenance, and capital improvement budget from fishing, and especially groundfish fishing, related business activities.

The local private business infrastructure which has developed to support the needs and demands of the fishery-based population of Dutch Harbor/Unalaska would very clearly suffer severe economic dislocation, should the number of employees in the local plants and fishing fleets decline in response to substantial TAC reductions. While insufficient cost and investment data exist with which to estimate the magnitude of probable net losses to these private sector businesses, it seems certain that a substantial number would fail. With no apparent economic development alternative available to replace groundfish harvesting and processing in Dutch Harbor/Unalaska (at least in the short run), there would be virtually no market value associated with these stranded assets.

4.5.3.2 Akutan

Akutan is located on Akutan Island in the eastern Aleutian Islands, one of the Krenitzin Islands of the Fox Island group. The community is approximately 35 miles east of Unalaska and 766 air miles southwest of Anchorage. Akutan is surrounded by steep, rugged mountains reaching over 2,000 feet in height. The village sits on a narrow bench of flat, treeless terrain. The small harbor is ice-free year-round, but frequent storms occur in winter and fog in summer. The community is reported to have a population of 414 persons, although the population can swell to well over 1,000 during peak fish processing months.

During the 1990 U.S. Census, 34 total housing units existed and 3 were vacant. 527 jobs were estimated to be in the community. The official unemployment rate at that time was .4 percent, with 7.4 percent of all adults not in the work force. The median household income was $27,813, and 16.6 percent of the residents were living below the poverty level.

As a CDQ community, the community of Akutan enjoys access to the BSAI groundfish resource independently of direct participation in the fishery. The CDQ communities as a group receive allocations of groundfish, halibut, and prohibited species under Section 3.7.4 of this FMP and allocations of crab under the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs. Similarly, the economic benefits the community derives from the local 1 percent raw fish tax from landings at the nearby plant are dependent on BSAI groundfish TACs and the resulting ex-vessel value of groundfish landings.

Indeed, while the village of Akutan was initially judged to be ineligible to participate in the State of Alaska's CDQ program, based largely upon its being associated with "...a previously developed harvesting and processing capability sufficient to support substantial groundfish participation in the BSAI...", it was subsequently determined that the community of Akutan was discrete and distinct from the Akutan groundfish processing complex.

As a result, Akutan has a very different relationship to the region's groundfish fisheries than does, for example, Dutch Harbor/Unalaska or Kodiak. While the community of Akutan derives economic benefits from its proximity to the large Trident Seafoods shore plant (and a smaller permanently moored processing vessel, operated by Deep Sea Fisheries, which does only crab), the entities have not been integrated in the way other landings ports and communities on the list have.

As a CDQ community, the community of Akutan enjoys access to the BSAI groundfish resource independently of direct participation in the fishery. The CDQ communities as a group will receive CDQs equal to 7.5 percent of each BSAI groundfish TAC, except for the fixed gear sablefish, pollock, and squid TACs. The CDQ communities will receive 20 percent of the fixed gear sablefish and 10 percent of the pollock TACs for the eastern Bering Sea and the Aleutian Islands subareas. Similarly, the economic benefits the community derives from the local 1 percent raw fish tax from landings at the nearby plant are dependent on BSAI groundfish TACs and the resulting ex-vessel value of groundfish landings.

Although this conclusion pertains to the community of Akutan, implications for the groundfish landings port of Akutan are quite different. The Trident plant is the principal facility in the Akutan port and, historically, a number of smaller, mobile processing vessels have operated seasonally out of the port of Akutan. Akutan does not have a boat harbor or an airport in the community. Beyond the limited services provided by the plant, no other opportunity exists in Akutan to provide a support base for other major commercial fisheries. Indeed, alternative economic opportunities of any kind are extremely limited.

While crab processing was a major source of income for the Akutan plant during the boom years of the late 1970s and early 1980s, with the economic collapse of this resource base in the early 1980s, groundfish processing became the primary source of economic activity. In 1997, for example, State of Alaska and NMFS catch records indicate that, while landings of herring and crabs were reported for the Akutan plant, more than 98 percent of the total pounds landed were groundfish, and these made up more than 80 percent of the estimated total value.

No data on cost, net revenues, capital investment and debt structure are available with respect to Trident Seafood's Akutan plant complex. It is not possible, therefore, to quantify probable attributable net impacts to plant owners/operators of a potential reduction in groundfish catches, although as noted above, the Akutan facility is almost completely dependent upon pollock and Pacific cod deliveries. While some adjustment to alternative groundfish species might be possible, in response to a sharp decline in pollock and/or Pacific cod TACs, the fact that the plant has not become more involved with other groundfish species during the times of the year in which pollock and Pacific cod are not available suggests that the economic viability of such alternatives is limited and certainly inferior for the plant.

Whereas the 1990 U.S. Census reported the population of Akutan at just under 600 (and the Alaska Department of Community and Regional Affairs CIS data places the figure at 414, in 1997), the local resident population is estimated at 80, with the remaining individuals being regarded as non-resident employees of the plant.

The permanent residents of the village are, reportedly, almost all Aleut. While some are directly involved in the cash economy (e.g., a small boat near-shore commercial fishery), many depend upon subsistence activities or other non-cash economic activities to support themselves and their families. The species important for subsistence users reportedly include: salmon, halibut, Pacific cod, pollock, flounders, Dolly Varden, greenling, sea lions, harbor and fur seals, reindeer, ducks and geese and their eggs, as well as intertidal creatures (e.g., clams, crabs, mussels). Berries and grasses are also collected as part of the subsistence harvest (NPFMC 1994a).

4.5.3.3 Kodiak

The groundfish landings port of Kodiak is located near the eastern tip of Kodiak Island, southeast of the Alaska Peninsula, in the Gulf of Alaska. The City of Kodiak is the sixth largest city in Alaska, with a population of 6,869 (Alaska Department of Community and Regional Affairs 1998). The City of Kodiak is 252 air miles south of Anchorage. The port and community are highly integrated, both geographically and structurally. The port and community are the de facto center of fishing activity for the western and central Gulf of Alaska.

Kodiak is primarily non-Native, and the majority of the Native population are Sugpiaq Eskimos and Aleuts. Filipinos are a large subculture in Kodiak due to their work in the canneries. During the 1990 U.S. Census, 2,177 total housing units existed and 126 were vacant. An estimated 3,644 jobs were in the community. The official unemployment rate at that time was 4.4 percent, with 23 percent of the adult population not in the work force. The median household income was $46,050, and 6.2 percent of residents were living below the poverty level.

Kodiak supports at least nine processing operations which receive groundfish harvested from the GOA and, to a lesser extent, the BSAI management areas, and four more which process exclusively non-groundfish species. The port also supports several hundred commercial fishing vessels, ranging in size from small skiffs to large catcher/processors.

According to data supplied by the City:

> The Port of Kodiak is home port to 770 commercial fishing vessels. Not only is Kodiak the state's largest fishing port, it is also home to some of Alaska's largest trawl, longline, and crab vessels.

Unlike Akutan, or even Dutch Harbor/Unalaska, Kodiak has a more generally diversified seafood processing sector. The port historically was very active in the crab fisheries and, although these fisheries have declined from their peak in the late 1970s and early 1980s, Kodiak continues to support shellfish fisheries, as well as significant harvesting and processing operations for Pacific halibut, herring, groundfish, and salmon.

Kodiak processors, like the other onshore operations profiled in this section, are highly dependent on pollock and Pacific cod landings, with these species accounting for 43 percent and 36 percent of total groundfish deliveries, by weight, respectively. The port does, however, participate in a broader range of groundfish fisheries than any of the other ports cited. Most of this activity centers on the numerous flatfish species which are present in the GOA, but also includes relatively significant rockfish and sablefish fisheries.

In fact, Kodiak often ranks near the top of the list of U.S. fishing ports, on the basis of landed value, and is frequently regarded as being involved in a wider variety of North Pacific fisheries than any other community on the North Pacific coast.

In 1997, for example, the port recorded salmon landings of just under 44 million pounds, with an estimated ex-vessel value of over $12 million. Approximately 4.3 million pounds of Pacific herring were landed in Kodiak with an ex-vessel value of more than $717 thousand. Crab landings exceeded 1.1 million pounds and were valued at ex-vessel at more than $2.7 million.

While comparable product value estimates are not currently available for groundfish and non-groundfish production (i.e., first wholesale value), it may be revealing to note that groundfish landings accounted for 79 percent of the total tons of fish and shellfish landed in this port, in 1997.

In addition to seafood harvesting and processing, the Kodiak economy includes sectors such as transportation (being regarded as the transportation hub for southwest Alaska), federal/state/local government, tourism, and timber. The forest products industry, based upon Sitka spruce, is an important and growing segment of the Kodiak economy.

The community is, also, home to the largest U.S. Coast Guard base in the Nation. Located a few miles outside of the city center-proper, it contributes significantly to the local economic base. The University of

Alaska, in conjunction with the National Marine Fisheries Service, operates a state-of-the-art fishery utilization laboratory and fishery industrial technology center in Kodiak, as well.

Kodiak appears to be a much more mature and diversified economy that those of any other of the five primary groundfish landings ports in Alaska.

The absence of detailed cost, net revenue, capital investment and debt structure data for the Kodiak groundfish fishing and processing sectors precludes a quantitative analysis of the probable net economic impacts. Nonetheless, one may draw insights from history, as when in the early-1980s king crab landings declined precipitously and Kodiak suffered a severe community-wide economic decline. It was largely the development of the groundfish fisheries which reinvigorated the local economy.

4.5.3.4 Sand Point and King Cove

These are two independent and geographically separate groundfish 'landings ports' (lying approximately 160 miles from one another), but because each has only a single processor and each community is small and remote, they are described jointly in this section.

Alaska CIS data place Sand Point's 1998 population at 808, while King Cove's population is listed as 897. Sand Point is located on Humboldt Harbor, Popof Island, 570 air miles from Anchorage. Sand Point is described by the Alaska Department of Community and Regional Affairs as "a mixed Native and non-Native community," with a large transient population of fish processing workers. During the April 1990 U.S. Census, 272 total housing units were in existence and 30 of these were vacant. A total of 438 jobs were estimated to be in the community. The official unemployment rate at that time was 2.9 percent, with 32.1 percent of all adults not in the work force. The median household income was $42,083, and 12.5 percent of the residents were living below the poverty level.

King Cove is located on the Gulf of Alaska side of the Alaska Peninsula, 625 miles southwest of Anchorage. The community is characterized as a mixed non-Native and Aleut village. In the 1990 U.S. Census, 195 total housing units were in existence, with 51 of these vacant. The community had an estimated 276 jobs, with an official unemployment rate of 1.8 percent and 24.0 percent of all adults not in the work force. The median household income was $53,631, and 10 percent of the residents were living below the poverty level.

Sand Point and King Cove, like Akutan, are part of the Aleutians East Borough. Unlike Akutan, however, neither Sand Point nor King Cove qualify as a CDQ community. Indeed, both Sand Point and King Cove have had extensive historical linkages to commercial fishing and fish processing, and currently support resident commercial fleets delivering catch to local plants. These local catches are substantially supplemented by deliveries from large, highly mobile vessels, based outside of the two small Gulf of Alaska communities.

King Cove boasts a deep water harbor which provides moorage for approximately 90 vessels of various sizes, in an ice-free port. Sand Point, with a 25 acre/144 slip boat harbor and marine travel-lift, is home port to what some have called, "the largest fishing fleet in the Aleutian Islands" (NPFMC 1994a).

For decades, the two communities have principally concentrated on their respective area's salmon fisheries. In 1997, for example, Sand Point and King Cove recorded salmon landings of several million pounds, each. State of Alaska data confidentiality requirements preclude reporting actual quantities and value when fewer than four independent operations are included in a category. Sand Point and King Cove each have one processor reporting catch and production data. In addition, King Cove had significant deliveries of Pacific herring and crabs. Recently, each community has actively sought to diversify its fishing and processing capability, with groundfish being key to these diversification plans.

According to a recent report presented to the Council (Impact Assessment Incorporated 1998):

> In terms of employment, 87 percent of Sand Point's workforce is employed full time in the commercial fishery; for King Cove this figure is more than 80 percent (United States Army Corps of Engineers 1997, and 1998). In both cases, fishing employment is followed by local government (borough and local) and then by private businesses. Seafood processing ranks after each of these other employers, meaning that the vast majority of the workforce at the shore plants are not counted as community residents.

By any measure, these two communities are fundamentally dependent upon fishing and fish processing. In recent years, groundfish resources have supplanted salmon, herring, and crabs as the primary target species-group, becoming the basis for much of each community's economic activity and stability.

Few alternatives to commercial fishing and fish processing exist, within the cash-economy, in these communities by which to make a living. However, subsistence harvesting is an important source of food, as well as a social activity, for local residents in both Sand Point and King Cove. Salmon and caribou are reportedly among the most important subsistence species, but crabs, herring, shrimps, clams, sea urchins, halibut and cod are also harvested by subsistence users. It is reported that Native populations in these communities also harvest seals and sea lions for meat and oil (Impact Assessment Incorporated 1998).

Any action that significantly diminishes the harvest of GOA and BSAI groundfish resources (especially those of pollock and Pacific cod) would be expected to adversely impact these two communities. King Cove is somewhat unique among the five key groundfish ports insofar as it is relatively more dependent upon Pacific cod than pollock, among the groundfish species landed (69 percent and 31 percent, respectively). Sand Point follows the more typical pattern with 69 percent of its groundfish landings being composed of pollock and 29 percent of Pacific cod (in 1997).

No data on cost, net revenues, capital investment and debt structure are available with respect to the Sand Point or King Cove plant complexes.

4.5.4 Community Development Quota Program Communities

The purpose of the CDQ program was to provide western Alaska fishing communities an opportunity to participate in the BSAI fisheries that had been foreclosed to them because of the high capital investment needed to enter the fishery. The program was intended to help western Alaska communities to diversify their local economies and to provide new opportunities for stable, long-term employment. The original Council guidance for implementing the CDQ Program focused on using the allocations to develop a self-sustaining fisheries economy.

Although the program was initially proposed for the fixed gear sablefish fishery, it was first implemented for BSAI pollock. The program originally set aside 7.5 percent of the annual BSAI pollock TAC for allocation to qualifying rural Alaskan communities. The Sustainable Fisheries Act, which amended the Magnuson-Stevens Act, institutionalized the program in 1996. CDQ allocations for BSAI sablefish and halibut were added in 1995, and the multispecies groundfish CDQ Program was implemented in late 1998. The program currently allocates CDQ for each groundfish species or species group with a directed fishery in the BSAI, and halibut and crab. A portion of the PSC limits for halibut, crab, and salmon also are allocated to the CDQ Program. In 1999, the American Fisheries Act increased the pollock allocation to 10 percent as a directed fishing allowance. Amendments to the Magnuson-Stevens Act required an allocation to the CDQ Program of 10.7 percent of the TAC for each directed fishery in the BSAI, except pollock, sablefish, halibut, and crab, starting in 2008.

The purpose of the CDQ program is, essentially, to allow a portion of the economic and social benefits derived from the rich fishery resources of the BSAI management areas to accrue to coastal communities in western Alaska that had not been able to capitalize on their proximity to these commercial fisheries. The CDQ region is historically an area with few economic alternatives. By providing CDQ shares to qualifying communities, these communities are able to invest in capital infrastructure, community development projects, training and education of local residents, and develop regionally based commercial fishing or related businesses.

The eligibility criteria for the CDQ communities are established in the Magnuson-Stevens Act. The CDQ communities are comprised of predominantly Alaska Native residents. They are remote, isolated settlements with few natural assets with which to develop and sustain a viable diversified economic base. As a result, unemployment rates are chronically high, which impedes community instability.

While these communities effectively border some of the richest fishing grounds in the world, they have not been able, for the most part, to exploit their advantageous proximity. The full Americanization of these highly valued offshore fisheries has taken place relatively quickly (i.e., the last participation by foreign fishing vessels ended in the Bering Sea in 1990). But the scale of these fisheries (e.g., 2 million mt groundfish TAC), the severe physical conditions within which the fisheries are prosecuted, and the very high capital investment required to compete in the open-access management environment, all contributed to effectively precluding these villages from participating in this development. The CDQ program serves to extend an opportunity to qualifying communities to directly benefit from the exploitation of these local resources.

The communities that are currently eligible to participate in the CDQ program include 65 coastal Alaska villages, with a combined population estimated at roughly 274,000. The CDQ-qualifying communities have organized themselves into six non-profit groups (with between 1 and 20 villages in each group). The CDQ-villages are geographically dispersed, extending from Atka, on the Aleutian chain, along the Bering Sea coast, to the village of Wales, near the Arctic Circle. The current CDQ groups are listed below.

Aleutian Pribilof Island Community Development Association (APICDA): The communities represented by APICDA are relatively small and located adjacent to the fishing grounds. Population of the six communities is approximately 1,140.

Bristol Bay Economic Development Corporation (BBEDC): BBEDC represents villages distributed around the circumference of Bristol Bay, including Dillingham, the second-largest CDQ community with approximately 2,470 residents and the location of BBEDC's home office. Total population is approximately 5,930.

Central Bering Sea Fisherman's Association (CBSFA): CBSFA is unusual among CDQ groups in that it represents a single community, St. Paul in the Pribilof Islands, with a population of 530.

Coastal Villages Region Fund (CVRF): CVRF manages the CDQ harvest for its member villages. The villages are located along the coast between the southern end of Kuskokwim Bay and Scammon Bay, including Nunivak Island.

Norton Sound Economic Development Corporation (NSEDC): Approximately 8,500 people make up the region represented by NSEDC, which ranges from St. Michael to Diomede.

Yukon Delta Fisheries Development Association (YDFDA): YDFDA represents the communities, Alakanuk, Emmonak, Grayling, Kotlik, Mountain Village, and Sheldon Point, containing approximately 3,120 people.

One of the criteria for community eligibility in the CDQ Program is that the community could not have previously developed harvesting or processing capability sufficient to support substantial groundfish fisheries participation in the BSAI (unless the community could show that benefits from CDQ allocations would be the only way to realize a return on previous investments). Therefore, to derive economic benefit from their respective allocations, it has been necessary (with the exception of some of the halibut and sablefish CDQs) for each CDQ group to enter into a relationship with one or more of the commercial fishing companies which participate in the fisheries. In this way, the CDQ community brings to the relationship preferential access to the fish and the partnering firm brings the harvesting/processing capacity. The nature of these relationships differs from group to group, but all of the groups are part owners in one or more fishing vessels and companies. In every case, the CDQ community receives royalty payments on apportioned catch shares. Some of the agreements also provide for training and employment of CDQ-community members within the partners' fishing operations, as well as other community development benefits.

4.6 Ecosystem Characteristics

Ecosystem characteristics of the Bering Sea and Aleutian Islands are assessed annually in the *Ecosystem Considerations* appendix to the *Bering Sea and Aleutian Islands and Gulf of Alaska Stock Assessment and Fishery Evaluation* report. Since 1995, this document has been prepared in order to provide information about the effects of fishing from an ecosystem perspective, and the effects of environmental change on fish stocks. Since 1999, the section has included information on indicators of ecosystem status and trends, and more ecosystem-based management performance measures.

Since 2003, an annual Ecosystem Assessment has also been included in the appendix to the SAFE. The primary intent of the assessment is to summarize historical climate and fishing effects of the shelf and slope regions of the eastern Bering Sea and Aleutian Islands, and Gulf of Alaska, from an ecosystem perspective and to provide an assessment of the possible future effects of climate and fishing on ecosystem structure and function. The *Ecosystem Considerations* sections from 2000 to the present are available online at www.afsc.noaa.gov/refm/reem/Assess/Default.htm or by request from the Council office.

4.6.1 Ecosystem Trends in the Bering Sea and Aleutian Islands Management Area

This section is drawn from the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries* (NMFS 2004), available on the NMFS Alaska Region website (www.fakr.noaa.gov), or by request from the NMFS Alaska Region office.

In a review of fishery trends and potential fishery-related impacts within the BSAI ecosystem, Livingston et al. (1999) examined historical biomass trends of three different trophic guilds to see if there was a relationship between fishing or climate and changes in total guild biomass or changes in species composition within guilds. For example, large fishing removals of one guild species might result in increases in other members of that guild as competitive pressures ease. Similarly, if fishing removes large numbers of a prey species important to all members of the guild, an overall decrease in the abundance of all the guild species might be observed, as well as decreased mean size at age of predators relying on that prey. Alternatively, if the factor inducing the observed change is environmental, trends in abundance or in mean size at age that correlate positively or negatively with temperature or other physical oceanographic factors might be seen. Three trophic guilds were examined:

1. offshore fish, mammals, and seabirds that consume small pelagic fish;
2. inshore fish, crabs, and other benthic epifauna that primarily consume infauna; and
3. a ubiquitous group that feeds on crab and fish (Figure 4-18).

Despite conservative exploitation rates, a variety of species in diverse trophic groups (e.g., arrowtooth flounder, Greenland turbot, some seabirds, and marine mammals) showed either increasing or decreasing long-term trends in abundance, and both fished and unfished species (pollock, cod, crabs, sea stars, and others) showed cyclic fluctuations in abundance over the two decades from 1979 to 1999. No link was found between species declines and prey abundance. The timing of some species declines, e.g., marine birds, was actually correlated with increases in the adult populations of their main prey species – in this case, pollock. Similarly, the timing of increases in some guild member biomass values did not relate to fishing intensity on other guild members (e.g., skate versus cod). The Livingston et al. study, however, did not consider spatial changes in prey abundance or availability that could occur, and these factors cannot be ruled out as potential causal links to changes in predator abundance.

Physical oceanographic factors, particularly northward or southward shifts in regional climatic regimes, were correlated with the recruitment of some guild members (see Section 4.6.2), and decreases in individual growth of some species (rock sole) were linked to increases in rock sole biomass. Diversity changes in some trophic guilds were related to increases in a dominant guild member (e.g., pollock in the pelagic fish consumer guild, and rock sole in the benthic infauna consumer guild) rather than to fishing-induced changes in diversity.

The study by Livingston et al. (1999) showed a stable trophic level of catch and stable populations overall. The trophic level of the Bering Sea harvest has risen slightly since the early 1950s and appears to have stabilized as of 1994.

4.6.1.1 Modeling Biological Interactions Among Multiple Species

Livingston and Jurado-Molina (1999) have developed a computer-based model of predator-prey interactions among the dominant groundfish species in the eastern Bering Sea. Three goals have directed the development of this multi-species model: 1) to examine trends in mortality due to predation, 2) to examine the relative importance of predation versus climate in influencing fish recruitment, and 3) to provide a basis for evaluating how future changes in fishing intensity might affect the groundfish community. The model uses information on historical catch estimates and predation among the species to estimate numbers at age and predation mortality of groundfish populations. The following species are modeled as predators: walleye pollock, Pacific cod, Greenland turbot, yellowfin sole, arrowtooth flounder, and northern fur seal. Arrowtooth flounder and northern fur seal are considered "other predators," which means that population and mortality estimates are not made directly for these species. However, it is feasible to estimate the impact of their predation on other species in the model. Prey species are walleye pollock, Pacific cod, Greenland turbot, yellowfin sole, rock sole, and Pacific herring.

Results from the modeling indicate that most predation mortality occurs on juveniles, particularly juvenile walleye pollock. This juvenile mortality varies over time, and recruitment of juveniles into the adult population also varies. Cannibalism by adult pollock explains some of the recruitment variation, but it appears that much of the variability is related to climatic variation (see Section 4.6.2). Understanding of predation and climate as structuring forces on groundfish communities will be advanced when multi-species predation models like these are linked to climate models that predict survival rates of larval fish before they are vulnerable to predation.

Output from this predation model can be used to evaluate the multi-species implications of various fishing strategies. One question asked about the BSAI by groundfish stock assessment biologists is: What effects might uneven groundfish harvesting rates have on groundfish community dynamics? For example, some species, such as Pacific cod, are fished up to the recommended level of ABC, while others, such as rock sole and yellowfin sole, are fished at levels below ABC for economic and bycatch reasons. Using a multi-species model, Jurado-Molina and Livingston (2000) examined what could happen over the long-term future to groundfish population size if species were harvested more evenly or were not harvested at all. They compared these projected changes with model predictions based on current groundfish fishing rates. They also compared the results with predictions using single-species models that did not consider predation interactions.

In the scenario where groundfish were fished more evenly (F_{ABC}) than actually occurs under the present harvesting regime (F_{REF}), the single-species models predicted almost the same population changes that the multi-species model did. The biggest differences between multi-species and single-species models were seen in the predictions for prey species biomasses of herring and rock sole, but even these were not very large (Figure 4-19).

Small differences in the predictions are the result of evaluating relatively small changes in fishing intensity. Larger differences between single-species models and the multi-species model are seen when the present fishing strategy (F_{REF}) is compared with a no-fishing strategy (Figure 4-20). Here, the main reason for the difference is that the multi-species model predicts that predators increase their consumption of prey when there is no fishing. The model results indicate that when pollock fishing is stopped, the largest beneficiary species is pollock itself. This is because adult pollock consume mostly younger (age 0 and age 1) pollock, while other predators tend to consume mostly older (age 1 and older) pollock. In the long-term, consumers of small pollock get the first opportunity to benefit from the increased abundance of juveniles when fishing stops.

In summary, the results of multi-species predator-prey modeling suggest that implementation of a more even harvesting regime would not produce effects much different from changes predicted by single-species models. The largest difference occurs in predictions under a no-fishing scenario, with the multi-species model predicting smaller increases in prey species such as pollock, rock sole, and herring than those predicted by the single-species models. Increases in predator populations, and thus predation mortality, under a no-fishing scenario are the reason for the lower rate of increase in prey populations in the multi-species model.

4.6.1.2 Multi-species Technological Interactions

Harvesting can have multi-species implications through technological interactions (i.e., co-occurrence of multiple species in a single target species fishery). When specific fisheries are unable to catch their target species exclusively, their fishing effort imposes some mortality on each species that is taken as bycatch. Bycatch of non-target flatfish species is a particularly important characteristic of several eastern Bering Sea target fisheries, including yellowfin sole, rock sole, flathead sole, and Alaska plaice. These species, along with Pacific halibut, occupy similar habitats on the eastern Bering Sea shelf and co-occur to varying degrees in the harvest. Additionally, the retention of Pacific halibut is prohibited in the federally managed groundfish fishery, and quotas of halibut bycatch—not directed target quotas—have been the main factor in restricting the fishery in recent years.

The total trawling effort for all flatfish fisheries combined imposes a variety of fishing mortality rates on the individual flatfish species. This has been evaluated with a multi-species yield-per-recruit model (Spencer et al. 1999). One motivation for such modeling is to consider management options that would increase the total flatfish yield, factoring in the bycatch of flatfish in the various fisheries. A main feature of this model is that a catchability coefficient is computed for each species and fishery, based on recent catch and effort data; the distribution of effort among the various eastern Bering Sea trawl fisheries (defined by species catch composition) is based on the same data. The slope of each line in Figure 4-21 is the total catchability for a particular species, resulting from all fisheries that harvest the species. For example, the catchability of yellowfin sole is higher than other species because a significant proportion of total trawling effort is directed toward this fishery, and this species has relatively high catchabilities in several fisheries.

Reaching halibut bycatch quotas early has resulted in early closures of the flatfish fisheries, thus resulting in large differences between fishing levels that would attain the ABC at F_{ABC} (triangles in Figure 4-21) and recent average F levels (asterisks in Figure 4-21) for most fisheries. One way to manage these species that are caught together would be to derive biological reference points for the complex as a whole. The $F_{40\%}$ level for the group combined (squares in Figure 4-21) would produce higher yields (in the absence of halibut bycatch quotas) than the single-species approach. This approach for managing flatfish as a group, however, would expose the yellowfin sole population to a higher fishing rate than the rate that would be recommended in a single-species management scheme. Therefore, this strategy might not provide optimal protection for yellowfin sole. If the complex were managed to protect the weakest stock (yellowfin sole), the combined flatfish fisheries would be able to increase effort by only a relatively small amount above the current effort levels (to the level of effort that would reach the yellowfin sole ABC at F_{ABC} (triangle in Figure 4-21). There is a relatively small difference between the recent average yellowfin sole F and the yellowfin sole $F_{40\%}$, indicating that there would be no significant change from current practice.

The limitation currently imposed on flatfish fisheries by the halibut bycatch quota has motivated fishermen to develop methods of reducing trawling effort that has high catchability on halibut (Gauvin et al. 1995) and also to develop fishing gear with lower halibut catchability (i.e., halibut excluder devices). These gear improvements and the already mandated phasing-in of requirements for retaining flatfish bycatch under the improved retention/improved utilization management approach show promise for producing a fishery management system with increased protection for protected species such as halibut and a large reduction in the levels of flatfish discards in flatfish fisheries. Because the gear improvements and improved retention scheme implementation will change the nature of the effort and multi-species catch characteristics of these target fisheries, the impacts of the improvements must be evaluated before multi-species biological reference points can be developed for target flatfish.

Figure 4-18 Biomass trends in Bering Sea trophic guilds, 1979-1998.

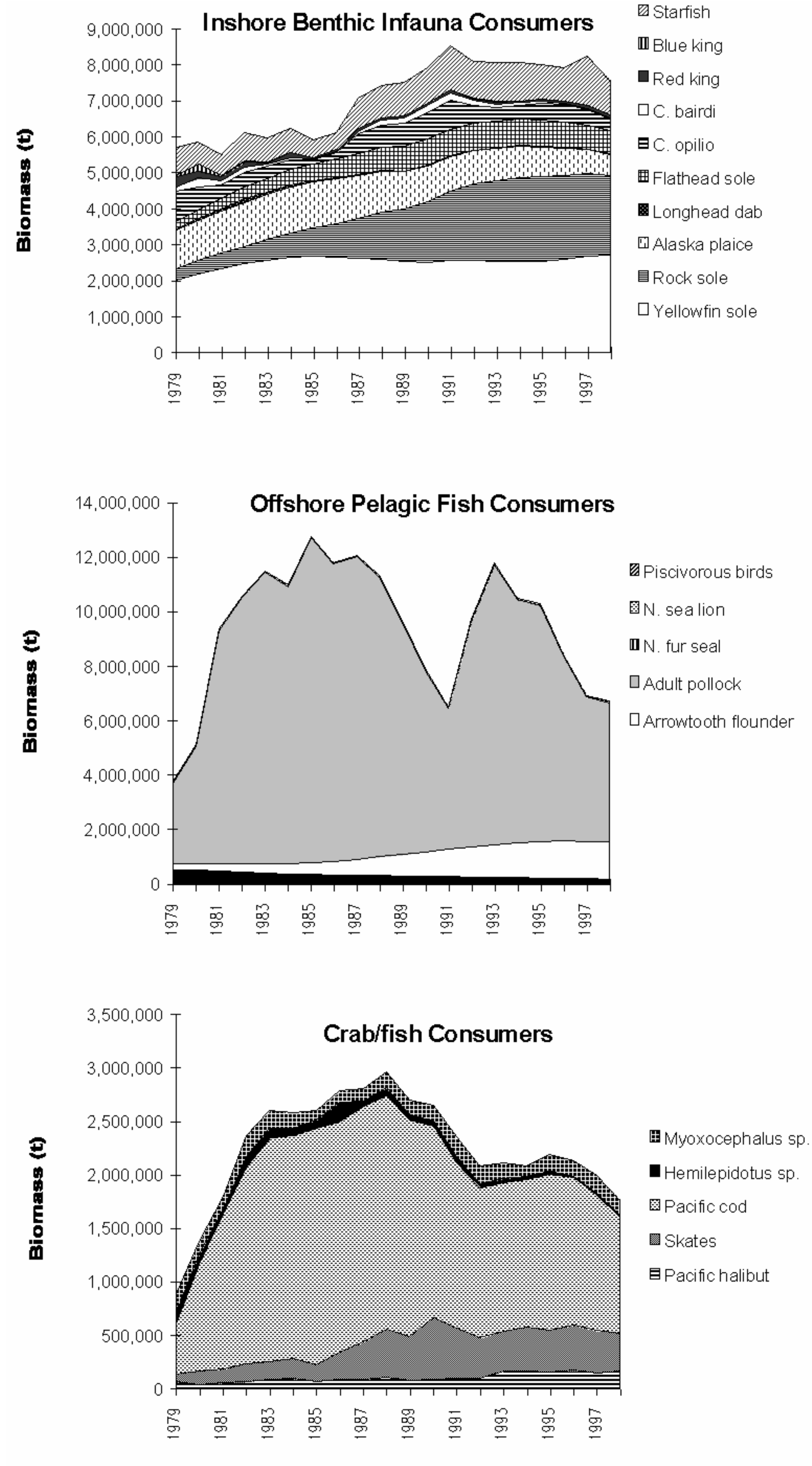
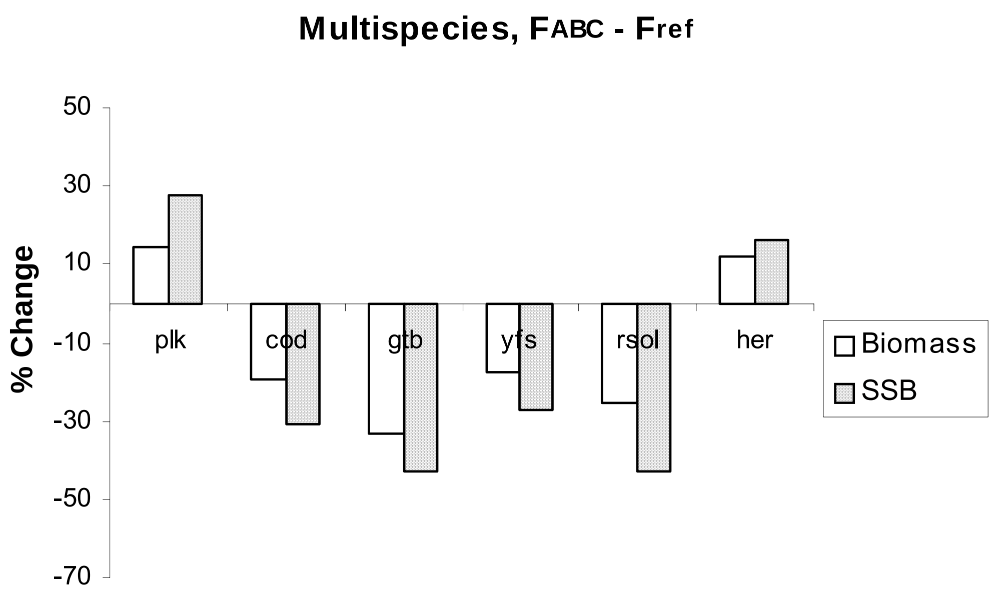
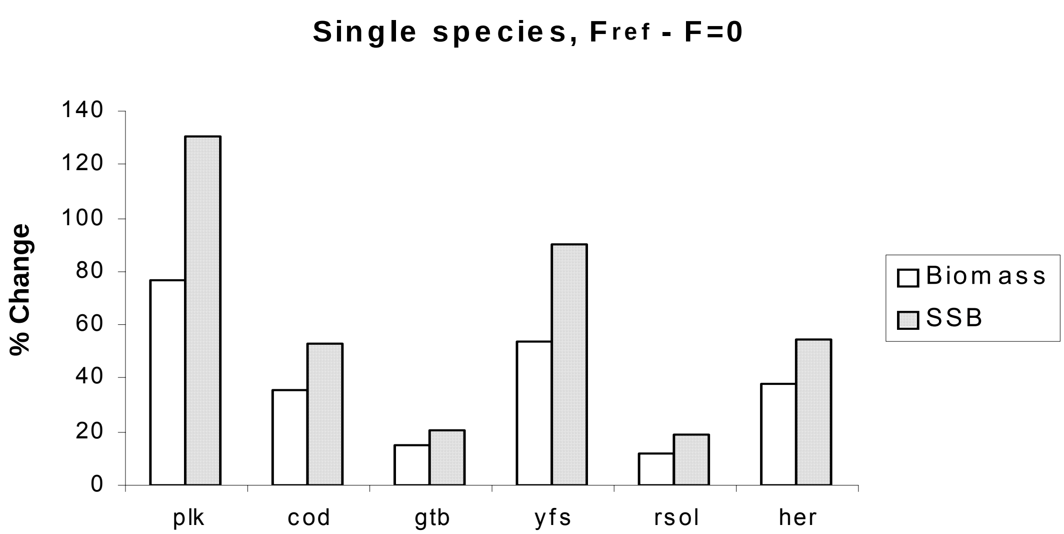


Figure 4-19 Multispecies and single-species model results for change in equilibrium biomass between the present fishing rates (Fref) and more even harvesting of all species (Fabc).



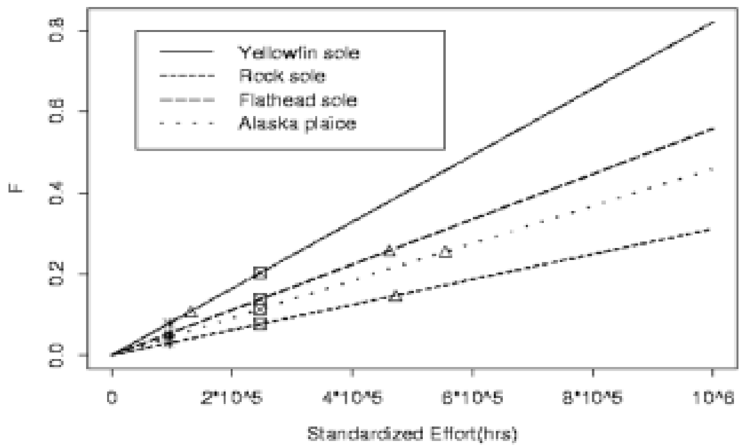
Note: plk = pollock, cod = Pacific cod, gtb = greenland turbot, yfs = yellowfin sole, rsol = rock sole, her = herring, SSB = steady state biomass.

Figure 4-20 Percent change in single-species and multispecies model predictions of biomass between the present fishing strategy (F_{ref}) and a no-fishing ($F=0$) scenario.



Note: plk = pollock, cod = Pacific cod, gtb = greenland turbot, yfs = yellowfin sole, rsol = rock sole, her = herring, SSB = steady state biomass.

Figure 4-21 Eastern Bering Sea flatfish instantaneous fishing mortality rates as a function of total standardized trawling effort.



Results were obtained from a multispecies yield per recruit model, and each species incorporates the contribution of all eastern Bering Sea trawl fisheries. Triangles indicate the $F_{40\%}$ single-species reference points, asterisks indicate the recent average *F*s and total trawl standardized effort, and squares indicate the $F_{40\%}$ multi-species reference point for the flatfish complex as a whole. Source: NMFS.

4.6.2 Climate-Implicated Change

This section is drawn from the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries* (NMFS 2004), available on the NMFS Alaska Region website (www.fakr.noaa.gov), or by request from the NMFS Alaska Region office.

Evidence from observations during the past two decades and the results of modeling studies using historical and recent data from the North Pacific Ocean suggest that physical oceanographic processes, particularly climatic regime shifts, might be driving ecosystem-level changes that have been observed in the BSAI and GOA. Commercial fishing has not been largely implicated in BSAI and GOA ecosystem changes, but studies of other ecosystems with much larger fishing pressures indicate that fishing, in combination with climate change, can alter ecosystem species composition and productivity (Jennings and Kaiser 1998, Livingston and Tjelmeland 2000).

During 1997 and 1998, a period of warmer-than-usual ambient air temperatures (Hare and Mantua 2000), a number of unusual species occurrences were observed in the BSAI and GOA, including the following examples:

- 1998, several warm-water fish species, including Pacific barracuda (*Sphyraena argentea*), were observed and/or caught in the GOA. Ocean sunfish (*Mola mola*) and chub mackerel (*Scomber japonicus*), occasionally recorded in southeast Alaskan waters, were documented there in unusually large numbers. Similarly, Pacific sleeper sharks (*Somniosus pacificus*) were caught (and released) in higher than normal levels in Cook Inlet, and salmon sharks (*Lamna ditropis*) were taken in fairly large numbers off Afognak Island (Kevin Brennan, ADF&G, personal communication).
- Spiny dogfish (*Squalus acanthias*) substantially increased in the Kodiak area and in Prince William Sound (Bill Bechtol and Dave Jackson, ADF&G, personal communication). In 1998, this species' inclusion in collection tows increased by more than 40 percent. A corresponding increase in spiny dogfish has been observed in the International Pacific Halibut Commission's GOA halibut longline bycatch surveys (Lee Hulbert, NMFS, personal communication).
- Individuals of several marine mammal species were seen at unusual times and/or places during 1998, including a Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) near Haines and a northern right whale (*Eubalaena glacialis*) off Kodiak Island.

- Unusual bird sightings in the GOA included a gray-tailed tattler (*Heteroscelus brevipes*) south of the Kenai Peninsula and a mallard (*Anas platyrhynchos*) several miles offshore in the open ocean. Common murre (*Uria aalge*) die-offs were reported in Cook Inlet, Kodiak, the eastern Aleutians, Resurrection Bay, and the eastern Bering Sea.
- Three northern elephant seals (*Mirounga angustirostris)* were spotted in nearshore waters around Unalaska during late June and early July, whereas they are usually found farther offshore and at a different time of year.
- There were poor returns of chinook (*Oncorhynchus tshawytscha*) and sockeye (*Oncorhynchus nerka*) salmon to Bristol Bay during both years.

Research on climate shifts as a forcing agent on species and community structure of the North Pacific Ocean can be found in Francis and Hare (1994), Klyashtorin (1998), McGowan et al. (1998), Hollowed *et al.* (1998), and Hare and Mantua (2000). The approach used in these studies assesses correlations between past climatic patterns and changes in biomass or recruitment rate for particular marine species. Because cause-and-effect relationships between temporal and spatial patterns of climate change and corresponding patterns of change in biological populations have not been proven for the BSAI and GOA, the correlations must be considered circumstantial. But there are reasons to expect that causal links do exist. For example, stronger recruitment would be expected under more favorable climatic conditions, because more juveniles would be likely to survive to adulthood, whereas harsh conditions would result in weak recruitment because fewer juveniles would survive. In both cases, the recruitment patterns would be reflected in the strength or weakness of the affected age groups within future fisheries.

Francis and Hare (1994) analyzed historical data supporting a climate shift that caused a precipitous decline in the sardine (*Sardinops sagax*) population off Monterey, California in the 1950s. Although it had been widely concluded that this decline resulted solely from overfishing, the data indicate instead that a change in sea surface temperature was closely correlated with the sardines' disappearance, and this related closely to patterns of sardine numbers in marine sediments off Southern California. Consequently, both climate and fishing are now recognized to be implicated in the sardine population decline.

Francis and Hare (1994) related the intensity of the Aleutian low pressure system (Aleutian low), a weather pattern, with production of salmon and zooplankton. Winter ambient air temperatures at Kodiak and the North Pacific Index, an index tracking the intensity of the Aleutian low during the winter, were used as indicators of climatic severity. Strong correlations were found between long-term climatic trends and Alaskan salmon production. Annual weather patterns were found to be closely correlated with changes in zooplankton populations.

For the northeastern North Pacific Ocean, McGowan *et al.* (1998) showed that interannual climatic variations linked to the ENSO and decadal-scale climate shifts can be detected in physical oceanographic data. For instance, the depth of the mixed layer in the California Current and GOA became shallower over time, whereas the mixed-layer depth in the Central Pacific deepened during the same period. This was not, however, reflected in the mass flow of the California Current. Greater depth of the mixed layer during elevated sea surface temperature events was correlated with decreased nutrient availability, plankton abundance, and shifts in community structure. These researchers concluded that climatic events such as ENSO are correlated with changes in biological populations associated with the California Current. Biological processes in the GOA appear to be more strongly influenced by variations in the Aleutian low.

According to McGowan *et al.* (1998), climate-related changes in the biological communities of the California Current system ranged from declines in kelp forests to shifts in the total abundance and dominance of various zooplankton species. Some fish and invertebrate populations declined, and the distributional ranges of species shifted northward. In addition, seabird and marine mammal reproduction were apparently affected by El Niño-Southern Oscillation (ENSO) conditions. Interdecadal changes in community structure also occurred, with intertidal communities becoming dominated by northward-moving southern species and changes in species proportions occurring in most other sectors of the ecosystem.

Interdecadal shifts observed in the northeastern North Pacific Ocean ecosystem have been of the opposite sign from those in the California Current system, with increases in zooplankton biomass and salmon landings observed in the GOA (McGowan *et al.* 1998, Francis and Hare 1994). These shifts have corresponded to the intensity and location of the winter mean Aleutian low, which changes on an interdecadal time scale.

Klyashtorin (1998) linked catch dynamics of Japanese sardines, California sardines, Peruvian sardines, Pacific salmon, Alaska pollock, and Chilean jack mackerel in the Pacific with an atmospheric circulation index that shows trends similar to the North Pacific Index used by other researchers. Other species, such as Pacific herring and Peruvian anchovy, are negatively associated with this index.

Hollowed *et al.* (1998) analyzed oceanographic and climatic data from the eastern North Pacific Ocean and compared those data with information on recruitment for 23 species of groundfish and five non-salmonid species and with catch data for salmon. The fish recruitment data were compared to environmental factors over various time scales and with varying time lags. Hollowed *et al.* (1998) found that, for species such as pollock, cod, and hake, recruitment was generally stronger during ENSO events. Whereas salmon and large-mouthed flatfish such as arrowtooth flounder, Greenland turbot, and Pacific halibut responded more strongly to longer-term events such as decadal-scale climatic regime shifts. Because both ENSO and decadal-scale ecosystem shifts are environmentally controlled, the results of this analysis support climate change as an important controlling factor in ecosystem dynamics.

There is considerable evidence that decadal and basin-scale climatic variability can affect fish production and ecosystem dynamics. Sudden basin-wide shifts in climatic regime have been observed in the North Pacific Ocean (Mantua *et al.* 1997), apparently due to changes in atmospheric forcing. Eastward- and northward-propagating storm systems dominate the wind stress on surface waters for short periods (less than one month), mixing the upper layers and altering sea surface temperatures (Bond *et al.* 1994). Because fish are very sensitive to ambient water temperature, even changes in surface temperature, if sufficiently frequent or prolonged, can alter fish distribution and reproductive success as well as recruitment (the number of juveniles that survive to enter the adult, reproducing portion of the population).

In a long-term trends analysis by computer, Ingraham and Ebbesmeyer (Ingraham *et al.* 1998) used the Ocean Surface Current Simulator model to simulate wind-driven surface drift trajectories initiated during winter months (December through February) for the period 1946 to present. The model-generated endpoints of the 3-month drift trajectories shifted in a bimodal pattern to the north and south around the mean. The winter flow during each year was persistent enough to result in a large displacement of surface mixed-layer water. The displacement also varied in a decadal pattern. Using the rule that the present mode is maintained until three concurrent years of the opposite mode occur, four alternating large-scale movements in surface waters were suggested: a southward mode from 1946 to 1956, a northward mode from 1957 to 1963, a southward mode from 1964 to 1974, and a northward mode from 1975 to 1994. As more northern surface water shifts southward, colder conditions prevail farther south, and as southward water moves northward, warmer conditions prevail farther north, both potentially affecting fish distribution and population dynamics.

Real-world evidence that atmospheric forcing alters sea surface temperatures comes from two principal sources: shorter-term ENSO events and longer-term Pacific Decadal Oscillations (Mantua *et al.* 1997). Temperature anomalies in the BSAI and GOA indicate a relatively warm period in the late 1950s, followed by cooling especially in the early 1970s, followed by a rapid temperature increase in the latter part of that decade. Since 1983, the BSAI and GOA have undergone different temperature changes. Sea surface temperatures in the BSAI have been below normal, whereas those in the GOA have been generally above normal. Consequently, the temperature difference between the two bodies of water has jumped from about 1.1° C to about 1.9° C (U.S. GLOBEC 1996).

Subsurface temperatures, potentially an even more important influence on biological processes, have been documented to change in response to climatic drivers. There was a warming trend in subsurface temperatures in the coastal GOA from the early 1970s into the 1980s similar to that observed in GOA sea surface waters (U.S. GLOBEC 1996).

In addition, seawater temperature changes in response to ENSO events occurred, especially at depth, in 1977, 1982, 1983, 1987, and in the 1990s. The 1997-1998 ENSO event, one of the strongest recorded in the twentieth century, substantially changed the distribution of fish stocks off California, Oregon, Washington, and Alaska. The longer-term impacts of the 1997-1998 ENSO event remain to be seen. Francis *et al.* (1998) reviewed the documented ecological effects of this most recent regime shift through lower, secondary, and top trophic levels of the North Pacific Ocean marine ecosystem. Some of the following impacts on higher trophic levels are based on this review:

- Parker *et al*. (1995) demonstrated marked similarities between time series of the lunar nodal tidal cycle and recruitment patterns of Pacific halibut.
- Hollowed and Wooster (1995) examined time series of marine fish recruitment and observed that some marine fish stocks exhibited an apparent preference (measured by the probability of strong year and average production of recruits during the period) for a given climate regime.
- Hare and Francis (1995) found a striking similarity between large-scale atmospheric conditions and salmon production in Alaska.
- Quinn and Niebauer (1995) studied the Bering Sea pollock population and found that high recruitment coincided with years of warm ocean conditions (above normal air and bottom temperatures and reduced ice cover). This fit was improved by accounting for density-dependent processes.

Additional evidence of marine ecosystem impacts linked to climatic forcing comes from Piatt and Anderson (1996), who provided evidence of possible changes in prey abundance due to decadal-scale climate shifts. These authors examined relationships between significant declines in marine birds in the northern GOA during the past 20 years and found that statistically significant declines in common murre populations occurred from the mid- to late 1970s into the early 1990s. They also found a substantial alteration in the diet composition of five seabird species collected in the GOA from 1975 to 1978 and from 1988 to 1991, changing from a capelin-dominated diet in the late 1970s to a diet in which capelin was virtually absent in the later period.

The effects of ten-year regime shifts on the inshore GOA were analyzed using data from 1953 to 1997 (Anderson and Piatt 1999). Three taxonomic groups dominated (approximately 90 percent) the biomass of commercial catches during this period: shrimp, cod and pollock, and flatfish. When the Aleutian low was weak, resulting in colder water, shrimp dominated the catches. When the Aleutian low was strong, water temperatures were higher, and the catches were dominated by cod, pollock, and flatfish. Similar results were reported in very nearshore areas of lower Cook Inlet (Robards *et al.* 1999).

Few patterns were seen in the less-common species over the course of the study. Generally, the transitions in dominance lagged behind the shift in water temperature, strengthening the argument that the forcing agent was environmental. However, different species responded to the temperature shift with differing time lags. This was most evident for species at higher trophic levels, which are typically longer-lived and take longer to exhibit the effects of changes. The evidence suggests that the inshore community was reorganized following the 1977 climate regime shift. Although large fisheries for pandalid shrimp may have hastened the decline for some stocks (Orensanz *et al.* 1998), unfished or lightly fished shrimp stocks showed declines. Both Orensanz *et al.* (1998) and Anderson and Piatt (1999) concluded that the large geographic scale of the changes across so many taxa is a strong argument that climate change is responsible.

Other studies have linked production, recruitment, or biomass changes in the BSAI with climatic factors. For example, a climate regime shift that might have occurred around 1990 has been implicated in a large increase in gelatinous zooplankton in the BSAI (Brodeur *et al.* 1999). Recruitment in both crabs and groundfish in the BSAI has been linked to climatic factors (Zheng and Kruse 1998, Rosenkranz *et al.* 1998, Hollowed *et al.* 1998, Hare and Mantua 2000).

There are indications from several studies that the BSAI ecosystem responds to decadal oscillations and atmospheric forcing, and that the 1976-1977 regime shift had pronounced effects. A peak in chlorophyll concentrations in the late 1970s was closely correlated with an increase in summer mixed-layer stability documented at that time (Sugimoto and Tadokoro 1997). Also, on a decadal time scale, chlorophyll concentrations in the summer were positively correlated with winter wind speeds, indicating a positive response of BSAI phytoplankton to stronger Aleutian lows (Sugimoto and Tadokoro 1997).

Evidence of biological responses to decadal-scale climate changes are also found in the coincidence of global fishery expansions or collapses of similar species complexes. Sudden climate shifts in 1923, 1947, and 1976 in the North Pacific Ocean substantially altered marine ecosystems off Japan, Hawaii, Alaska, California, and Peru. Sardine stocks off Japan, California, and Peru exhibited shifts in abundance that appear to be synchronized with shifts in climate (Kawasaki 1991). These historical 60-year cycles are seen in paleo-oceanographic records of scales of anchovies, sardines, and hake as well. Other examples are salmon stocks in the GOA and the California Current whose cycles are out of phase. When salmon stocks do well in the GOA, they do poorly in the California Current and vice-versa (Hare and Francis 1995, Mantua *et al.* 1997).

In addition to decadal-scale shifts, interannual events such as the ENSO can have significant impacts on fish distribution and survival, and can affect reproduction, recruitment, and other processes in ways that are not yet understood. This is particularly true for higher-latitude regions such as the northern California Current and GOA. As noted above, the 1997-1998 ENSO event significantly changed the distribution of fish stocks off California, Oregon, Washington, and Alaska. A change that has persisted to the present. Predicting the implications of this trend for future fishery management is problematic, in part because ENSO signals propagate from the tropics to high latitudes through the ocean as well as through the atmosphere, and it is difficult to separate these two modes of influence. Information on the dynamics of North Pacific Ocean climate and how this is linked to equatorial ENSO events is not adequate to adjust fisheries predictions for such abrupt, far-reaching, and persistent changes. Warm ocean conditions observed in the California Current during the present regime may be due, in large part, to the increased frequency of ENSO-like conditions.

In conclusion, evidence from past and present observations and modeling studies at the community and ecosystem levels for the BSAI and GOA suggest that climate-driven processes are responsible for a large proportion of the multi-species and ecosystem-level changes that have been documented. Modeling studies have been a valuable tool for elucidating the possible long-term implications of various fishing strategies. As with all computer-based models, these have been sensitive to unproven assumptions about recruitment and its relationship to climate. As the preceding discussion suggests, the models could be improved by incorporating components that include climatic effects on species, particularly with respect to recruitment. However, this approach has not been widely applied yet to species in the BSAI and GOA ecosystems.

4.6.3 Interactions Among Climate, Commercial Fishing, and Ecosystem Characteristics

This section is drawn from the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries* (PSEIS) (NMFS 2004), available on the NMFS Alaska Region website (www.fakr.noaa.gov), or by request from the NMFS Alaska Region office.

Groundfish fishery management in the BSAI and GOA is implemented in a dynamic environment where both commercial fishing and climate-driven physical oceanographic processes interact in complex ways to affect the marine ecosystem. To characterize these interactions, it is necessary to distinguish, where feasible, the separate effects of fishing and climate on biological populations. The following discussion reviews current knowledge regarding these effects and their relationship to ecosystem characteristics.

Three processes underlie the population structure of species in marine ecosystems: competition, predation, and environmental factors. Natural variations in the recruitment, survival, and growth of fish stocks are consequences of these processes. The first process, competition, is a basic concept underlying many ecological theories (e.g., Hairston *et al.* 1960, Welden and Slauson 1986, Yodzis 1978, 1994). It requires an assumption that species in an ecosystem are limited in their access to critical resources such as food, space, reproductive mates, and time for important activities. Predation is important, because it changes prey density, thereby directly or indirectly affecting populations throughout the ecosystem. Finally, environmental factors, particularly climatic processes, are thought to be major agents of change in North Pacific Ocean ecosystems. Climate has the potential to influence the important biological processes of reproduction, growth, consumption and predation, movement, and, ultimately, the survival of marine organisms.

Against this complex and dynamic natural background, human activities such as commercial fishing can influence the structure and function of marine ecosystems. Like competition, predation, and climate change, the effects of commercial fishing can extend over a range of temporal, spatial, and population scales. Large-scale commercial fishing has the potential to influence ecosystems in several ways. It may alter the amount and flow of energy in an ecosystem by removing energy and altering energetic pathways though the return of discards and fish processing offal back into the sea. The recipients, locations, and forms of this returned biomass may differ from those in an unfished system. In addition, the selective removal of species has the potential to change predator-prey relationships and community structures. Fishing gear may alter bottom habitat and damage benthic organisms and communities.

Both climate and commercial fishing activity currently influence the structure and function of the North Pacific Ocean ecosystem (Francis *et al.* 1999). Since climate change and commercial fishing can co-vary, it may be difficult to distinguish the impacts of the two (e.g., Trites *et al.* 1999). The primary way in which complex scientific knowledge is integrated to further the understanding of the influence of natural and human-related processes on marine ecosystems is through the use of models. Models can be as simple as conceptual diagrams that show a picture of how we think a certain ecosystem process operates, or they can be very complicated, with quantitative descriptions of the relationships between various factors and species growth, recruitment, movement, or survival. Reviews of the status of models that have been developed to understand the effects of climate and fishing on ecosystems have been produced by Livingston (1997) and Hollowed *et al.* (2000a). These reviews outline the types of models presently being used and the state of our ability to understand and predict the effects of the two important factors of climate and fishing in marine ecosystems by using models.

Most models that consider more than one species link the species together through knowledge about their feeding (trophic) interactions. Once the trophic linkages among species are understood, questions about impacts of predators and prey on one another (Yodzis 1994), or how natural or human-induced habitat changes affect the food-web structure (Yodzis 1996), can be addressed with a variety of multi-species or ecosystem models. Another model type, called a technical interaction model, may consider the simultaneous capture of groups of species by a particular fishery or type of fishing gear.

With the exception of information on forage fish, which – unlike many marine species – are preyed on as adults and not just mainly as juveniles, most scientific advice from multi-species models is not presently being used in making short-term management decisions. These models are mainly useful for trying to understand the possible medium- (6 to 10 years) and longer-term implications of various management strategies on the ecosystem.

However, long-term predictions from single-species, multi-species, and ecosystem-level models remain uncertain, because the predictions rely heavily on assumptions about recruitment, particularly for predators (Gislason 1991, 1993), which may be strongly influenced by environmental variation. Limitations still exist regarding the ability to predict both future changes in climate and recruitment rates resulting from a particular climate state.

Therefore, as noted by Parkes (2000) and Hall (1999a), predator-prey models are not considered reliable enough to provide directly applicable management advice at the present time. Hall (1999b) notes that ecosystem-based management advice should move toward setting single-species biological reference points for non-target species, developing single-species reference points for localized regions (i.e., spatially explicit management), and using measures of system-level properties (e.g., species diversity, trophic level of the catch, biomass-size distributions) to derive ecosystem-level reference points.

Food web models of the BSAI, specifically, the Eastern Bering Sea shelf, ecosystem have been developed for the 1950s and 1980s (Trites *et al.* 1999). These models use the Ecopath strategy for evaluating mass-balance in marine ecosystems. Ecopath uses estimates of biomass, consumption, diet, and turnover rates of populations or groups of populations to evaluate energy flow and mass-balance in a particular ecosystem (Christensen 1990).

Ecopath creates static biomass flow models of ecosystems and represents a snapshot of the ecosystem for a given time period. Species in these models are linked, so that the biomass transfer resulting from processes such as fecundity, mortality, production, respiration, and predation are in equilibrium (balanced). These types of models provide a way to identify large-scale views of ecosystems and to highlight data gaps (Christensen 1990, 1992, 1994; Pauly and Christensen 1995).

An examination of energy flow within the ecosystem is instructive, although one must be careful in interpreting the inevitable differences among the flow estimates. For instance, although the magnitude of biomass flow from prey to tertiary consumers (e.g., juvenile pollock to seabird predators) is modest relative to that between primary producers and primary consumers (e.g., phytoplankton to crustaceans), it may nonetheless play a significant role in the dynamics of the food web (P. Yodzis, University of Guelph, Ontario, Canada, personal communication). Further, if a food web is composed of few, highly connected species in a trophic sense, removal of a predator may yield a larger ecosystem perturbation than a similar removal from an ecosystem with weaker trophic links among many predators and prey (e.g., Pimm 1982).

The Ecopath models for the Bering Sea were initially developed to see if impacts of intensive whale harvesting that occurred in the 1950s and 1960s were sufficient to explain the ecosystem structural changes that were observed in the 1980s, discussed in Section 3.10.1.3 of the PSEIS. The primary removal of energy in both decades was by harvesting whales and pelagic fishes in the 1950s, and pollock in the 1980s. The production estimate for the 1950s simulation showed baleen whales as the dominant ecosystem component. These whales were classed as a midlevel consumer with a trophic level slightly higher than pollock, due to their consumption of squid. The dominant component in the 1980s simulation was pollock, the dominant fishery. There was a slight drop in trophic level of the catch between the two periods, but this was acknowledged to be an artifact of the volume of squid assumed in the diet of the baleen whales. Without this assumption, there was little change in trophic level of harvest. Trophic level of the catch actually increased from the 1950s to the 1980s, if only fish harvests are considered. This would suggest that harvesting in the Bering Sea at present is at a level that has been sustained over long periods. A further result of this simulation was that whale harvests required an estimated 47 percent of net primary production in the Bering Sea in the 1950s. Fisheries of the 1980s, dominated by pollock, required only 6.1 percent of primary production.

Measures of ecosystem maturity show some differences between the two Bering Sea models. The ratio of primary production to respiration, net system production, and the ratio of biomass to throughput indicate a more mature ecosystem state in the 1950s compared with the 1980s. This is due to the assumption that benthic infauna biomass was lower in the 1980s. However, benthic infaunal surveys used to estimate biomass for the two models used different methods and may not be comparable.

Trophic pyramids are similar for the two time periods, and both indicate that biomass and energy flow were distributed fairly well throughout the system. The steep-sided shape of the pyramids indicates that there is a lot of energy flow at lower trophic levels. One system maturity index, the ratio of primary production to total biomass, actually indicates a more mature system in the 1980s relative to the 1950s. However, this was due to assumptions about the change in primary production between the two time periods, for which there is conflicting evidence. Conclusions about system maturity will be premature until trends in primary production and benthic infauna biomass are better understood.

The Bering Sea appears to be more mature than other modeled ecosystems, particularly with regard to total system throughput, which measures the sum of all energy flows in the system. It has ecosystem measures that indicate it has significant strength in reserve, which makes it more resilient or resistant to perturbations compared with other ecosystems.

Ecosim, a forward-looking simulation coupled to Ecopath, was used to project the results of various scenarios. The model was run in either an equilibrium or dynamic mode. The equilibrium mode assumed that the total biomass of the ecosystem remained stable, and as the biomass of one component declined, others were required to increase to balance it. Dynamic models do not have this requirement.

The equilibrium mode of Ecosim was used to examine the results of changes in a species' abundance on interacting groups. The results of the equilibrium model suggest that changes in baleen whale numbers could significantly affect pollock populations, and that increases in sperm whale numbers could yield decreases in the numbers of Steller sea lions through competition. Reducing pelagic fish numbers reduces the numbers of seabirds that feed on them, as well as numbers of Steller sea lions and large flatfish. Increasing fishing pressure on pollock would have little effect on their biomass, and increasing fishing pressure on large flatfish would result in increased Steller sea lion populations through the removal of a competitor.

In a different approach, the dynamic mode of Ecosim was used to look at possible mechanisms involved in the historical marine biomass changes seen between the 1950s and the 1980s. Scenarios used for the dynamic model were a regime shift that resulted in changes in primary production; a commercial fishery simulation to see if fishing whale could account for the observed changes; three pollock fishing scenarios that project into the future; and scenarios which varied the fishery mortalities on pollock and pelagic fishes.

These simulations suggested that commercial harvesting of fish and whales had little likelihood of producing the changes seen in actual pollock populations since the 1950s. The effect of increasing primary production provided a much more realistic change in the pollock population. While most groupings showed increases, Steller sea lions did not.

There are substantial uncertainties about the abundance of small pelagic fish in both time periods and the abundance of pollock in the 1950s model. Low abundance of pollock and higher abundance of small pelagic fish in the 1950s was assumed. However, although non-standardized surveys by the Soviets during the 1950s showed apparently lower pollock abundance, their research on diet composition of groundfish indicated that pollock was a primary prey item of many species. It is possible that pollock may have been more abundant in the 1950s than has been assumed. Further model testing with this change in assumptions should be done.

Another dynamic simulation showed that, contrary to what might be expected, stopping the commercial pollock harvest had a slight negative effect on Steller sea lions. This is because two of the Steller sea lion prey items, small pelagic fish and juvenile pollock, declined when adult pollock increased. Adult pollock are cannibalistic and compete with small pelagic fish for large zooplankton prey in this model. More recent versions of the model, which changed the assumptions regarding recruitment now show that juvenile pollock actually increase under this scenario, but that Steller sea lions still show a slight negative effect. This is presumably because of the assumption of the dominance of small pelagic fish as a prey item of Steller sea lions. Small pelagic fish still decline under the assumption of increasing pollock, because adult pollock compete with them for large zooplankton prey.

In conclusion, these model simulations indicate uncertainty about the biomass of lower trophic level species in the two time periods. It appears that climate-related shifts in lower trophic level production could partly explain the ecosystem changes that occurred between the 1950s and the 1980s. However, the model only captures predation-related recruitment variability and cannot show climate-related variability in recruitment, which is probably much larger. More detailed scenarios that examine the spatial availability of prey will have to be performed to improve our understanding of the complex interaction between fishery removals and predator-prey interactions.

Chapter 5 Relationship to Applicable Law and Other Fisheries

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) is the primary domestic legislation governing management of the U.S. marine fisheries. The relationship of the Fishery Management Plan (FMP) for Groundfish of the Bering Sea and Aleutian Islands (BSAI) Management Area with the Magnuson-Stevens Act and other applicable Federal law is discussed in Section 5.1. The relationship of the FMP to international conventions is addressed in Section 5.2. The relationship of the FMP to other federal fisheries is addressed in Section 5.3, and to State of Alaska fisheries in Section 5.4.

5.1 Relationship to the Magnuson-Stevens Act and Other Applicable Federal Law

The FMP is consistent with the Magnuson-Stevens Act (16 USC 1851), including the ten National Standards, and other applicable law.

5.2 Relationship to International Conventions

The U.S. is party to many international conventions. Those that directly or indirectly address conservation and management needs of groundfish in the Bering Sea and Aleutian Islands region include:

- Convention for the Preservation of the Halibut Fishery of the North Pacific Ocean and the Bering Sea (basic instrument for the International Pacific Halibut Commission – IPHC)
- Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (Donut Hole convention)

The Pacific halibut fishery is managed by the International Pacific Halibut Commission. Yet because of the significant interaction between the BSAI groundfish fishery and the halibut fishery, many of the management measures contained herein are for the expressed purpose of mitigating possible adverse effects of the groundfish fisheries on the halibut resource.

5.2.1 International Pacific Halibut Commission

The IPHC was created to conserve, manage, and rebuild the halibut stocks in the Convention Area to those levels which would achieve and maintain the maximum sustainable yield from the fishery. The halibut resource and fishery have been managed by the IPHC since 1923. The IPHC was established by a Convention between the United States and Canada, which has been revised several times to extend the Commission's authority and meet new conditions in the fishery. "Convention waters" are defined as the waters off the west coasts of Canada and the United States, including the southern as well as the western coasts of Alaska, within the respective maritime areas in which either Party exercises exclusive fisheries jurisdiction. Under the Protocol to the Convention, the Commission retains a research staff and recommends, for the approval of the Parties, regulations regarding: 1) the setting of quotas in the Convention Area, and 2) joint regulation of the halibut fishery in the entire Convention Area under Commission regulations. Neither U.S. nor Canadian halibut fishing vessels are presently allowed to fish in the waters of the other country.

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.

5.2.2 Donut Hole Convention

The development, in the mid to late 1980s, of an extensive pollock fishery in the central Bering Sea (donut hole) area of the Aleutian Basin, beyond the U.S. and Russian 200-mile zones, was of great concern to U.S. and Russian fishing interests. The U.S. closed a domestic fishery as a result of the adverse impact this unregulated fishery, which was being prosecuted mostly by distant-water fishing nations, was having on U.S. pollock stocks. Concern also extended to bycatch problems associated with the fishery. The donut hole fishery was being conducted by trawl vessels from Japan, the Republic of Korea, Poland, the People's Republic of China, and the former Soviet Union. Catch data submitted by these countries indicated that annual harvests in the donut area rose to approximately 1.5 million mt in the years leading up to 1989. Largely due to drastic declines in catch and catch-per-unit-effort from 1990, leading to a total catch of under 300,000 mt in 1991 and under 11,000 mt in 1992, the governments involved agreed to a voluntary suspension of fishing in the area for 1993-94. During the 2 year suspension of fishing, an agreed scientific monitoring program was carried out that showed no evidence of the recovery of the resource.

On February 11, 1994, the Parties completed 3 years of negotiations and initialed the Convention on the Conservation and Management of Pollock Resources in the central Bering Sea. Its major principles include: no fishing permitted in the donut hole unless the biomass of the Aleutian Basin stock exceeds a threshold of 1.67 million mt (if the parties cannot agree on an estimate of the biomass, the estimate of the Alaska Fisheries Science Center and its Russian counterpart will be used); allocation procedures; 100 percent observer and satellite transmitter coverage; and prior notification of entry into the donut hole and of transshipment activities. The Convention entered into force in December 1995 (January 1996 for the Republic of Korea).

Despite a moratorium on commercial fishing in the central Bering Sea for the past 10 years, the pollock stocks have not rebuilt. The Aleutian Basin total biomass estimate continues to be low, and trial fishing results continue to show little or no pollock in the central Bering Sea.

5.3 Relationship to Other Federal Fisheries

The North Pacific Fishery Management Council (Council) has implemented four other FMPs in the Alaska exclusive economic zone (EEZ). These FMPs govern groundfish fishing in the Gulf of Alaska (GOA), king and tanner crab fishing in the BSAI, and scallop and salmon fishing in the Alaska EEZ. The relationship of the BSAI groundfish FMP with these other management plans is discussed below.

5.3.1 Gulf of Alaska Groundfish FMP

The BSAI and GOA groundfish fisheries are managed in close connection 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, Section 3.7.2).

5.3.2 BSAI King and Tanner 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.

5.3.3 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.

5.3.4 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.

5.4 Relationship to State of Alaska Fisheries

The Constitution of the State of Alaska states the following in Article XIII:

Section 2 General Authority. The legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State, including land and waters, for the maximum benefit of the people.

Section 4 Sustained Yield. Fish, forest, wildlife, grasslands, and all other replenishable resources belonging to the State shall be utilized, developed, and maintained on the sustained yield principle, subject to preferences among beneficial uses.

Section 15 No Exclusive Right of Fishery, has been amended to provide the State the power "to limit entry into any fishery for purposes of resource conservation" and "to prevent economic distress among fishermen and those dependent upon them for a livelihood".

The relationship of the BSAI Groundfish FMP with State of Alaska fisheries is discussed below.

5.4.1 State groundfish fishery

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.

5.4.2 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.

5.4.3 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.

5.4.4 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.

5.4.5 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.

Chapter 6 References

This chapter contains references for the Fishery Management Plan (FMP) for the Groundfish of the Bering Sea and Aleutian Islands management area (BSAI). Section 6.1 describes the sources of available data regarding the BSAI groundfish fisheries, including annually updated reference material. Section 6.2 provides management and enforcement considerations for the BSAI groundfish fisheries. A list of the literature cited in the FMP is included in Section 6.3.

6.1 Sources of Available Data

Although every effort is made to keep the FMP updated with recent descriptions of the stocks and fisheries, the availability of new data far exceeds the ability of the Council and National Marine Fisheries Service (NMFS) to amend the FMP. As a result, in some cases, it may be more expeditious to access the regularly updated reference material directly in order to gain a current picture of the status of the groundfish fisheries. The North Pacific Fishery Management Council (Council) (Section 6.1.1), the NMFS Alaska Fisheries Science Center (AFSC) (Section 6.1.2), and NMFS Alaska Region office (Section 6.1.3), each produce an abundance of reference material that is useful for understanding the groundfish fisheries. The sections below provide an overview of the types of reports and data available through the various organizations and their websites.

6.1.1 North Pacific Fishery Management Council

6.1.1.1 Stock Assessment and Fishery Evaluation Report

The *Stock Assessment and Fishery Evaluation* (SAFE) report is compiled annually by the BSAI Groundfish Plan team, which is appointed by the Council. The sections are authored by AFSC and State of Alaska scientists. As part of the SAFE report, a volume assessing the *Economic Status of the Groundfish Fisheries off Alaska* is also prepared annually, as well as a volume on *Ecosystem Considerations*.

The SAFE report provides information on the historical catch trend, estimates of the maximum sustainable yield of the groundfish complex as well as its component species groups, assessments on the stock condition of individual species groups; assessments of the impacts on the ecosystem of harvesting the groundfish complex at the current levels given the assessed condition of stocks, including consideration of rebuilding depressed stocks; and alternative harvest strategies and related effects on the component species groups.

The SAFE report annually updates the biological information base necessary for multispecies management. It also provides readers and reviewers with knowledge of the factual basis for total allowable catch (TAC) decisions, and illustrates the manner in which new data and analyses are used to obtain individual species groups' estimates of acceptable biological catch and maximum sustainable yield.

Copies of the most recent SAFE report are available online (see below), and by request from the North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska, 99501.

6.1.1.2 Website

Much of the information produced by the Council can be accessed through its website, to be found at:

http://www.fakr.noaa.gov/npfmc

The information available through the website includes the following.

- FMPs: summaries of the FMPs as well as the FMPs themselves are available on the website.
- Meeting agendas and reports: annual quota specifications, amendments to the FMPs or implementing regulations, and other current issues are all discussed at the five annual meetings of the Council. Meeting agendas, including briefing materials where possible, and newsletter summaries of the meeting are available on the website, as well as minutes from the meetings.
- Current issues: the website includes pages for issues that are under consideration by the Council, including amendment analyses where appropriate.

6.1.2 NMFS Alaska Fisheries Science Center

Much of the information produced by the AFSC can be accessed through its website, to be found at:

http://www.afsc.noaa.gov/

The information available through the website includes the following.

- Species summaries: a summary of each groundfish species is available online, including AFSC research efforts addressing that species where applicable.
- Issue summaries: a summary of major fishery issues is also available, such as bycatch or fishery gear effects on habitat.
- Research efforts: a summary of the research efforts for each of the major AFSC divisions is provided on the website.
- Observer Program: the homepage describes the history of the program and the sampling manuals that describe, among other things, the list of species identified by observers.
- Survey reports: the groundfish stock assessments are based in part on the independent research surveys that are conducted annually, biennially, and triennially in the management areas. Reports of the surveys are made available as NMFS-AFSC National Oceanic and Atmospheric Administration (NOAA) Technical Memoranda, and are available on the website; the data maps and data sets are also accessible.
- Publications: the AFSC Publications Database contains more than 4,000 citations for publications authored by AFSC scientists. Search results provide complete citation details and links to available on-line publications.
- Image library: the website contains an exhaustive library of fish species.

6.1.3 NMFS Alaska Region

6.1.3.1 Programmatic SEIS for the Alaska Groundfish Fisheries

Published in 2004, the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries* (NMFS 2004) is a programmatic evaluation of the BSAI and GOA groundfish fisheries. The document includes several alternative management policies for the fisheries, and provides the supporting analysis for Amendment 81 to the BSAI FMP, which changed the FMP management policy.

The document contains a detailed evaluation of the impact of the FMP on groundfish resources, other fish and marine invertebrates, habitat, seabirds, marine mammals, economic and socioeconomic considerations, and the ecosystem as a whole. The impacts are evaluated in comparison to a baseline condition (for most resources this is the condition in 2002) that is comprehensively summarized and includes the consideration of lingering past effects. Additionally, sections of the document describe the fishery management process in place for the Alaska federal fisheries, and the changes in management since the implementation of the FMP in 1982.

6.1.3.2 EIS for Essential Fish Habitat Identification and Conservation in Alaska

In 2005 NMFS and the Council completed the Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska (EFH EIS) (NMFS 2005). The EFH EIS provided a thorough analysis of alternatives and environmental consequences for amending the Council's FMPs to include EFH information pursuant to Section 303(a)(7) of the Magnuson-Stevens Act and 50 CFR 600.815(a). Specifically, the EFH EIS examined three actions: (1) describing and identifying EFH for Council managed fisheries, (2) adopting an approach to identify HAPCs within EFH, and (3) minimizing to the extent practicable the adverse effects of fishing on EFH. The Council's preferred alternatives from the EFH EIS were implemented through Amendment 78 to the BSAI Groundfish FMP and corresponding amendments to the Council's other FMPs.

6.1.3.3 Website

Much of the information produced by NMFS Alaska region can be accessed through its website, to be found at:

http://www.fakr.noaa.gov/

The information available through the website includes the following.

- Regulations: the FMP's implementing regulations can be found on the Alaska region website, as well as links to the Magnuson-Stevens Act, the American Fisheries Act, the International Pacific Halibut Commission, and other laws or treaties governing Alaska's fisheries
- Catch statistics: inseason and end of year catch statistics for the groundfish fisheries can be found dating back to 1993, or earlier for some fisheries; annual harvest specifications and season opening and closing dates; and reports on share-based fishery programs (such as the individual fishing quota program for fixed-gear sablefish)
- Status of analytical projects: the website includes pages for the many analytical projects that are ongoing in the region
- Habitat protection: maps of essential fish habitat, including a queriable database; status of marine protected areas and habitat protections in Alaska
- Permit information: applications for and information on permits for Alaska fisheries; data on permit holders
- Enforcement: reports, requirements, and guidelines
- News releases: recent information of importance to fishers, fishery managers, and the interested public.

The NMFS Alaska region website also links to the national NMFS website, which covers national issues. For example, NMFS-wide policies on bycatch or improving stock assessments, may be found on the national website. Also, NMFS produces an annual report to Congress on the status of U.S. fisheries, which can be accessed from this website.

6.2 Management and Enforcement Considerations

This section provides information about management and enforcement of the groundfish fisheries off Alaska. Management and enforcement responsibilities include the following:

- Data collection, research, and analysis to prepare annual stock assessments;
- The annual groundfish specifications process through which TAC limits and prohibited species catch (PSC) limits are established;
- The ongoing process of amending the FMPs and regulations to implement fishery management measures recommended by the Council or NMFS;

- Monitoring of commercial fishing activities to estimate the total catch of each species and to ensure compliance with fishery laws and regulations;
- Actions to close commercial fisheries once catch limits have been reached; and
- Actions taken by NMFS Enforcement, the U.S. Coast Guard (USCG), and NOAA General Counsel to identify, educate, and, in some cases, penalize people who violate the laws and regulations governing the groundfish fisheries.

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

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

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

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

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

6.2.1 Expected costs of groundfish management

Estimates of the costs of BSAI and GOA groundfish management are summarized in Table 6-1 below. For reasons discussed in the table, it has not been possible to make accurate estimates of exact expenditures on groundfish management, nor, in some cases, to distinguish between the two groundfish fisheries. An examination of the Table 6-1 suggests that the BSAI and GOA groundfish fisheries appear to cost the U.S. in excess of $60 million, annually, in management and related research efforts. A larger share of this appears to be spent in the BSAI than the GOA.

A comparison of the costs reported in this section with estimates of revenues generated by the groundfish fisheries does not constitute a cost-benefit analysis of this management effort. There are a number of reasons for this:

- The gross revenues from fishing are not a measure of the value of the commercial groundfish fisheries. On one hand, they ignore the private costs (the opportunity costs of labor and capital) used to catch and process the fish resources. On the other hand, they ignore the appropriate measure of benefits to consumers - the "consumers' surplus" or the value that consumers would be willing to pay for consuming the fish, over and above what they actually have to pay.
- Management costs are only imperfectly identified. Many costs are incurred for multiple purposes, and it is difficult to determine what costs were incurred for which function. Research into ecosystem dynamics may support groundfish management, as well as many other goals. Agency staff often had difficulty determining what portion of an agency budget was spent on groundfish management; staff were often unable to make the even more detailed cost assignment to GOA or BSAI management. This is a problem inherent in the nature of the joint or fixed costs that are often involved. There often simply is no logical way to make these allocations. Even when cost estimates are provided, they are generally very rough approximations.
- The comparison would imply that the management activity was related to the revenues in a specific way. However, specific causal relationships have not been analyzed here. Moreover, even if a causal relationship were implied, it would only be an evaluation of whether or not management at the given level had higher benefits than costs. It would not involve an evaluation of alternative approaches or levels of management. It would thus be of very limited use for policy decisions.
- The BSAI and GOA groundfish fisheries produce a range of social and ecological services beyond the commercial production and consumption of groundfish products. Groundfish support sport and subsistence fisheries and are an integral part of the North Pacific ecosystem. For example, groundfish provide forage for other fish species, seabirds, and marine mammals. The commercial values above only represent one "use" of the groundfish resources.

Table 6-1 presents the estimated cost of groundfish fishery management in a "typical" year in the period 2002-2006. Often the cost estimates are based on operations in the 2003 Federal year, the most recently completed fiscal year at the time the estimates were completed (May 2004). In some instances they incorporate projections; for example, the estimates for the NMFS Alaska Region's Restricted Access Management Program are estimates of anticipated costs following implementation of the new Crab Rationalization Program. Almost all of the agencies listed here have multiple functions. Often an activity—such as a USCG patrol—will carry out a wide range of tasks in addition to supporting groundfish management. It has therefore often been impossible for agency staff to separate groundfish management costs from overall expenditures, or to separate out GOA and BSAI groundfish management expenditures from groundfish expenditures. Where agency staff did not feel they had a basis on which to make an estimate, no estimate has been provided. In general, estimates are provided to the hundred thousand dollar level. This convention may reasonably approximate costs in some instances where budgets are relatively small and well defined criteria exist for making estimates. In other instances, the reader should be aware that they may provide an undue sense of precision. In general, these estimates are very rough.

The general procedure has been to get budget information from the various departments and to allocate that to groundfish, GOA groundfish, and BSAI groundfish drawing on agency expertise. There are a number of problems inherent with this process. Many activities produce multiple outcomes and it is difficult or impossible to assign their costs to one of those outcomes. Often there is no clear bright line between fishery management activities and other activities. In many cases, the appropriate criteria for allocating costs to one activity or another were not well defined. Much of this analysis depends on the judgment of agency analysts, and the use of different analysts for each agency means that differing judgments might have been used by different agencies. For all of these reasons, the reader should be aware that these estimates can only be treated as rough approximations.

Table 6-1 Estimated cost of fishery management by government agencies.

Agency/ Division	Function	$Millions			
		Overall Alaska region expenditures	Groundfish fisheries	GOA	BSAI
North Pacific Fishery Management Council					
	The Council is one of eight regional councils established by the Magnuson Fishery Conservation and Management Act in 1976 (which has been renamed the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)) to oversee management of the nation's fisheries. With jurisdiction over the 900,000 square mile Exclusive Economic Zone (EEZ) off Alaska, the Council has primary responsibility for groundfish management in the GOA and BSAI, including cod, pollock, flatfish, mackerel, sablefish, and rockfish species harvested mainly by trawlers, hook and line longliners and pot fishermen. The Council also makes allocative and limited entry decisions for halibut, though the U.S. - Canada International Pacific Halibut Commission is responsible for conservation of halibut. Other large Alaska fisheries such as salmon, crab and herring are managed primarily by the State of Alaska. The Council budget is about $3 million, annually. Staff reports that groundfish takes about 80% of their effort, with a 1 to 2 ratio of GOA to BSAI concerns.	$3.0	$2.4	$0.8	$1.6
National Marine Fisheries Service (Alaska Region)					
Sustainable Fisheries Division (SFD)	The SFD implements the intent of the Council and NMFS approved management programs consistent with the Magnuson-Stevens Act and other applicable law. SFD coordinates with the State of Alaska on the development of management programs, including halibut subsistence, and the International Pacific Halibut Commission on the development of regulations governing the Pacific halibut fishery off Alaska. SFD collects and manages catch data from North Pacific groundfish fisheries, develops and maintains information systems for integrating catch and observer data for estimating species specific total catch and uses those data to manage fisheries in an orderly and safe manner while maintaining harvest amounts within specified total allowable catch and prohibited species catch limits. SFD staff provides current and historic fishery statistics to other government agencies and the public, maintaining the confidentiality of protected statistics; and providing guidance to the Council and other management agencies on implementation and monitoring considerations of proposed management measures. The SFD administers and manages the Western Alaska Community Development Quota Program so that allocations of groundfish, crab, and halibut quotas to the CDQ groups are accomplished consistent with applicable law and are harvested within established administrative and fishery management regulations to provide the maximum economic benefits to western Alaska communities.	$3.6	$2.9	$0.9	$2.0
Protected Resources Division (PRD)	The PRD is responsible under the Endangered Species Act (ESA) for consultations on Federal actions that may affect listed marine mammal species for which NMFS has trust responsibility. NMFS is also responsible for recovering listed protected species to the point that they are no longer in danger of extinction and may be removed from listing under the ESA.	$2.2	$0.8	No estimate provided	
Habitat Conservation Division (HCD)	The HCD carries out NMFS' statutory responsibilities for habitat conservation in Alaska under the Magnuson-Stevens Act, Fish and Wildlife Coordination Act, National Environmental Policy Act (NEPA), Federal Power Act, and other laws. HCD has two principal programs: identification and conservation of Essential Fish Habitat (EFH) through fishery management, and environmental review of non-fishing activities that may adversely affect EFH or other habitats for living marine resources. HCD also supports habitat restoration projects in conjunction with the NMFS Restoration Center. HCD has staff located in the Alaska Regional Office in Juneau and a field office in Anchorage.	$1.6	$0.4	$0.2	$0.2

Agency/ Division	Function	$Millions			
		Overall Alaska region expenditures	Groundfish fisheries	GOA	BSAI
Restricted Access Management (RAM)	RAM implements the Alaska Region's licensing and permitting programs. Specific duties within that broad mandate include calculation and issuance of IFQ permits in the halibut and sablefish IFQ program, together with annual issuance of related permits and licenses, cost recovery activities mandated by the Magnuson-Stevens Act, and determinations on applications for transfers, hired skippers, and other program elements. Additionally, RAM oversees implementation of several other licensing programs, including the North Pacific groundfish and crab License Limitation program, the Federal Fisheries and Processing Permit program, and vessel, processor, and cooperative permitting under the American Fisheries Act (AFA). During Federal Year 2003, RAM assumed responsibilities for implementation of the subsistence halibut program.	$1.9	$0.4	$0.3	$0.1
Other NMFS Alaska Region organizational units: Regional Directorate, Operations, Management & Information	Fulfills a variety of Regional leadership & coordination roles. Includes: workload competence, quality, and management. Information technology support, grants administration, administrative appeals. Finance & logistical support. NEPA coordination & compliance, preparation of NEPA, E.O. 12866, and Regulatory Flexibility Act analyses for other divisions.	$6.2	$3.5	$1.0	$2.5
Grants administered by the Alaska Region	The Alaska Region dispenses millions of dollars in grants for fishery management administration and research. Grants to the State of Alaska to assist with groundfish related activity are discussed below, under the line for the State of Alaska. In general, there are few other funds distributed for groundfish related projects. Considerable funding is used for marine mammal related projects, and in recent years large sums have been dispensed for Steller sea lion (SSL) research. In Federal Year 2003, total marine mammal related grants were about $13 million, of which about $11 million were for SSL research. While much of this marine mammal work will have implications for groundfish management, it serves many other purposes as well, and cannot be considered primarily a groundfish management cost item. It is therefore not listed in the summary columns.	Grants to the state are described below. No additional significant grants specifically for groundfish.			
Alaska Fisheries Science Center					
Resource Assessment and Conservation Engineering Division (RACE)	RACE conducts fishery surveys to measure the distribution and abundance of approximately 40 commercially important fish and crab stocks in the eastern Bering Sea, GOA, and marine waters off California, Oregon, and Washington. Data derived from these surveys are analyzed by Center scientists and supplied to fishery management agencies and to the commercial fishing industry.	$17.7	$13.6	$5.8	$7.8
Resource Ecology and Fisheries Management (REFM)	The REFM Division conducts research and data collection to support management of Northeast Pacific and eastern Bering Sea fish and crab resources. Groundfish and crab stock assessments are developed annually and used by the Pacific and North Pacific Fishery Management Councils to set catch quotas (based on assessments). Division scientists also evaluate how fish stocks and user groups might be affected by fishery management actions.	$11.2	$10.7	$3.2	$7.5
Auke Bay Lab (ABL)	ABL has housed federal fisheries research in Alaska since 1960. The laboratory is located 12 miles north of Juneau and consists of six research programs.	$12.0	$3.9	$2.9	$1.0
NOAA Office of General Counsel - Alaska Region					
	The NOAA General Counsel serves as the chief legal officer for NOAA of the U.S. Department of Commerce. The position of the NOAA General Counsel was established in Section 2(e)(1) of Reorganization Plan No. 4 of 1970 that created NOAA. The General Counsel is appointed by the Secretary of Commerce, with the approval of the President. The Office of the General Counsel provides legal service and guidance for all matters that may arise in the conduct of NOAA's missions. The Office of the Alaska Regional Counsel (GCAK)s co-located with the Alaska Region of NMFS in Juneau, Alaska. GCAK provides legal advice and assistance on issues related to the administration of NOAA programs in Alaska.	$2.0	No estimates provided		

Agency/ Division	Function	$Millions			
		Overall Alaska region expenditures	Groundfish fisheries	GOA	BSAI
NOAA Office of Law Enforcement - Alaska Region					
	NMFS Office for Law Enforcement is dedicated to the enforcement of laws that protect and conserve our nation's living marine resources and their natural habitat. NMFS special agents and enforcement officers have specified authority to enforce over 100 legislative acts under 32 statutes, as well as numerous treaties related to the conservation and protection of marine resources and other matters of concern to NOAA. These are projected Federal Year 2004 costs. They do not include costs of sablefish IFQ enforcement. IFQ halibut and IFQ sablefish enforcement were so interlinked, staff was unable to break out the costs. Total IFQ enforcement expenditures were projected to be $1.73 million.	$5.0	$2.4	$1.8	$0.6
United States Coast Guard - 17th District					
	The USCG supports the groundfish fisheries by providing at-sea enforcement of all domestic fishery regulations. The numbers provided cannot capture the accurate cost of domestic fishery enforcement. Because all USCG ships and aircraft are multi-mission platforms, counting all fishery resources hours expended will overestimate the cost. The USCG does not conduct patrols that strictly examine fishery regulations nor does any boarding conducted by the USCG look only for compliance with fishery regulations. All federal laws and regulations are enforced on every boarding. Because of that, the true cost of at-sea enforcement is something less than the number provided but a more accurate number is intangible. Many of the resource hours used to build these numbers would have been conducted in the absence of FMP requirements for enforcement. Such patrols would enforce safety regulations and/or drug laws, and interdict alien migration. Currently all of these are being enforced concurrently with fishery regulations. The numbers provided include resources from the USCG budget in Alaska and the Pacific Area headquarters budget. This is necessary because some USCG ships patrolling in Alaska come from the lower 48 or Hawaii, and are not funded from the Alaskan USCG budget. The numbers are therefore not conducive to comparing amount spent on enforcement in Alaska to overall the USCG budget in Alaska.		< $40.2	< $13.9	< $26.3
Alaska Department of Fish and Game (ADF&G)					
	The groundfish fisheries in the EEZ are a source of jobs and income for many residents of Alaska; groundfish stocks and fishing operations move across the line dividing state from federal jurisdiction; a large proportion of groundfish harvests from the EEZ are delivered to state ports and are recorded on state fish landings records. For all these reasons, the State of Alaska has a significant role in the management of groundfish stocks and fisheries in the EEZ. The state spends money to support the Council process. State managers are particularly important in the management of the demersal shelf rockfish fishery in the eastern GOA. The state spends money on port sampling of groundfish landings, collecting landings records, and data processing and analysis of landings records. The Alaska Board of Fisheries interacts with the Council and considers management proposals to better coordinate federal and state regulations. State ADF&G offices provide local sources of information on EEZ management rules for the public. A significant part of the state's contribution is supported with federal funding. The figure for groundfish represents the value of federal grants awarded to the state. This understates ADF&G expenditures.		>$2.5	No estimates provided	
Other agencies of the State of Alaska					
	The Alaska Commercial Fisheries Entry Commission processes landings records and Commercial Operators' Annual Reports and is an important source for price information for shoreside landings; the Alaska Department of Commerce monitors CDQ group activity and is involved in the process of allocating CDQ among the groups; the Alaska Division of Measurement Standards checks scales for shoreside plants.	No estimate provided			

Agency/ Division	**Function**	**$Millions**			
		Overall Alaska region expenditures	**Groundfish fisheries**	**GOA**	**BSAI**
Fish and Wildlife Service (USFWS)					
	A representative of the USFWS serves on the Council and on the Ecosystem and Steller Sea Lion Mitigation committees. The USFWS is also represented on the Groundfish Planning Team. USFWS seabird and marine mammal expertise help provide a broader ecological perspective on fisheries management. In addition to long-term seabird and marine mammal population monitoring programs in the GOA and BSAI, USFWS staff are actively engaged with industry and NMFS to develop strategies and technologies to reduce the incidental take of seabirds in groundfish fisheries.	No estimate provided			
Alaska Fisheries Information Network (AKFIN)					
	AKFIN is a cooperative data program of the Pacific States Marine Fishery Commission, Alaska Department of Fish and Game, Commercial Fisheries Entry Commission, Council, and NMFS. AKFIN transfers, analyzes, and processes agency fishery data for reporting. AKFIN integrates and aggregates all state and federal harvest and value to produce data sets for FMP analyses and reports such as *Fisheries of the US.*	$0.8	$0.7	$0.4	$0.3
North Pacific Research Board (NPRB)					
	The NPRB's mission is to develop a comprehensive science program of the highest caliber to enhance understanding of the North Pacific, Bering Sea, and Arctic Ocean ecosystems and fisheries. It conducts its work through science planning, prioritization of pressing fishery management and ecosystem information needs, coordination and cooperation among research programs, competitive selection of research projects, increased information availability, and public involvement. The NPRB will seek to avoid duplicating other research. The NPRB expects to support $5 to $6 million in new research each year. Its annual administrative budget is about $0.85 million budget. The groundfish estimate includes NPRB 2003 expenditures for groundfish projects already funded, matching funds provided by grantees, and a third of the agency's annual budget. Costs associated with the NPRB may also be reflected in budgets for other agencies. For example, the ABL has used funds from the NPRB for Aleutian Islands coral investigations. The NPRB reports the $0.8 was expended on this project in 2003, and that there were $0.3 in matching funds.		$5.5	Not estimated	
Costs incurred by the private sector					
	The private sector incurs costs that could fairly be described as management costs. These include the costs of the paperwork associated with the management system, the private costs associated with the observer program, the costs of operating various cooperative or CDQ catch management programs, and the costs of participating in the Council and regulatory processes[1].	for paperwork:	$3.7		
		for observers:	>$10.8	> $1.1	> $9.7

Note: These estimates are rough approximations.

[1] The line between the costs of management and the costs associated with advocacy in the Council process, or with the normal management of an independent business, can be hard to draw. Some of the more important components of this cost item include:

- Costs incurred by private citizens, fisheries organizations, environmental organizations, and other private parties for participation in the Council process.
- Costs of meeting observer requirements (about $10.8 million per year - using 2002 observer days and a cost of $365/day). These provide a low estimate of the total cost of the observer program to fishing operations because fishing operations incur economic and operational impacts that are not directly reflected in the money they must spend on observer coverage. Fishing vessel operators may have to alter their travel plans and schedules to pick up or drop off observers; the observers take up limited space on vessels. Provisions must be made to accommodate the necessary work of the observer on deck (e.g., observing gear setting and retrieval, recording and sampling of catch and bycatch). The observer also occupies "living space" aboard, which otherwise could have housed additional crew members. These operational impacts may be reflected in both increased operating expenses and reduced harvests and revenues. It is not possible, with available information, to quantify these effects, but they may represent a substantial additional cost of operation.
- CDQ groups have significant responsibilities for managing target and non-target quotas. This quota management function may involve personnel and data processing contracts. AFA cooperatives similarly are involved in quota management.

- CDQ groups and AFA cooperatives, and other fishermen, contract with private firms to provide fishing companies with rapidly updated information about the location of PSC bycatch hotspots. Fishing companies are then able to alter their fishing behavior so as to avoid areas with high PSC bycatch. By reducing PSC bycatch, companies are able to extend fishing seasons and avoid other constraints on fishing activity.
- NMFS collects fees from fishermen to offset the costs of managing sablefish IFQ programs. In 2003, NMFS collected an estimated $1.0 million in sablefish cost recovery fees. These costs are already reflected in NMFS spending described above, and should not be counted a second time. However, they do represent a management cost incurred by industry, and are reported here to capture this distributive effect.

6.3 Literature Cited

Anderson, P.J., and Piatt, J.F. (1999). Community reorganization in the Gulf of Alaska following ocean climate regime shift. Marine Ecology Progress Series, 189, pp. 117-123.

Bakkala, R., L. Low, and V. Wespestad, 1979. Condition of groundfish resources in the Bering Sea and Aleutian area. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Tokyo, Japan, October 1979). 105 p., Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. E., Seattle, Washington, 98112.

Bakkala, R., V. Westpestad, L. Low, and J. Traynor, 1980. Condition of groundfish resources in the Eastern Bering Sea and Aleutian Islands Region in 1980. (Document submitted to the annual meeting of the International North Pacific Fisheries Commission, Anchorage, Alaska, October 1980). 98 p., Northwest and Alaska Fisheries Center, National Marine Fisheries Service, NOAA, 2725 Montlake Blvd. E., Seattle, Washington, 98112.

Bond, N.A., Overland, J.E., and Turet, P. (1994). Spatial and temporal characteristics of the wind forcing of the Bering Sea. Journal of Climate, 7, pp.1119-1130.

Brodeur, R.D., Mills, C.E., Overland, J.E., Walters, G.E., and Schumacher, J.D. (1999). Evidence for a substantial increase in gelatinous zooplankton in the Bering Sea, with possible links to climate change. Fisheries Oceanography, 8(4), pp.292-306.

Chikuni, S. 1975. Biological study on the population of the Pacific ocean perch in the North Pacific. Bull. Far Seas Fish. Res. Lab. (Shimizu) 12:1-119.

Christensen, V. (1990). "The ECOPATH II software, or how we can gain from working together." NAGA, 13, pp.9-10.

Christensen, V. (1992). "A model of trophic interactions in the North Sea in 1981, the year of the stomach." Rep.C.M., 1992/L, International Council for the Exploration of the Sea, Copenhagen, DK.pp.25.

Christensen, V. (1994). Energy-based ascendancy. Ecological Modelling, 72, pp.129-144.

Collie, J.S., and H. Gislason, 2001. Biological reference points for fish stocks in a multispecies context. Can. J. Fish. Aquat. Sci. 58: 2167-2176.

Favorite, F., A.J. Dodimead, and K. Nasu. 1976. AOceanography of the Subarctic Pacific region, 1960-71. In: International North Pacific Fisheries Commission Bulletin, 33. International North Pacific Fisheries Commission, 6640 Northwest Marine Drive, Vancouver, BC, Canada V6T 1X2. p. 187. In National Marine Fisheries Service 2001(a).

Favorite, Felix and Taivo Laevastu, 1981. Finfish and the environment. In Hood, D.W. and J.A. Calder (eds.): The eastern Bering Sea shelf: oceanography and resources, Vol. 1. Univ. of Washington Press, Seattle, Washington: 597-610.

Francis, R.C., and Hare, S.R. (1994). Decadal-scale regime shifts in the large marine ecosystems of the North-east Pacific: a case for historical science. Fisheries Oceanography, 3, pp.279-291.

Francis, R.C., Hare, S.R., Hollowed, A.B., and Wooster, W.S. (1998). Effects of interdecadal climate variability on the oceanic ecosystems of the northeast Pacific Ocean. Fisheries Oceanography, 7(1), pp.1-21.

Francis, R.C., Aydin, K., Merrick, R.L., and Bollens, S. (1999). “Modeling and management of the Bering Sea ecosystem.” Dynamics of the Bering Sea, T.R. Loughlin and K. Ohtani (eds.), University of Alaska Sea Grant, Fairbanks, AK. pp.409-433.

Gauvin, J.R., Haflinger, K., and Nerini, M. (1995). “Implementation of a voluntary bycatch avoidance program in the flatfish fisheries of the eastern Bering Sea.” In: Solving Bycatch: considerations for today and tomorrow, University of Alaska Fairbanks, AK Sea Grant College.

Gharrett, A..J. 2003. Population structure of rougheye, shortraker, and northern rockfish based on analysis of mitochondrial DNA variation and microsatellites: completion. Juneau Center of Fisheries and Ocean Sciences, University of Alaska-Fairbanks. 136 pp.

Gislason, H. (1991). The influence of variations in recruitment on multispecies yield predictions in the North Sea. ICES Marine Science Symposia, 193, pp.50-59.

Gislason, H. (1993). Effect of changes in recruitment levels on multispecies long-term predictions. Canadian Journal of Fisheries and Aquatic Science, 50, pp.2315-2322.

Gislason, H, 1999. Single and multispecies reference points for Baltic fish stocks. ICES J. Mar. Sci. 56:571-583.

Goodman, Daniel, Mangel, M., Parkes, G., Quinn, T., Restrepo, V., Smith, T., and Stokes, K., 2002. Scientific Review of the Harvest Strategy Currently Used in the BSAI and GOA Groundfish Fishery Management Plans. Prepared for the North Pacific Fishery Management Council. 145 p.

Grant, W. S., C. I. Zhang, and T. Kobayashi. 1987. Lack of genetic stock discretion in Pacific cod (Gadus macrocephalus). Can. J. Fish. Aquat. Sci. 44:490-498.

Hairston Jr., N.G., Smith, F.E., and Slobodkin, L.B. (1960). Community structure, population control and competition. American Naturalist, 94, pp.421-425.

Hall, S.J. (1999a). Managing fisheries within ecosystems: can the role of reference points by expanded? Aquatic Conservation: Marine and Freshwater Ecosystems, 9, pp.579-583.

Hall, S.J. (1999b). The effects of fishing on marine ecosystems and communities, Blackwell Science, Osford. 274 pp.Halvorson, R., Khalil, F., and Lawarree, J. (2000). “Inshore Sector Catcher Vessel Cooperatives in the Bering Sea/Aleutian Islands Pollock Fisheries.” Discussion paper prepared for the NPFMC.

Hare S.R.and Mantua, N. J. (2000). Empirical evidence for North Pacific regime shifts in 1977 and 1989. Progress in Oceanography 47: 103-145

Hare, S.R., and Francis, R.C. (1995). Climate change and salmon production in the Northeast Pacific Ocean.Climate Change and Northern Fish Populations. Canadian Special Publication of Fisheries and Aquatic Sciences, 121, pp.357-372.

Hattori, A., and J.J. Goering. 1986. ANutrient distributions and dynamics in the eastern Bering Sea. In: The Eastern Bering Sea Shelf: Oceanography and Resources, D. W. Hood and J. A. Calder, eds., University of Washington Press, Seattle, Washington. pp. 975-992. In National Marine Fisheries Service 2001(a).

Heifetz, J. and J. T. Fujioka. 1991. Movement dynamics of tagged sablefish in the northeastern Pacific Ocean. Fish. Res., 11:355-374.

Hollowed, A.B., and Wooster, W.S. (1995). “Decadal-scale variations in the eastern Subarctic Pacific: II. Response of northeast Pacific fish stocks. In Climate Change and Northern Fish Populations.” Canadian Special Publication of Fisheries and Aquatic Sciences, 121, pp.373-385.

Hollowed, A.B., Hare, S.R., and Wooster, W.S. (1998). “Pacific-Basin climate variability and patterns of northeast Pacific marine fish production.” In Biotic Impacts of Extratropical Climate Variability in the Pacific. Proceedings “Aha Huliko”a Hawaiian Winter Workshop, University of Hawaii at Manoa, pp.1-21.

Hollowed, A.B., Bax, N., Beamish, R.J., Collie, J., Fogarty, M., Livingston, P.A., Pope, J., and Rice, J.C. (2000a). Are multispecies models an improvement on single-species models for measuring fishing impacts on marine ecosystems? ICES Journal of Marine Science, 57, pp. In press.

Impact Assessment Incorporated. 1998. Inshore/Offshore 3 - Socioeconomic Description and Social Impact Analysis. Impact Assessment, Inc. 911 W 8th Ave, Suite 402, Anchorage, AK.

Ingraham Jr., W.J., Ebbesmeyer, C.C., and Hinrichsen, R.A. (1998). "Imminent Climate and Circulation Shift in Northeast Pacific Ocean Could Have Major Impact on Marine Resources." EOS, Transactions, American Geophysical Union.

Jennings, S., and Kaiser, M.J. (1998). The effects of fishing on marine ecosystems. Advances in Marine Biology, 34, pp.201-351.

Johnson, E.A. 1983. ATextural and compositional sedimentary characteristics of the Southeastern Bristol Bay continental shelf, Alaska, In: M.S., California State University, Northridge, California. In National Marine Fisheries Service 2001(a).

Kawasaki, T. (1991). "Long-term variability in the pelagic fish populations." Long-term variability of pelagic fish populations and their environment, T. Kawasaki, S. Tanaka, Y. Toba, and A. Taniguchi (eds.), Pergamon Press, New York, pp.47-60.

Kimura, D. K., A. M. Shimada, and F. R. Shaw. 1998. Stock structure and movement of tagged sablefish, Anoplopoma fimbria, in offshore northeast Pacific waters and the effects of El Niño-Southern Oscillation on migration and growth. Fish. Bull. 96: 462-481.

Kinder, T.H., and J.D. Schumacher. 1981. AHydrographic Structure Over the Continental Shelf of the Southeastern Bering Sea. In: The Eastern Bering Sea Shelf: Oceanography and Resources, D. W. Hood and J. A. Calder, eds., University of Washington Press, Seattle, Washington. pp. 31-52. In National Marine Fisheries Service 2001(a).

Klyashtorin, L.B. (1998). Long-term climate change and main commercial fish production in the Atlantic and Pacific. Fisheries Research, 37:115-125.

Laevastu, T. and Larkins, H.A. 1981. Marine Fisheries Ecosystem. Fishing News Book Ltd. Farnham, Surrey, England.

Livingston, P.A. (1997). "A review of models for predicting the effects of climate change on upper trophic level species." PICES Scientific Report, 7, PICES. pp.9-17.

Livingston, P.A., and Jurado-Molina, J. (1999). A multispecies virtual population analysis of the eastern Bering Sea. ICES Journal of Marine Science, 56, pp. In press.

Livingston, P.A., and S. Tjelmeland. 2000. AFisheries in boreal ecosystems. In: ICES Journal of Marine Science. p. 57. In National Marine Fisheries Service 2001(a).

Livingston, P.A., Low, L.L., and Marasco, R.J. (1999). "Eastern Bering Sea Ecosystem Trends." Large Marine Ecosystems of the Pacific Rim: Assessment, Sustainability, and Management, K. Sherman and Q. Tang (eds.), Blackwell Science, Inc., Malden, MA, pp.140-162.

Mantua, N.J., Hare, S.R., Zhang, Y., Wallace, J.M., and Francis, R.C. (1997). A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society, 78(6).

McConnaughey, R.A., and K.R. Smith. 2000. Associations between flatfish abundance and surficial sediments in the eastern Bering Sea. Can. J. Fisher. Aquat. Sci. 57(12):2,410-2,419.

McGowan, J.A., Cayan, D.R., and Dorman, L.M. (1998). Climate-ocean variability and ecosystem response in the Northeast Pacific. Science, 281: 210-217.

Mueter, F-J., 1999. Spatial and temporal changes in species composition of the groundfish community in the Gulf of Alaska. Ph.D. Thesis. University of Alaska Fairbanks, School of Fisheries and Ocean Sciences.

NMFS Observer (NORPAC) database. 1990 to 2001. http://www.afsc.noaa.gov/refm/observers/database.htm.

NMFS. 2003. Fisheries of the United States 2002. National Marine Fisheries Service, Office of Science and Technology, Fisheries Statistics and Economics Division. Silver Spring, MD. September 2003. 126 p.

NMFS. 2004. Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries. NMFS Alaska Region, P.O.Box 21668, Juneau, Alaska 99802-1668. pp.7000.

NMFS. 2005. Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. March 2005. NMFS P. O. Box 21668, Juneau, AK 99801.

North Pacific Fishery Management Council [NPFMC]. 1994. Faces of the Fisheries. North Pacific Fishery Management Council, 605 W 4th Ave Suite 306, Anchorage, AK 99501.

NPFMC. 1992. Draft EA/RIR for Amendment 29 to the GOA Groundfish FMP. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska, 99501. September 1992.

NPFMC. 1999. Environmental Assessment for Amendment 55 to the FMP for the BSAI Groundfish Fishery, Amendment 55 to the FMP for the GOA Groundfish Fishery, Amendment 8 to the FMP for BSAI Crab Fisheries, Amendment 5 to the FMP for Scallop Fisheries Off Alaska, and Amendment 5 to the FMP for Salmon Fisheries in the EEZ off Alaska: Essential Fish Habitat. NPFMC 605 West 4th St. Ste. 306, Anchorage, AK 99501-2252. 364pp.

NPFMC, 2003. Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea and Aleutian Islands Regions. Compiled by the Plan Team for the Groundfish Fisheries of the Bering Sea and Aleutian Islands. North Pacific Fishery Management Council, 605 W 4th Ave, Suite 306, Anchorage, Alaska, 99501. November 2003. pp. 888.

NPFMC. 2005. Environmental Assessment/Regulatory Impact Review/Regulatory Flexibility Analysis for Amendments 65/65/12/7/8 to the BSAI Groundfish FMP (#65), GOA Groundfish FMP (#65), BSAI Crab FMP (#12), Scallop FMP (#7) and the Salmon FMP (# 8) and regulatory amendments to provide Habitat Areas of Particular Concern. March 2005. NPFMC 605 West 4th St. Ste. 306, Anchorage, AK 99501-2252. 248pp.

Orensanz, J.M., Armstrong, J., Armstrong, D., and Hilborn, R. (1998). Crustacean resources are vulnerable to serial depletion-the multifaceted decline of crab and shrimp fisheries in the greater Gulf of Alaska. Reviews in Fisheries Science, 8, pp.117-176.

Parker, K.S., Royer, T.C., and Deriso, R.B. (1995). High-latitude climate forcing and tidal mixing by the 18.6-yr lunar nodal cycle and low-frequency recruitment trends in Pacific halibut (Hippoglossus stenolepis), pp.447-459. In R.J. Beamish (ed.) Climate changes and northern fish populations. Can. Spec. Publ. Fish. Aquat. Sci. 121.

Parkes, G. (2000). Precautionary fisheries management: the CCAMLR approach. Marine Policy, 24, pp.83-91.

Pauly, D., and Christensen, V. (1995). The primary production required to sustain global fisheries. Nature, 374, pp.255-257.

Piatt, J.F., and Anderson, P.J. (1996). “Response of Common Murres to the Exxon Valdez oil spill and long-term changes in the Gulf of Alaska ecosystem.” American Fisheries Society Symposium, 18, pp.720-737.

Pimm, S. (1982). “Food webs”. Chapman and Hall, London, UK.Quinn II, T.J., and Niebauer, H.J. (1995). “Relation of eastern Bering Sea walleye pollock (Theragra chalcogramma) recruitment to environmental and oceanographic variables. In climate change and northern fish populations.” Canadian Special Publication of Fisheries and Aquatic Sciences, 121, pp.497-507.

Potocsky, G.J., 1975. Alaska area 15- and 30-day ice forecasting guide. Naval Ocean. Office, Spec. Publ. 263: 190 p.

Reed, R.K. 1984. AFlow of the Alaskan Stream and its variations. In: Deep-Sea Research, 31:369-386. In National Marine Fisheries Service 2001(a).

Robards, M.D., Gould, P.J., and Piatt, J.F. (1997). "The highest global concentrations and increased abundance of oceanic plastic debris in the North Pacific: Evidence from seabirds." In Marine Debris: Sources, Impacts, and Solutions, J.M.Coe and D.B.Rogers (eds.), Springer-Verlag, New York, pp.71-80.

Robards, M.D., Piatt, J.F., Kettle, A.B., and Abookire, A.A. (1999). Temporal and geographic variation in fish communities of lower Cook Inlet, Alaska. Fishery Bulletin, 97(4), pp.962-977.

Rosenberg, A., P. Mace, G. Thompson, G. Darcy, W. Clark, J. Collie, W. Gabriel, A. MacCall, R. Methot, J. Powers, V. Restrepo, T. Wainwright, L. Botsford, J. Hoenig, and K. Stokes, 1994. Scientific review of definitions of overfishing in U.S. Fishery Management Plans. NOAA Tech. Memo. NMFS-F/SPO-17. 205 p.

Rosenkranz, G.E., Tyler, A.V., Kruse, G.H., and Niebauer, H.J. (1998). Relationship between wind and year class strength of Tanner crabs in the southeastern Bering Sea. Alaska Fishery Research Bulletin, 5, pp.18-24.

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

Sharma, G.D. (1979). The Alaskan shelf: hydrographic, sedimentary, and geochemical environment, Springer-Verlag, New York. 498 pp.

Shimada, A. M., and D. K. Kimura. 1994. Seasonal movements of Pacific cod (Gadus macrocephalus) in the eastern Bering Sea and adjacent waters based on tag-recapture data. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 92:800-816.

Smith, K.R., and R.A. McConnaughey. 1999. ASurficial sediments of the eastern Bering Sea continental shelf: EBSSED database documentation. In: NOAA Technical Memorandum, NMFS-AFSC-104, U.S. Department of Commerce, NMFS Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, Washington 98115-0070. 41 pp. In National Marine Fisheries Service 2001(a).

Spencer, P.D., and J.N. Ianelli. 2001. The implementation of an AD Modelbulder catch at age model for Bering Sea/Aleutian Islands Pacific ocean perch. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands region (September 2001),36 pp. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK 99510.

Spencer, P.D., Walters, G.E., and Wilderbuer, T.K. (1999). "Flathead sole." Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the Bering Sea/Aleutian Islands Region, NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252. pp.391-430.

Stabeno, P.J., Schumacher, J.D., and Ohtani, K. 1993. Dynamics of the Bering Sea: A Summary of Physical, Chemical, and Biological Characteristics, and a Synopsis of Research on the Bering Sea, T.R. Loughlin and K. Ohtani (eds.), North Pacific Marine Science Organization (PICES), University of Alaska Sea Grant, AK-SG-99-03, 1–28.

Sugimoto, T., and Tadokoro, K. (1997). Interannual-interdecadal variations in zooplankton biomass, chlorophyll concentration and physical environment in the subarctic Pacific and Bering Sea. Fisheries Oceanography, 6, pp.74-93.

Trites, A.W., Livingston, P.A., Vasconcellos, M.C., Mackinson, S., Springer, A.M., and Pauly, D. (1999). "Ecosystem change and the decline of marine mammals in the eastern Bering Sea: testing the ecosystem shift and commercial whaling hypotheses." Fisheries Centre Research Reports 1999, Vol. 7, University of British Columbia. pp.100.

United States Global Ocean Ecosystems Dynamics (U.S. GLOBEC). (1996). "Report on climate change and carrying capacity of the North Pacific Ecosystem." U.S. GLOBEC Report, 15, University of California, Berkeley, Berkeley, California. pp.95.

Walters, G. E., and T. K. Wilderbuer. 1997. Flathead sole. In Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the Bering Sea/Aleutian Islands Region as Projected for 1998, p.271-295. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Welden, C.W., and Slauson, W.L. (1986). The intensity of competition versus its importance: An overlooked distinction and some implications. Quarterly Review of Biology, 61, pp.23-44.

Wilimovsky, N.J., 1974. Fishes of the Bering Sea: the state of existing knowledge and requirements for future effective effort. In D. W. Hood and E. J. Kelly (eds.). Oceanography of the Bering Sea. Univ. Alaska, Inst. Mar. Sci., pp. 243-256.

Wolotira, R. J. J., T. M. Sample, S. F. Noel, and C. R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984. NOAA Tech. Memo. NMFS-AFSC-6. 184 pp.

Yodzis, P. (1978). "Competition for space and the structure of ecological communities". Springer-Verlag, New York..191 pp.

Yodzis, P. (1994). Predator-prey theory in management of multispecies fisheries. Ecological Applications, 4, pp.51-58.

Yodzis, P. (1996). "Food webs and perturbation experiments: theory and practice." Food webs: integration of patterns and dynamics, G.A.Polis and K.O.Winemiller, eds., Chapman and Hall, New York, NY, pp.192-200.

Zheng, J., and Kruse, G.H. (1998). Stock-recruitment relationships for Bristol Bay Tanner crab. Alaska Fishery Research Bulletin, 5, pp.116-130.

Fishery Management Plan
for Groundfish of the
Bering Sea and Aleutian Islands Management Area

APPENDICES

Appendix A History of the Fishery Management Plan

The Fishery Management Plan (FMP) for Bering Sea and Aleutian Islands (BSAI) Groundfish was implemented on January 1, 1982. Since that time it has been amended over seventy times, and its focus has changed from the regulation of mainly foreign fisheries to the management of fully domestic fisheries. The FMP was substantially reorganized in Amendment 83. Outdated catch data or other scientific information, and obsolete references, were also removed or updated.

Section A.1 contains a list of amendments to the FMP since its implementation in 1982. A detailed account of each of the FMP amendments, including its purpose and need, a summary of the analysis and implementing regulations, and results of the amendment, is contained in Appendix C to the *Final Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries*, published by National Marine Fisheries Service (NMFS) in 2004.

A.1 Amendments to the FMP

Amendment 1, implemented January 1, 1984, supersedes Amendments 2 and 4:

Established a multi-year, multi-species optimum yield for the groundfish complex.

Established a framework procedure for determining and apportioning total allowable catch (TAC), reserves, and domestic annual harvest (DAH).

Eliminated the "Misty Moon" grounds south of the Pribilof Islands from the Winter Halibut Savings Area.

Allowed experimental year-round domestic trawling in the Winter Halibut Savings Area that will be closely monitored to the extent possible.

Allowed year-round domestic trawling in the Bristol Bay Pot Sanctuary and year-round domestic longlining in the Winter Halibut Savings Area.

Closed the Petrel Bank area to foreign trawling from July 1 through June 30.

Established the Resource Assessment Document as the biological information source for management purposes.

Specified that the fishing and FMP year is the calendar year.

Amendment 1a, implemented January 2, 1982:

Set a chinook salmon prohibited species catch (PSC) limit of 55,250 fish for the foreign trawl fisheries for 1982.

Amendment 2, implemented January 12, 1982:

1. For Yellowfin Sole, increased DAH to 26,000 mt from 2,050 mt, increased joint venture processing (JVP) 25,000 mt from 850 mt, and decreased total allowable level of foreign fishing (TALFF) by 24,150 mt.

For Other Flatfish, increased DAH to 4,200 mt from 1,300 mt, increased JVP to 3,000 mt from 100 mt, and decreased TALFF by 2,900 mt.

For Pacific Cod, decreased maximum sustainable yield to 55,000 mt from 58,700 mt, increased equilibrium yield to 160,000 mt from 58,700 mt, increased acceptable biological catch to 160,000 mt from 58,700 mt, increased optimum yield to 78,700 mt from 58,700 mt, increased reserves to 3,935 mt from 2,935 mt, increased domestic annual processing (DAP) to 26,000 mt from 7,000 mt, and increased DAH to 43,265 mt from 24,265 mt.

Amendment 3, implemented July 4, 1983, supersedes Amendments 1a and 5:

1. Established procedures for reducing the incidental catch of halibut, salmon, king crab and Tanner crab by the foreign trawl fisheries.

Established a Council policy on the domestic groundfish fisheries and their incidental catch of prohibited species.

Amendment 4, implemented May 9, 1983, supersedes Amendment 2:

1. For Pollock, increased JVP for Bering Sea to 64,000 mt from 9,050 mt, increased DAH to 74,500 mt from 19,550 mt, and decreased TALFF to 875,500 mt from 930,450 mt.

For Yellowfin Sole, increased JVP to 30,000 mt from 25,000 mt, increased DAH to 31,200 mt from 26,200 mt, and decreased TALFF to 79,950 mt from 84,950 mt.

For Other Flatfish, increased JVP to 10,000 mt from 3,000 mt, increased DAH to 11,200 mt from 4,200 mt, and decreased TALFF to 46,750 mt from 53,750 mt.

For Atka Mackerel, increased JVP to 14,500 mt from 100 mt, increased DAH to 14,500 mt from 100 mt, and decreased TALFF to 9,060 mt from 23,460 mt.

For Other Species, increased JVP to 6,000 mt from 200 mt, increased DAH to 7,800 mt from 2,000 mt, and decreased TALFF to 65,648 mt from 68,537 mt. Also corrected acceptable biological catch to 79,714 mt, optimum yield to 77,314 mt, and reserves to 3,866 mt.

For Pacific Cod, increased equilibrium yield and acceptable biological catch to 168,000 mt from 160,000 mt, increased optimum yield to 120,000 mt from 78,700 mt, increased reserves to 6,000 mt from 3,935 mt, and increased TALFF to 70,735 mt from 31,500 mt.

For Other Rockfish, assigned DAP of 1,100 mt to BSAI area combined. This caused no change in total DAP. (This conformed FMP with federal regulations.)

For Pacific Ocean Perch, assigned DAP of 550 mt to Bering Sea and 550 mt to Aleutians but caused no change in total DAP. Also assigned JVP of 830 mt to Bering Sea and 830 mt to Aleutians without changing total JVP. (This conformed FMP with federal regulations.)

For Sablefish, assigned JVP of 200 mt to Bering Sea and 200 mt to Aleutians without changing total JVP. (This conformed FMP with federal regulations.) Changed maximum sustainable yield to 11,600 mt in Bering Sea and 1,900 mt in Aleutians to eliminate inconsistencies with annexes.

Changed foreign fisheries restrictions to allow trawling outside 3 miles north of the Aleutian Islands between 170°30' W. and 172° W. longitude, and south of the Aleutian Islands between 170° W. and 172° W. longitude; and to allow longlining outside 3 miles west of 170° W. longitude.

Amendment 5, withdrawn from Secretarial review.

Amendment 6, disapproved by NMFS on December 8, 1983:

Would have established a fishery development zone for exclusive use by U.S. fishing vessels where no foreign directed fishing is permitted.

Amendment 7, implemented August 31, 1983:

Modified the December 1 to May 31 depth restriction on the foreign longline fisheries in the Winter Halibut Savings Area.

Amendment 8, implemented February 24, 1984, supplements Amendment 3:

Established 1984 and 1985 salmon PSCs for the foreign trawl fishery. This amendment was a regulatory amendment which fell within the purview of Amendment 3 and did not require formal Secretarial approval.

Amendment 9, implemented December 1, 1985:

1. Require all catcher/processors that hold their catch for more than two weeks to check in and check out by radio from a regulatory area/district and to provide a written catch report weekly to the NMFS Regional Office.

Incorporated habitat protection policy.

Established definition for directed fishing as 20 percent or more of the catch.

Amendment 10, implemented March 16, 1987:

1. Established Bycatch Limitation Zones for domestic and foreign fisheries for yellowfin sole and other flatfish (including rock sole); an area closed to all trawling within Zone 1; red king crab, *C. bairdi* Tanner crab, and Pacific halibut PSC limits for DAH yellowfin sole and other flatfish fisheries; a *C. bairdi* PSC limit for foreign fisheries; and a red king crab PSC limit and scientific data collection requirement for U.S. vessels fishing for Pacific cod in Zone 1 waters shallower than 25 fathoms.

Revised the weekly reporting requirement for catcher/processors and mothership/processors.

Established explicit authority for reapportionment between DAP and JVP fisheries.

Established inseason management authority.

Amendment 11, implemented December 30, 1987:

1. Established a schedule for seasonal release of joint venture pollock apportionments in 1988 and 1989 (expires December 31, 1989).
2. Revised the definition of prohibited species.
3. Revised the definition of acceptable biological catch and added definitions for threshold and overfishing.

Amendment 11a, implemented April 6, 1988:

Augmented the current domestic catcher/processor and mothership/ processor reporting requirements with at-sea transfer information and modify the weekly reporting requirements.

Amendment 12, implemented May 26, 1989:

1. Revised federal permit requirements to include all vessels harvesting and processing groundfish from the EEZ.
2. Establish a PSC limit procedure for fully utilized groundfish species taken incidentally in JVP and TALFF fisheries.

3. Removed July 1 deadline for Stock Assessment and Fishery Evaluation Report (SAFE).
4. Established rock sole as a target species distinct from the "other flatfish" group.

Amendment 12a, implemented September 3, 1989, replaced Amendment 10:

Established a bycatch control procedure to limit the incidental take of *C. bairdi* Tanner crab, red king crab, and halibut in groundfish fisheries.

Amendment 13, implemented January 1, 1990:

1. Allocated sablefish in the Bering Sea and the Aleutian Islands Management Subareas.
2. Established a procedure to set fishing seasons on an annual basis by regulatory amendment.
3. Established groundfish fishing closed zones near the Walrus Islands and Cape Peirce.
4. Established a new data reporting system.
5. Established a new observer program.
6. Clarified the Secretary's authority to split or combine species groups within the target species management category by a framework procedure.

Amendment 14, implemented January 1, 1991:

1. prohibited roe-stripping of pollock; and established Council policy that the pollock harvest is to be used for human consumption to the maximum extent possible;

divided the pollock TAC into two seasonal allowances: roe-bearing ("A" season) and non roe-bearing ("B" season). The percentage of the TAC allocated to each allowance shall be determined annually during the TAC specifications process.

Amendment 15, approved by the Secretary on January 29, 1993, implemented March 15, 1995:

1. Established an Individual Fishing Quota (IFQ) program for directed fixed gear sablefish fisheries in the Bering Sea and Aleutian Islands management areas.
2. Established a Western Alaska Community Development Quota (CDQ) Program.

Amendment 16, implemented January 1, 1991, replaced Amendment 12a:

1. Extended the effective date of Amendment 12a (originally scheduled to expire December 31, 1990) with the following three changes:
   a) PSC apportionments would be established for the DAP rock sole and deep water turbot/arrowtooth flounder fisheries;
   b) PSC limits could be seasonally apportioned; and
   c) An interim incentive program established to encourage vessels to avoid excessive bycatch rates.

Established a definition of overfishing;

Established procedures for interim TAC specifications; and

Provided for fishing gear restrictions to be modified by regulatory amendments.

Amendment 16a, implemented July 12, 1991.

1. Established inseason authority to temporarily close statistical areas, or portions thereof, to reduce high prohibited species bycatch rates.
2. Provided authority to the Regional Administrator, in consultation with the Council, to set a limit on the amount of the pollock TACs that may be taken with other than pelagic trawl gear.
3. Established a framework for determining an annual herring PSC limit as 1 percent of the estimated herring biomass, attainment of which triggers trawl closures in three Herring Savings Areas.

Amendment 17, implemented April 24, 1992:

1. Authorize the NMFS Regional Administrator to approve exempted fishing permits after consultation with the Council.
2. Establish a unique Bogoslof District as part of the Bering Sea subarea, for which a pollock harvest quota would be annually specified. Fishing for pollock in the remaining parts of the Bering Sea subarea will be unaffected by any closure of the Bogoslof District.

Amendment 18, implemented June 1, 1992 and revised Amendment 18 on December 18, 1992:

1. The Pollock TAC in the BSAI, after subtraction of the reserve, is allocated between inshore and offshore components during the years 1992 through 1995. The inshore component receives 35 percent of the pollock TAC, and the offshore component receives 65 percent.
2. A Catcher Vessel Operational Area (CVOA) is established to limit access to pollock within the area to catcher vessels delivering to the inshore component. This area is between 163° W. and 168° W. longitude, south of 56° N. latitude, and north of the Aleutian Islands. During the 1992 "B" season, the offshore component will not be allowed to fish within the CVOA.
3. Half of the amount of BSAI pollock assigned to the nonspecific reserve (7.5 percent of the BSAI TAC) is allocated as Western Alaska CDQ program.

Amendment 19, implemented September 23, 1992, supplemented Amendment 16:

1. Revise time and area closure (hotspot) authority in the BSAI to authorize, by regulatory amendment, the establishment of time and area closures to reduce bycatch rates of prohibited species. Any closure of an area would require a determination by the Secretary, in consultation with the Council.
2. Expand the Vessel Incentive Program to include all trawl fisheries in the BSAI.
3. Delay opening of all trawl fisheries in the BSAI until January 20. The opening date for non-trawl fisheries, including hook and line, pot and jigging, will continue to be January 1.
4. Establish, for the 1992 season only, a halibut PSC limit of 5,033 mt for the BSAI trawl fishery. Also, a 750 mt halibut PSC mortality limit for the non-trawl fisheries will be established for one year.
5. Establish new halibut and crab PSC apportionment categories. A trawl fishery category closes when it reaches a PSC bycatch allowance allocated to that category.
6. Establish new fishery definitions. The fishery definitions for both the Vessel Incentive Program and the PSC allowance limits would be the same. The definitions of fisheries for these programs would be as follows:
   a) Mid-water pollock if pollock is ≥ to 95 percent of the total catch.
   b) Other targets determined by the dominate species in terms of retained catch.
   c) For the BSAI, a flatfish fishery consisting of rocksole, yellowfin sole, and other flatfish (excluding Greenland turbot and arrowtooth flounder) will be defined and then subdivided into three fisheries.

If yellowfin sole accounts for at least 70% of the retained flatfish catch, it is a yellowfin sole fishery. Otherwise, it is a rock sole or other flatfish fishery depending on the which is dominant in terms of retained catch.

7. To allow more effective enforcement of directed fishery closures and to further limit trawl bycatch amounts of halibut after a halibut PSC bycatch allowance has been reached, changes to Directed Fishing Standards include:
   a) Directed fishing standards would be seven percent of the aggregate amounts of GOA and BSAI groundfish other than pollock, that are caught while fishing for pollock with pelagic trawl gear.
   b) For purposes of the directed fishing rule, the operator of a vessel is engaged in a single fishing trip, from the date when fishing commences or continues in an area after the effective date of a notice prohibiting directed fishing in that area, until the first date on which at least one of following occurs: 1) a weekly reporting period ends; 2) the vessel enters or leaves a reporting area for which an area specific TAC or directed fishing standard is established; or 3) any fish or fish product is offloaded or transferred from that vessel.

<u>Amendment 20,</u> implemented January 19, 1992:

Prohibit trawling year round in the BSAI within 10 nautical miles of 27 Steller sea lion rookeries. In addition, five of these rookeries will have 20 nautical mile trawl closures during the pollock "A" season. These closures will revert back to 10 nautical miles when the "A" season is over, either on or before April 15.

<u>Amendment 21,</u> implemented March 17, 1993, superseded Amendment 16:

Established FMP authority to specify trawl and non-trawl gear halibut bycatch mortality limits by regulatory amendment.

<u>Amendment 21a,</u> implemented January 20, 1995:

Established a Pribilof Islands Habitat Conservation Area.

<u>Amendment 21b,</u> implemented November 29, 1995:

Established trawl closure areas called the Chinook Salmon Savings Areas.

<u>Amendment 22,</u> implemented December 22, 1992:

Established trawl test areas for the testing of trawl gear in preparation of the opening of fishing seasons. Fishermen are allowed to test trawl gear when the BSAI would otherwise be closed to trawling.

<u>Amendment 23</u>, implemented August 10, 1995 and effective on September 11, 1995:

Created a moratorium on harvesting vessels entering the BSAI groundfish fisheries other than fixed gear sablefish after January 1, 1996. The vessel moratorium will last until the Council replaces or rescinds the action, but in any case will end on December 31, 1998. The Council extended the moratorium to January 1, 1999 under Amendment 59. The Council may however extend the moratorium up to 2 additional years, if a permanent limited access program is imminent.

Amendment 24, implemented February 28, 1994, and effective through December 31, 1996:

1. Established the following gear allocations of BSAI Pacific cod TAC as follows: 2 percent to vessels using jig gear; 44.1 percent to vessels using hook-and-line or pot gear, and 53.9 percent to vessels using trawl gear.
2. Authorized the seasonal apportionment of the amount of Pacific cod allocated to gear groups. Criteria for seasonal apportionments and the seasons authorized to receive separate apportionments will be set forth in regulations.

Amendment 25, implemented May 20, 1994, superseded Amendment 21:

Eliminated the primary halibut bycatch mortality limit established for the trawl gear fisheries (3,300 mt). The overall bycatch mortality limit established for these fisheries (3,775 mt) remained unchanged.

Amendment 26, implemented July 24, 1996:

Established a Salmon Donation Program that authorizes the voluntary retention and distribution of salmon taken as bycatch in the groundfish trawl fisheries off Alaska to economically disadvantaged individuals.

Amendment 27, implemented October 6, 1994, superseded Amendments 13 and 18, repealed and replaced by Amendment 47:

Implemented language changes to the Fishery Management Plans to indicate that observer requirements under the FMPs are contained in the North Pacific Fisheries Research Plan.

Amendment 28, implemented August 11, 1993, supplemented Amendment 20:

Established three districts in the Aleutian Islands management subarea for purposes of distributing the groundfish TACs spatially.

Amendment 29, not submitted.

Amendment 30, implemented September 23, 1994, revised Amendment 18:

Raised the CDQ allocation limit for qualified applicants from 12 to 33 percent.

Amendment 31, implemented November 7, 1994, revised Amendment 15:

Implemented the Modified Block plan to prevent excessive consolidation of the halibut and sablefish fisheries, and clarifies the transfer process for the IFQ program.

Amendment 32, implemented February 23, 1996, revised Amendment 15:

Established a one-time transfer of halibut and sablefish IFQ for CDQ.

Amendment 33, implemented July 26, 1996, revised Amendment 15:

Allowed freezing of non-IFQ species when fishing sablefish IFQ.

Amendment 34, implemented January 30, 1994:

Allocated Atka mackerel to vessels using jig gear. Annually, up to 2 percent of the TAC specified for this species in the eastern Aleutian Islands District/Bering Sea subarea will be allocated to vessels using jig gear in this area.

Amendment 35, implemented August 1, 1995:

Established a trawl closure area called the *Chum Salmon Savings Area*.

Amendment 36, implemented April 16, 1998:

Defined a forage fish species category and authorized that the management of this species category be specified in regulations in a manner that prevents the development of a commercial directed fishery for forage fish which are a critical food source for many marine mammal, seabird and fish species.

Amendment 37, implemented January 1, 1997

Established a non-pelagic trawl closure area called the *Red King Crab Savings Area*, a trawl closure area called the Nearshore Bristol Bay Trawl Closure, and revised the red king crab PSC limits.

Amendment 38, implemented January 1, 1996, superseded Amendment 18:

Extended provision of Amendment 18, inshore/offshore allocation and modified the Catcher Vessel Operating Area.

Amendment 39, implemented January 1, 1999, except for some parts on January 1, 2000, replaced Amendment 23 and revised Amendment 18:

1. Created a license program for vessels targeting groundfish in the BSAI, other than fixed gear sablefish that is pending regulatory implementation. The license program will replace the vessel moratorium and will last until the Council replaces or rescinds the action.
2. Allocated 7.5 percent of groundfish TACs to the CDQ multispecies fishery.

Amendment 40, implemented January 21, 1998:

Established PSC limits for *C. opilio* crab in trawl fisheries and a snow crab bycatch limitation zone.

Amendment 41, implemented April 23, 1997, revised Amendment 12a:

Revised the *C. bairdi* Tanner crab PSC limit in Zones 1 and 2.

Amendment 42, implemented August 16, 1996, revised Amendment 15

Increased sweep-up levels for small quota share blocks for sablefish managed under the sablefish and halibut IFQ program.

Amendment 43, implemented December 20, 1996, revised Amendment 15:

Established sweep-up provisions to consolidate very small quota share blocks for halibut and sablefish.

Amendment 44, implemented January 9, 1997, revised Amendment 16:

Established a more conservative definition of overfishing.

Amendment 45, implemented January 21, 1999, superseded Amendment 38:

Reauthorized the pollock CDQ allocation.

Amendment 46, implemented January 1, 1997, superseded Amendment 24:

Replaced the three year Pacific cod allocation established with Amendment 24, with the following gear allocations in BSAI Pacific cod: 2 percent to vessels using jig gear; 51 percent to vessels using hook-and-line or pot gear; and 47 percent to vessels using trawl gear. The trawl apportionment will be divided 50 percent to catcher vessels and 50 percent to catcher processors. These allocations as well as the seasonal apportionment authority established in Amendment 24 will remain in effect until amended.

Amendment 47, not submitted.

Amendment 48, implemented December 8, 2004:

1. Revised the harvest specifications process.
2. Changed the title of the FMP.
3. Update the FMP to reflect current groundfish fisheries.

Amendment 49, implemented January 3, 1998:

Implemented an Increased Retention/Increased Utilization Program for pollock and Pacific cod beginning January 1, 1998 and rock sole and yellowfin sole beginning January 1, 2003.

Amendment 50, implemented July 13, 1998, revised Amendment 26:

Established a Prohibited Species Donation Program that expands the Salmon Donation Program to include halibut taken as bycatch in the groundfish trawl fisheries off Alaska to economically disadvantaged individuals.

Amendment 51, partially implemented January 20, 1999, superseded Amendment 38:

Replaced the three year inshore/offshore allocation established with Amendment 38, with the following allocations of BSAI pollock after subtraction of reserves: 39 percent inshore; 61 percent offshore. That portion of the Bering Sea inshore “B” season allocation which is equivalent to 2.5 percent of the BSAI pollock TAC, after subtraction of reserves, shall be made available only to vessels under 125 ft length overall for delivery to the inshore sector, prior to the Bering Sea “B” season, starting on or about August 25. Any overages or underages will be subtracted/added as part of the inshore “B” season. The rules and regulations pertaining to the CVOA shall remain the same, except that during the “B” season, operations in the CVOA will be restricted to catcher vessels delivering to the inshore sector. These allocations will remain in effect until December 31, 2001, unless replaced by another management regime approved by the Secretary.

Amendment 52, not submitted.

Amendment 53, implemented July 22, 1998:

Allocates shortraker and rougheye rockfish TAC 70 percent to trawl fisheries and 30 percent to non-trawl fisheries.

Amendment 54, implemented April 29, 2002, revised Amendment 15:

Revised use and ownership provisions of the sablefish IFQ program.

Amendment 55, implemented April 26, 1999:

Implemented the Essential Fish Habitat (EFH) provisions contained in the Magnuson-Stevens Fishery Conservation and Management Act and 50 CFR 600.815. Amendment 55 describes and identifies EFH fish habitat for BSAI groundfish and describes and identifies fishing and non-fishing threats to BSAI groundfish EFH, research needs, habitat areas of particular concern, and EFH conservation and enhancement recommendations.

Amendment 56, implemented March 8, 1999, revised Amendment 44:

Revised the overfishing definition.

Amendment 57, implemented June 15, 2000, revised Amendment 37 and Amendment 40:

1. Prohibited the use of nonpelagic trawl gear in the directed pollock fishery.
2. Reduced the PSC limit for red king crab by 3,000 animals.

Amendment 58, implemented November 13, 2000, revised Amendment 21b:

Revised Chinook Salmon Savings Areas trawl closure areas.

Amendment 59, implemented January 19, 1999, superseded Amendment 23:

Extended the vessel moratorium through December 31, 1999.

Amendment 60, implemented October 24, 2001 and January 1, 2002; superseded Amendment 59:

1. Required that the vessel would be a specific characteristic of the license and could not be severed from it.
2. Authorized license designations for the type of gear to harvest LLP groundfish as either “trawl” or “non-trawl” gear (or both).
3. Rescinded the requirement that CDQ vessels hold a crab or groundfish license.
4. Added a crab recency requirement which requires one landing during 1/1/96-2/7/98 in addition to the general license and area endorsement qualifications.
5. Allowed limited processing (1 mt) for vessels less than 60 ft LOA with catcher vessel designations.

Amendment 61, implemented January 21, 2000, conformed the FMP with the American Fisheries Act (AFA) of 1998 that:

1. Removed excess capacity in the offshore pollock sector through the retirement of 9 factory trawlers.

Established U.S. ownership requirements for the harvest sector vessels.

Established specific allocations of the BSAI pollock quota as follows - 10 percent to the western Alaska CDQ program, with the remainder allocated 50 percent to the onshore sector, 40 percent to the offshore sector, and 10 percent to the mothership sector.

Identified the specific vessels and processors eligible to participate in the BSAI pollock fisheries

Established the authority and mechanisms by which the pollock fleet can form fishery cooperatives.

Established specific measures to protect the non-AFA (non-pollock) fisheries from adverse impacts resulting from the AFA or pollock fishery cooperatives.

Amendment 62 , approved by the Council in October 2002, revised Amendment 61:

1. Increases the number of times that a Bering Sea stationary floating processor may move to a different inshore location during the fishing year, from one time per year to a total of four times per year. The relocation may not result in more than one recorded landing location in a weekly reporting period.
2. Updates the use restrictions on the Bering Sea Catcher Vessel Operational Area to reflect the changes in the American Fisheries Act.

Amendment 63, pending.

Amendment 64, implemented September 1, 2000, revised Amendment 46:

Allocated the Pacific cod Total Allowable Catch to the jig gear (2 percent), fixed gear (51 percent), and trawl gear (47 percent) sectors.

Amendment 65, implemented July 28, 2006:

Identified four specific sites as habitat areas of particular concern, and established management measures to reduce potential adverse effects of fishing. The sites are: Aleutian Islands Coral Habitat Protection Areas and the Alaska Seamount Habitat Protection Areas, in which the use of bottom contact gear is prohibited; and the Bowers Ridge Habitat Conservation Zone, in which the use of mobile bottom contact gear is prohibited.

Amendment 66, implemented April 6, 2002:

Exempted squid from the CDQ program.

Amendment 67, implemented May 15, 2002, revised Amendment 39:

Established participation and harvest requirements to qualify for a BSAI Pacific cod fishery endorsement for fixed gear vessels.

Amendment 68, not submitted.

Amendment 69, implemented March 13, 2003, revised Amendment 61:

Allows an inshore pollock cooperative to contract with AFA catcher vessels that are qualified for the inshore sector, but outside their cooperative, to harvest the cooperative’s pollock allocation.

Amendment 70, not submitted.

Amendment 71, not submitted.

Amendment 72, implemented August 28, 2003, revised Amendment 15:

Required a verbal departure report instead of a vessel clearance requirement for vessels with IFQ halibut or sablefish leaving the jurisdiction of the Council.

Amendment 73, recommended by the Council in April 2007, but not yet approved by the Secretary of Commerce.

Remove dark rockfish (*S. ciliatus*) from the FMP, which allows the State of Alaska to manage this species.

Amendment 74, unassigned.

Amendment 75, partially implemented May 29, 2003, revised Amendment 49:

Delayed indefinitely the implementation of the flatfish retention and utilization requirements.

Amendment 76, not submitted.

Amendment 77, implemented January 1, 2004, revised Amendment 64:

Implemented a Pacific cod fixed gear allocation between hook and line catcher processors (80 percent), hook and line catcher vessels (0.3 percent), pot catcher processors (3.3 percent), pot catcher vessels (15 percent), and catcher vessels (pot or hook and line) less than 60 feet (1.4 percent).

Amendment 78, implemented July 28, 2006, supersedes Amendment 55:

1. Refined and updated the description and identification of EFH for managed species.
2. Revised approach for identifying Habitat Areas of Particular Concern within EFH, by adopting a site-based approach.
3. Established a new area (Aleutian Islands Habitat Conservation Area) in which non-pelagic trawling is prohibited, to protect sensitive habitats from potential adverse effects of fishing.

Amendment 79, implemented on August 31, 2005.

Implemented a groundfish retention standard in the non-AFA trawl catcher-processor fleet.

Amendment 80, implemented on July 26, 2007, superseded Amendments 49 and 75:

1. Allocates non-pollock groundfish in the BSAI among trawl sectors
2. Creates a limited access privilege program to facilitate the formation of harvesting cooperative in the non-American Fisheries Act trawl catcher/processor sector.

Amendment 81, implemented August 27, 2004:

Revised the management policy and objectives.

Amendment 82, implemented February 24, 2005:

1. Created separate Chinook Salmon PSC limits for the Bering Sea and Aleutian Islands subareas, and modified the closures when the PSC limits are attained.
2. Allocated the non-CDQ directed pollock fishery in the AI subarea to the Aleut Corporation for the purpose of economic development in Adak, Alaska.

Amendment 83, implemented June 13, 2005:

1. Updated the FMP's descriptive sections, technically edited the language, and reorganized the content of the FMP.

Required the TAC for a species or species complex to be equal or less than ABC.

Amendment 84, implemented on June 22, 2007:

Established the salmon bycatch intercooperative agreement which allows vessels participating in the directed fisheries for pollock in the Bering Sea to utilize their internal cooperative structure to reduce salmon bycatch using a method called the ''voluntary rolling hotspot system.''

Amendment 85, partially implemented on March 5, 2007, superseded Amendments 46 and 77:

Implemented a gear allocation among all non-CDQ fishery sectors participating in the directed fishery for Pacific cod. After deduction of the CDQ allocation, the Pacific cod TAC is apportioned to vessels using jig gear (1.4 percent); catcher processors using trawl gear listed in Section 208(e)(1)-(20) of the AFA (2.3 percent); catcher processors using trawl gear as defined in Section 219(a)(7) of the Consolidated Appropriations Act, 2005 (Public Law 108-447) (13.4 percent); catcher vessels using trawl gear (22.1 percent); catcher processors using hook-and-line gear (48.7 percent); catcher vessels ≥60' LOA using hook-and-line gear (0.2 percent); catcher processors using pot gear (1.5 percent); catcher vessels ≥60' LOA using pot gear (8.4 percent); and catcher vessels <60' LOA that use either hook-and-line gear or pot gear (2.0 percent).

Amendment 86, (Observer Program Restructuring) not yet submitted.

Amendment 87, (CDQ eligibility) recommended by the Council in April 2006, but not yet approved by the Secretary of Commerce, superseded by 2006 MSA amendments.

Amendment 88 implemented on February 19, 2008:

Revised the Aleutian Islands Habitat Conservation Area to close additional waters near Buldir Island and to open waters near Agattu Island to nonpelagic trawl gear.

Amendment 89 implemented on May 19, 2008:

1. Established new habitat conservation areas (HCA) (Bering Sea HCA; St. Matthew Island HCA; St. Lawrence Island HCA; and Nunivak Island, Etolin Strait, and Kuskokwim Bay HCA) in which nonpelagic trawling is prohibited, to protect bottom habitat from potential adverse effects of fishing.

2. Established the Northern Bering Sea Research Area in which nonpelagic trawling is prohibited except under an exempted fishing permit that is consistent with a research plan approved by the Council to study the effects of nonpelagic trawling on the management of crab species, marine mammals, ESA-listed species, and subsistence needs for Western Alaska communities.

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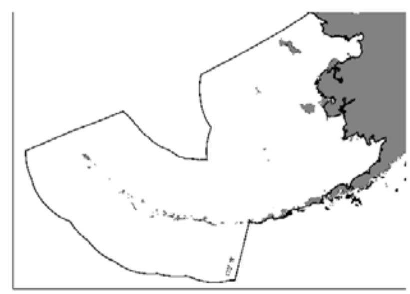
Appendix B Geographical Coordinates of Areas Described in the Fishery Management Plan

This appendix describes the geographical coordinates for the areas described in the Fishery Management Plan (FMP). This appendix divides the descriptions into three types: Bering Sea and Aleutian Islands (BSAI) management area, subareas, and districts (Section B.1), closed areas (Section B.2), and prohibited species bycatch (PSC) bycatch limitation zones (Section B.3).

B.1 Management Area, Subareas, and Districts

Management Area

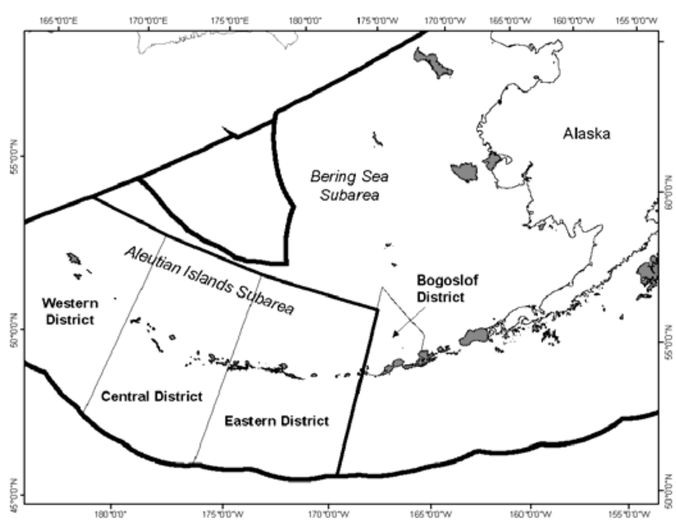
The management area for the BSAI groundfish FMP is the United States (U.S.) Exclusive Economic Zone (EEZ) of the Bering Sea, including Bristol Bay and Norton Sound, and that portion of the North Pacific Ocean adjacent to the Aleutian Islands which is between 170° W. longitude and the U.S.-Russian Convention Line of 1867. To the north, the management area is bounded by the Bering Strait.



Subareas

Two subareas are described in Section 3.1 of the FMP and are defined as follows:

Bering Sea subarea:	The area of the EEZ east of 170° W. longitude that is north of the Aleutian Islands, and the area of the EEZ west of 170° W. longitude that is north of 55° N. latitude.
Aleutian Islands subarea:	The area of the EEZ west of 170°W. longitude and south of 55°N. latitude.



Districts

The Bering Sea subarea contains one district, defined as follows:

Bogoslof District: The area of the EEZ east of 170° W. longitude, west of 167° W. longitude, south of the straight line connecting the coordinates (55°46' N., 170° W.) and (54°30' N., 167° W.), and north of the Aleutian Islands.

The Aleutian Islands subarea is divided into three districts, defined as follows:

Eastern District: That part of the Aleutian Islands subarea between 170° W. longitude and 177° W. longitude.

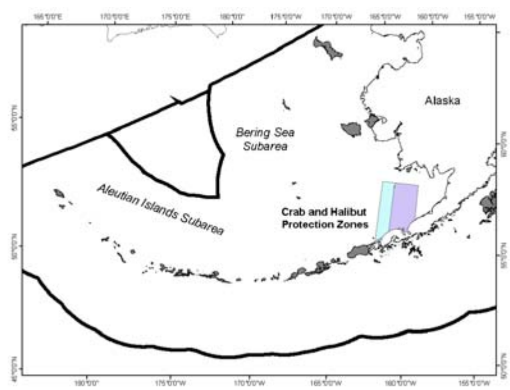
Central District: That part of the Aleutian Islands subarea between 177° W. longitude and 177° E. longitude.

Western District: That part of the Aleutian Islands subarea west of 177° E. longitude.

B.2 Closed Areas

Specific areas of the BSAI are closed to some or all fishing during certain times of the year and are described in Section 3.5.2 of the FMP.

Crab and Halibut Protection Zone



For the periods January 1 - March 14 and June 16 - December 31 of each fishing year, the Crab and Halibut Protection Zone is defined as that portion of the EEZ north of the Alaska Peninsula, south of 58° N. latitude, west of 160° W. longitude and east of 162° W. longitude. For the period March 15 - June 15 of each fishing year the Crab and Halibut Protection Zone is defined as that portion of the EEZ north of the Alaska Peninsula, south of 58° N. latitude, west of 160° W. longitude and east of 163° W. longitude.

Pribilof Islands Habitat Conservation Area

Trawling is prohibited at all times in the EEZ within the area bounded by a straight line connecting the following pairs of coordinates in the following order:

(57° 57.0' N., 168° 30.0' W.)

(56° 55.2' N., 168° 30.0' W.)

(56° 48.0' N., 169° 2.4' W.)

(56° 34.2' N., 169° 2.4' W.)

(56° 30.0' N., 169° 25.2' W.)

(56° 30.0' N., 169° 44.1' W.)

(56° 55.8' N., 170° 21.6' W.)

(57° 13.8' N., 171° 0.0' W.)

(57° 57.0' N., 171° 0.0' W.)

(57° 57.0' N., 168° 30.0' W.)

Chum Salmon Savings Area

Trawling is prohibited from August 1 through August 31 within the area bounded by a straight line connecting the following pairs of coordinates in the order listed:

(56°00' N., 167°00' W.)

(56°00' N., 165°00' W.)

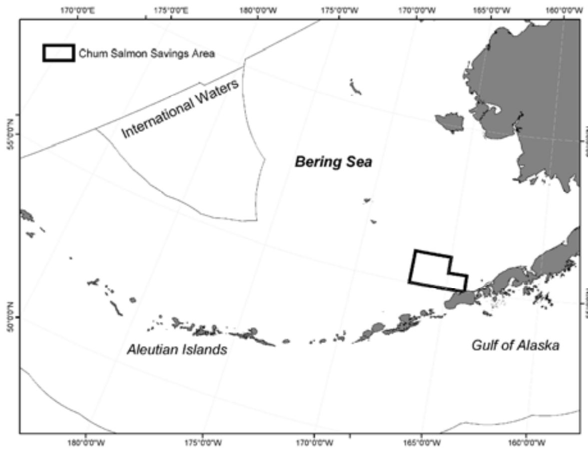
(55°30' N., 165°00' W.)

(55°30' N., 164°00' W.)

(55°00' N., 164°00' W.)

(55°00' N., 167°00' W.)

(56°00' N., 167°00' W.)



Trawling is also prohibited for the remainder of the period September 14 through October 14 upon the attainment of an ‘other salmon’ bycatch limit; see Section B.3.

Red King Crab Savings Area

Non-pelagic trawling is prohibited year round within the area bounded by a straight line connecting the following pairs of coordinates in the order listed below:

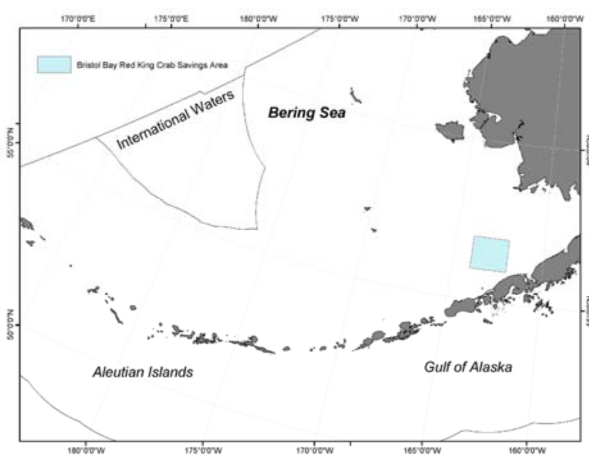
(56° N., 162° W.)

(56° N., 164° W.)

(57° N., 164° W.)

(57° N., 162° W.)

(56° N., 162° W.)



with the exception that a subarea of the Red King Crab Savings Area between 56°00' N. and 56°10' N. latitude and 162° W. and 164° W. longitude may be opened as outlined in Section 3.5.2.1.

Nearshore Bristol Bay Trawl Closure

All trawling is prohibited year round in Bristol Bay east of 162° W. longitude, except the subarea bounded by a straight line connecting the following pairs of coordinates in the order listed below that is open to trawling during the period April 1 to June 15 each year:

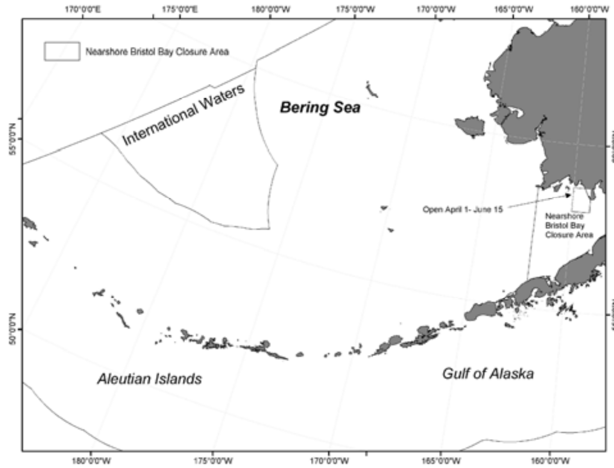
(58°00' N., 160° W.)

(58°43' N., 160° W.)

(58°43' N., 159° W.)

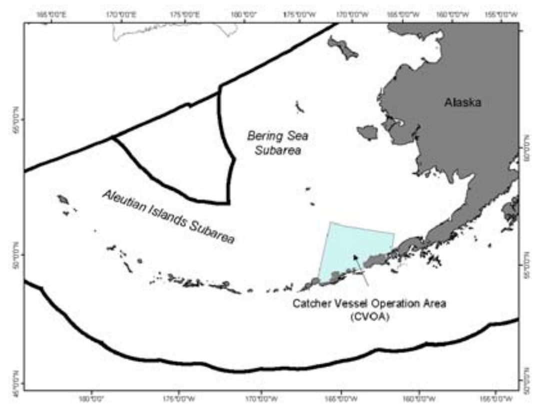
(58°00' N., 159° W.)

(58°00' N., 160° W.)



Catcher Vessel Operational Area (CVOA)

The CVOA is defined as the area of the BSAI east of 167°30' W. longitude, west of 163° W. longitude, south of 56° N. latitude, and north of the Aleutian Islands. The CVOA shall be in effect during the pollock "B" season from September 1 until the date that closes the inshore component "B" season allocation to directed fishing. Vessels in the offshore component or vessels catching pollock for processing by the offshore component are prohibited from conducting directed fishing for pollock in the CVOA unless they are participating in a CDQ fishery.



Alaska Seamount Habitat Protection Area (ASHPA)

Bottom contact gear fishing is prohibited in the portion of the Alaska Seamount Habitat Protection Area located in the BSAI. Coordinates for this habitat protection area are listed in the table below.

Name	Latitude			Longitude		
Bowers Seamount	54	9.00	N	174	52.20	E
	54	9.00	N	174	42.00	E
	54	4.20	N	174	42.00	E
	54	4.20	N	174	52.20	E

Note: The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates is connected to the first set of coordinates by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Aleutian Islands Habitat Conservation Area (AIHCA)

Nonpelagic trawl gear fishing is prohibited in the AIHCA. Note: Unless otherwise footnoted (see footnotes at end of table, beginning on page**Error! Reference source not found.Error! Bookmark not defined.**), each area is delineated by connecting in order the coordinates listed by straight lines. Except for the Amlia North/Seguam donut and the Buldir donut, each area delineated in the table is open to nonpelagic trawl gear fishing. The remainder of the entire Aleutian Islands subarea and the areas delineated by the coordinates for the Amlia North/Seguam and Buldir donuts are closed to nonpelagic trawl gear fishing, as specified at § 679.22. Unless otherwise noted, the last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Name	Latitude			Longitude			Footnote
Islands of 4 Mountains North	52	54.00	N	170	18.00	W	
	52	54.00	N	170	24.00	W	
	52	42.00	N	170	24.00	W	
	52	42.00	N	170	18.00	W	
Islands of 4 Mountains West	53	12.00	N	170	0.00	W	
	53	12.00	N	170	12.00	W	
	53	6.00	N	170	12.00	W	
	53	6.00	N	170	30.00	W	
	53	0.00	N	170	30.00	W	
	53	0.00	N	170	48.00	W	
	52	54.00	N	170	48.00	W	
	52	54.00	N	170	54.00	W	
	52	48.00	N	170	54.00	W	
	52	48.00	N	170	30.00	W	
	52	54.00	N	170	30.00	W	
	52	54.00	N	170	24.00	W	
	53	0.00	N	170	24.00	W	
	53	0.00	N	170	0.00	W	
Yunaska I South	52	24.00	N	170	30.00	W	
	52	24.00	N	170	54.00	W	
	52	12.00	N	170	54.00	W	
	52	12.00	N	170	30.00	W	
Amukta I North	52	54.00	N	171	6.00	W	
	52	54.00	N	171	30.00	W	
	52	48.00	N	171	30.00	W	
	52	48.00	N	171	36.00	W	
	52	42.00	N	171	36.00	W	
	52	42.00	N	171	12.00	W	
	52	48.00	N	171	12.00	W	
	52	48.00	N	171	6.00	W	
Amukta Pass North	52	42.00	N	171	42.00	W	
	52	42.00	N	172	6.00	W	
	52	36.00	N	172	6.00	W	
	52	36.00	N	171	42.00	W	
Amlia North/Seguam	52	42.00	N	172	12.00	W	
	52	42.00	N	172	30.00	W	

Name	Latitude			Longitude			Footnote
	52	30.00	N	172	30.00	W	
	52	30.00	N	172	36.00	W	
	52	36.00	N	172	36.00	W	
	52	36.00	N	172	42.00	W	
	52	39.00	N	172	42.00	W	
	52	39.00	N	173	24.00	W	
	52	36.00	N	173	30.00	W	
	52	36.00	N	173	36.00	W	
	52	30.00	N	173	36.00	W	
	52	30.00	N	174	0.00	W	
	52	27.00	N	174	0.00	W	
	52	27.00	N	174	6.00	W	
	52	23.93	N	174	6.00	W	1
	52	13.71	N	174	6.00	W	
	52	12.00	N	174	6.00	W	
	52	12.00	N	174	0.00	W	
	52	9.00	N	174	0.00	W	
	52	9.00	N	173	0.00	W	
	52	6.00	N	173	0.00	W	
	52	6.00	N	172	45.00	W	
	51	54.00	N	172	45.00	W	
	51	54.00	N	171	48.00	W	
	51	48.00	N	171	48.00	W	
	51	48.00	N	171	42.00	W	
	51	54.00	N	171	42.00	W	
	52	12.00	N	171	42.00	W	
	52	12.00	N	171	48.00	W	
	52	18.00	N	171	48.00	W	
	52	18.00	N	171	42.00	W	
	52	30.00	N	171	42.00	W	
	52	30.00	N	171	54.00	W	
	52	24.00	N	171	54.00	W	
	52	24.00	N	172	0.00	W	
	52	12.00	N	172	0.00	W	
	52	12.00	N	172	42.00	W	
	52	18.00	N	172	42.00	W	
	52	18.00	N	172	37.13	W	2
	52	18.64	N	172	36.00	W	
	52	24.00	N	172	36.00	W	
	52	24.00	N	172	12.00	W	6
Amlia North/Seguam donut	52	33.00	N	172	42.00	W	5

Name	Latitude			Longitude			Footnote
	52	33.00	N	173	6.00	W	5
	52	30.00	N	173	6.00	W	5
	52	30.00	N	173	18.00	W	5
	52	24.00	N	173	18.00	W	5
	52	24.00	N	172	48.00	W	5
	52	30.00	N	172	48.00	W	5
	52	30.00	N	172	42.00	W	5, 7
Atka/Amlia South	52	0.00	N	173	18.00	W	
	52	0.00	N	173	54.00	W	
	52	3.08	N	173	54.00	W	2
	52	6.00	N	173	58.00	W	
	52	6.00	N	174	6.00	W	
	52	0.00	N	174	18.00	W	
	52	0.00	N	174	12.00	W	
	51	54.00	N	174	12.00	W	
	51	54.00	N	174	18.00	W	
	52	6.00	N	174	18.00	W	
	52	6.00	N	174	21.86	W	1
	52	4.39	N	174	30.00	W	
	52	3.09	N	174	30.00	W	1
	52	2.58	N	174	30.00	W	
	52	0.00	N	174	30.00	W	
	52	0.00	N	174	36.00	W	
	51	54.00	N	174	36.00	W	
	51	54.00	N	174	54.00	W	
	51	48.00	N	174	54.00	W	
	51	48.00	N	173	24.00	W	
	51	54.00	N	173	24.00	W	
	51	54.00	N	173	18.00	W	
Atka I North	52	30.00	N	174	24.00	W	
	52	30.00	N	174	30.00	W	
	52	24.00	N	174	30.00	W	
	52	24.00	N	174	48.00	W	
	52	18.00	N	174	48.00	W	
	52	18.00	N	174	54.00	W	
	52	12.00	N	174	54.00	W	
	52	12.00	N	175	18.00	W	
	52	1.14	N	175	18.00	W	1
	52	2.19	N	175	12.00	W	
	52	6.00	N	175	12.00	W	
	52	6.00	N	174	55.51	W	1

Name	Latitude			Longitude			Footnote
	52	6.00	N	174	54.04	W	
	52	6.00	N	174	48.00	W	
	52	12.00	N	174	48.00	W	
	52	12.00	N	174	26.85	W	1
	52	12.94	N	174	18.00	W	
	52	16.80	N	174	18.00	W	1
	52	17.06	N	174	18.00	W	
	52	17.64	N	174	18.00	W	1
	52	18.00	N	174	19.12	W	
	52	18.00	N	174	20.04	W	1
	52	19.37	N	174	24.00	W	
Atka I South	52	0.68	N	175	12.00	W	2
	52	0.76	N	175	18.00	W	
	52	0.00	N	175	18.00	W	
	52	0.00	N	175	12.00	W	
Adak I East	52	12.00	N	176	36.00	W	
	52	12.00	N	176	0.00	W	
	52	2.59	N	176	0.00	W	1
	52	1.79	N	176	0.00	W	
	52	0.00	N	176	0.00	W	
	52	0.00	N	175	48.00	W	
	51	57.74	N	175	48.00	W	1
	51	55.48	N	175	48.00	W	
	51	54.00	N	175	48.00	W	
	51	54.00	N	176	0.00	W	1
	51	53.09	N	176	6.00	W	
	51	51.40	N	176	6.00	W	1
	51	49.67	N	176	6.00	W	
	51	48.73	N	176	6.00	W	1
	51	48.00	N	176	6.36	W	
	51	48.00	N	176	9.82	W	1
	51	48.00	N	176	9.99	W	
	51	48.00	N	176	16.19	W	1
	51	48.00	N	176	24.71	W	
	51	48.00	N	176	25.71	W	1
	51	45.58	N	176	30.00	W	
	51	42.00	N	176	30.00	W	
	51	42.00	N	176	33.92	W	1
	51	41.22	N	176	42.00	W	
	51	30.00	N	176	42.00	W	
	51	30.00	N	176	36.00	W	

Name	Latitude			Longitude			Footnote
	51	36.00	N	176	36.00	W	
	51	36.00	N	176	0.00	W	
	51	42.00	N	176	0.00	W	
	51	42.00	N	175	36.00	W	
	51	48.00	N	175	36.00	W	
	51	48.00	N	175	18.00	W	
	51	51.00	N	175	18.00	W	
	51	51.00	N	175	0.00	W	
	51	57.00	N	175	0.00	W	
	51	57.00	N	175	18.00	W	
	52	0.00	N	175	18.00	W	
	52	0.00	N	175	30.00	W	
	52	3.00	N	175	30.00	W	
	52	3.00	N	175	36.00	W	
Cape Adagdak	52	6.00	N	176	12.44	W	
	52	6.00	N	176	30.00	W	
	52	3.00	N	176	30.00	W	
	52	3.00	N	176	42.00	W	
	52	0.00	N	176	42.00	W	
	52	0.00	N	176	46.64	W	
	51	57.92	N	176	46.51	W	1
	51	54.00	N	176	37.07	W	
	51	54.00	N	176	18.00	W	
	52	0.00	N	176	18.00	W	
	52	0.00	N	176	12.00	W	
	52	2.85	N	176	12.00	W	1
	52	4.69	N	176	12.44	W	
Cape Kiguga/Round Head	52	0.00	N	176	53.00	W	
	52	0.00	N	177	6.00	W	
	51	56.06	N	177	6.00	W	1
	51	54.00	N	177	2.84	W	
	51	54.00	N	176	54.00	W	
	51	48.79	N	176	54.00	W	1
	51	48.00	N	176	50.35	W	
	51	48.00	N	176	43.14	W	1
	51	55.69	N	176	48.59	W	
	51	55.69	N	176	53.00	W	
Adak Strait South	51	42.00	N	176	55.77	W	
	51	42.00	N	177	12.00	W	
	51	30.00	N	177	12.00	W	
	51	36.00	N	177	6.00	W	

Name	Latitude			Longitude			Footnote
	51	36.00	N	177	3.00	W	
	51	39.00	N	177	3.00	W	
	51	39.00	N	177	0.00	W	
	51	36.00	N	177	0.00	W	
	51	36.00	N	176	57.72	W	3
Bay of Waterfalls	51	38.62	N	176	54.00	W	
	51	36.00	N	176	54.00	W	
	51	36.00	N	176	55.99	W	3
Tanaga/Kanaga North	51	54.00	N	177	12.00	W	
	51	54.00	N	177	19.93	W	
	51	51.71	N	177	19.93	W	
	51	51.65	N	177	29.11	W	
	51	54.00	N	177	29.11	W	
	51	54.00	N	177	30.00	W	
	51	57.00	N	177	30.00	W	
	51	57.00	N	177	42.00	W	
	51	54.00	N	177	42.00	W	
	51	54.00	N	177	54.00	W	
	51	50.92	N	177	54.00	W	1
	51	48.00	N	177	46.44	W	
	51	48.00	N	177	42.00	W	
	51	42.59	N	177	42.00	W	1
	51	45.57	N	177	24.01	W	
	51	48.00	N	177	24.00	W	
	51	48.00	N	177	14.08	W	4
Tanaga/Kanaga South	51	43.78	N	177	24.04	W	1
	51	42.37	N	177	42.00	W	
	51	42.00	N	177	42.00	W	
	51	42.00	N	177	50.04	W	1
	51	40.91	N	177	54.00	W	
	51	36.00	N	177	54.00	W	
	51	36.00	N	178	0.00	W	
	51	38.62	N	178	0.00	W	1
	51	42.52	N	178	6.00	W	
	51	49.34	N	178	6.00	W	1
	51	51.35	N	178	12.00	W	
	51	48.00	N	178	12.00	W	
	51	48.00	N	178	30.00	W	
	51	42.00	N	178	30.00	W	
	51	42.00	N	178	36.00	W	
	51	36.26	N	178	36.00	W	1

Name	Latitude			Longitude			Footnote
	51	35.75	N	178	36.00	W	
	51	27.00	N	178	36.00	W	
	51	27.00	N	178	42.00	W	
	51	21.00	N	178	42.00	W	
	51	21.00	N	178	24.00	W	
	51	24.00	N	178	24.00	W	
	51	24.00	N	178	12.00	W	
	51	30.00	N	178	12.00	W	
	51	30.00	N	177	24.00	W	
Amchitka Pass East	51	42.00	N	178	48.00	W	
	51	42.00	N	179	18.00	W	
	51	45.00	N	179	18.00	W	
	51	45.00	N	179	36.00	W	
	51	42.00	N	179	36.00	W	
	51	42.00	N	179	39.00	W	
	51	30.00	N	179	39.00	W	
	51	30.00	N	179	36.00	W	
	51	18.00	N	179	36.00	W	
	51	18.00	N	179	24.00	W	
	51	30.00	N	179	24.00	W	
	51	30.00	N	179	0.00	W	
	51	25.82	N	179	0.00	W	
	51	25.85	N	178	59.00	W	
	51	24.00	N	178	58.97	W	
	51	24.00	N	178	54.00	W	
	51	30.00	N	178	54.00	W	
	51	30.00	N	178	48.00	W	
	51	32.69	N	178	48.00	W	1
	51	33.95	N	178	48.00	W	
Amatignak I	51	18.00	N	178	54.00	W	
	51	18.00	N	179	5.30	W	1
	51	18.00	N	179	6.75	W	
	51	18.00	N	179	12.00	W	
	51	6.00	N	179	12.00	W	
	51	6.00	N	179	0.00	W	
	51	12.00	N	179	0.00	W	
	51	12.00	N	178	54.00	W	
Amchitka Pass Center	51	30.00	N	179	48.00	W	
	51	30.00	N	180	0.00	W	
	51	24.00	N	180	0.00	W	
	51	24.00	N	179	48.00	W	

Name	Latitude			Longitude			Footnote
Amchitka Pass West	51	36.00	N	179	54.00	E	
	51	36.00	N	179	36.00	E	
	51	30.00	N	179	36.00	E	
	51	30.00	N	179	45.00	E	
	51	27.00	N	179	48.00	E	
	51	24.00	N	179	48.00	E	
	51	24.00	N	179	54.00	E	
Petrel Bank	52	51.00	N	179	12.00	W	
	52	51.00	N	179	24.00	W	
	52	48.00	N	179	24.00	W	
	52	48.00	N	179	30.00	W	
	52	42.00	N	179	30.00	W	
	52	42.00	N	179	36.00	W	
	52	36.00	N	179	36.00	W	
	52	36.00	N	179	48.00	W	
	52	30.00	N	179	48.00	W	
	52	30.00	N	179	42.00	E	
	52	24.00	N	179	42.00	E	
	52	24.00	N	179	36.00	E	
	52	12.00	N	179	36.00	E	
	52	12.00	N	179	36.00	W	
	52	24.00	N	179	36.00	W	
	52	24.00	N	179	30.00	W	
	52	30.00	N	179	30.00	W	
	52	30.00	N	179	24.00	W	
	52	36.00	N	179	24.00	W	
	52	36.00	N	179	18.00	W	
	52	42.00	N	179	18.00	W	
	52	42.00	N	179	12.00	W	
Rat I/Amchitka I South	51	21.00	N	179	36.00	E	
	51	21.00	N	179	18.00	E	
	51	18.00	N	179	18.00	E	
	51	18.00	N	179	12.00	E	
	51	23.77	N	179	12.00	E	1
	51	24.00	N	179	10.20	E	
	51	24.00	N	179	0.00	E	
	51	36.00	N	178	36.00	E	
	51	36.00	N	178	24.00	E	
	51	42.00	N	178	24.00	E	
	51	42.00	N	178	6.00	E	
	51	48.00	N	178	6.00	E	

Name	Latitude			Longitude			Footnote
	51	48.00	N	177	54.00	E	
	51	54.00	N	177	54.00	E	
	51	54.00	N	178	12.00	E	
	51	48.00	N	178	12.00	E	
	51	48.00	N	178	17.09	E	1
	51	48.00	N	178	20.60	E	
	51	48.00	N	178	24.00	E	
	52	6.00	N	178	24.00	E	
	52	6.00	N	178	12.00	E	
	52	0.00	N	178	12.00	E	
	52	0.00	N	178	11.01	E	1
	52	0.00	N	178	5.99	E	
	52	0.00	N	177	54.00	E	
	52	9.00	N	177	54.00	E	
	52	9.00	N	177	42.00	E	
	52	0.00	N	177	42.00	E	
	52	0.00	N	177	48.00	E	
	51	54.00	N	177	48.00	E	
	51	54.00	N	177	30.00	E	
	51	51.00	N	177	30.00	E	
	51	51.00	N	177	24.00	E	
	51	45.00	N	177	24.00	E	
	51	45.00	N	177	30.00	E	
	51	48.00	N	177	30.00	E	
	51	48.00	N	177	42.00	E	
	51	42.00	N	177	42.00	E	
	51	42.00	N	178	0.00	E	
	51	39.00	N	178	0.00	E	
	51	39.00	N	178	12.00	E	
	51	36.00	N	178	12.00	E	
	51	36.00	N	178	18.00	E	
	51	30.00	N	178	18.00	E	
	51	30.00	N	178	24.00	E	
	51	24.00	N	178	24.00	E	
	51	24.00	N	178	36.00	E	
	51	30.00	N	178	36.00	E	
	51	24.00	N	178	48.00	E	
	51	18.00	N	178	48.00	E	
	51	18.00	N	178	54.00	E	
	51	12.00	N	178	54.00	E	
	51	12.00	N	179	30.00	E	

Name	Latitude			Longitude			Footnote
	51	18.00	N	179	30.00	E	
	51	18.00	N	179	36.00	E	
Amchitka I North	51	42.00	N	179	12.00	E	
	51	42.00	N	178	57.00	E	
	51	36.00	N	178	56.99	E	
	51	36.00	N	179	0.00	E	
	51	33.62	N	179	0.00	E	2
	51	30.00	N	179	5.00	E	
	51	30.00	N	179	18.00	E	
	51	36.00	N	179	18.00	E	
	51	36.00	N	179	12.00	E	
Pillar Rock	52	9.00	N	177	30.00	E	
	52	9.00	N	177	18.00	E	
	52	6.00	N	177	18.00	E	
	52	6.00	N	177	30.00	E	
Murray Canyon	51	48.00	N	177	12.00	E	
	51	48.00	N	176	48.00	E	
	51	36.00	N	176	48.00	E	
	51	36.00	N	177	0.00	E	
	51	39.00	N	177	0.00	E	
	51	39.00	N	177	6.00	E	
	51	42.00	N	177	6.00	E	
	51	42.00	N	177	12.00	E	
Buldir	52	6.00	N	177	12.00	E	
	52	6.00	N	177	0.00	E	
	52	12.00	N	177	0.00	E	
	52	12.00	N	176	54.00	E	
	52	9.00	N	176	54.00	E	
	52	9.00	N	176	48.00	E	
	52	0.00	N	176	48.00	E	
	52	0.00	N	176	36.00	E	
	52	6.00	N	176	36.00	E	
	52	6.00	N	176	24.00	E	
	52	12.00	N	176	24.00	E	
	52	12.00	N	176	12.00	E	
	52	18.00	N	176	12.00	E	
	52	18.00	N	176	30.00	E	
	52	24.00	N	176	30.00	E	
	52	24.00	N	176	0.00	E	
	52	18.00	N	176	0.00	E	
	52	18.00	N	175	54.00	E	

Name	Latitude			Longitude			Footnote
	52	6.00	N	175	54.00	E	
	52	6.00	N	175	48.00	E	
	52	0.00	N	175	48.00	E	
	52	0.00	N	175	54.00	E	
	51	54.00	N	175	54.00	E	
	51	54.00	N	175	36.00	E	
	51	42.00	N	175	36.00	E	
	51	42.00	N	175	30.00	E	
	51	36.00	N	175	30.00	E	
	51	36.00	N	175	36.00	E	
	51	30.00	N	175	36.00	E	
	51	30.00	N	175	42.00	E	
	51	36.00	N	175	42.00	E	
	51	36.00	N	176	0.00	E	
	52	0.00	N	176	0.00	E	
	52	0.00	N	176	6.00	E	
	52	6.00	N	176	6.00	E	
	52	6.00	N	176	12.00	E	
	52	0.00	N	176	12.00	E	
	52	0.00	N	176	30.00	E	
	51	54.00	N	176	30.00	E	
	51	54.00	N	177	0.00	E	
	52	0.00	N	177	0.00	E	
	52	0.00	N	177	12.00	E	
Buldir donut	51	48.00	N	175	48.00	E	5
	51	48.00	N	175	42.00	E	5
	51	45.00	N	175	42.00	E	5
	51	45.00	N	175	48.00	E	5, 7
Buldir Mound	51	54.00	N	176	24.00	E	
	51	54.00	N	176	18.00	E	
	51	48.00	N	176	18.00	E	
	51	48.00	N	176	24.00	E	
Buldir West	52	30.00	N	175	48.00	E	
	52	30.00	N	175	36.00	E	
	52	36.00	N	175	36.00	E	
	52	36.00	N	175	24.00	E	
	52	24.00	N	175	24.00	E	
	52	24.00	N	175	30.00	E	
	52	18.00	N	175	30.00	E	
	52	18.00	N	175	36.00	E	
	52	24.00	N	175	36.00	E	

Name	Latitude			Longitude			Footnote
	52	24.00	N	175	48.00	E	
Tahoma Canyon	52	0.00	N	175	18.00	E	
	52	0.00	N	175	12.00	E	
	51	42.00	N	175	12.00	E	
	51	42.00	N	175	24.00	E	
	51	54.00	N	175	24.00	E	
	51	54.00	N	175	18.00	E	
Walls Plateau	52	24.00	N	175	24.00	E	
	52	24.00	N	175	12.00	E	
	52	18.00	N	175	12.00	E	
	52	18.00	N	175	0.00	E	
	52	12.00	N	175	0.00	E	
	52	12.00	N	174	42.00	E	
	52	6.00	N	174	42.00	E	
	52	6.00	N	174	36.00	E	
	52	0.00	N	174	36.00	E	
	52	0.00	N	174	42.00	E	
	51	54.00	N	174	42.00	E	
	51	54.00	N	174	48.00	E	
	52	0.00	N	174	48.00	E	
	52	0.00	N	174	54.00	E	
	52	6.00	N	174	54.00	E	
	52	6.00	N	175	18.00	E	
	52	12.00	N	175	24.00	E	
Semichi I	52	30.00	N	175	6.00	E	
	52	30.00	N	175	0.00	E	
	52	36.00	N	175	0.00	E	
	52	36.00	N	174	48.00	E	
	52	42.00	N	174	48.00	E	
	52	42.00	N	174	33.00	E	
	52	36.00	N	174	33.00	E	
	52	36.00	N	174	24.00	E	
	52	39.00	N	174	24.00	E	
	52	39.00	N	174	0.00	E	
	52	42.00	N	173	54.00	E	
	52	45.16	N	173	54.00	E	1
	52	46.35	N	173	54.00	E	
	52	54.00	N	173	54.00	E	
	52	54.00	N	173	30.00	E	
	52	48.00	N	173	30.00	E	
	52	48.00	N	173	36.00	E	

Name	Latitude			Longitude			Footnote
	52	40.00	N	173	36.00	E	
	52	40.00	N	173	25.00	E	
	52	30.00	N	173	25.00	E	
	52	33.00	N	173	40.00	E	
	52	33.00	N	173	54.00	E	
	52	18.00	N	173	54.00	E	
	52	18.00	N	174	30.00	E	
	52	30.00	N	174	30.00	E	
	52	30.00	N	174	48.00	E	
	52	24.00	N	174	48.00	E	
	52	24.00	N	175	6.00	E	
Agattu South	52	18.00	N	173	54.00	E	
	52	18.00	N	173	24.00	E	
	52	9.00	N	173	24.00	E	
	52	9.00	N	173	36.00	E	
	52	6.00	N	173	36.00	E	
	52	6.00	N	173	54.00	E	
Attu I North	53	3.00	N	173	24.00	E	
	53	3.00	N	173	6.00	E	
	53	0.00	N	173	6.00	E	
	53	0.00	N	173	24.00	E	
Attu I West	52	54.00	N	172	12.00	E	
	52	54.00	N	172	0.00	E	
	52	48.00	N	172	0.00	E	
	52	48.00	N	172	12.00	E	
Stalemate Bank	53	0.00	N	171	6.00	E	
	53	0.00	N	170	42.00	E	
	52	54.00	N	170	42.00	E	
	52	54.00	N	171	6.00	E	

Note: Unless otherwise footnoted, each area is delineated by connecting in order the coordinates listed by straight lines. Except for the Amlia North/Seguam donut and the Buldir donut, each area delineated in the table is open to nonpelagic trawl gear fishing. The remainder of the entire Aleutian Islands subarea and the areas delineated by the coordinates for the Amlia North/Seguam and Buldir donuts are closed to nonpelagic trawl gear fishing, as specified at § 679.22. Unless otherwise noted, the last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

[1]The connection of these coordinates to the next set of coordinates is by a line extending in a clockwise direction from these coordinates along the shoreline at mean lower-low water to the next set of coordinates.
[2]The connection of these coordinates to the next set of coordinates is by a line extending in a counter clockwise direction from these coordinates along the shoreline at mean lower-low water to the next set of coordinates.
[3]The connection of these coordinates to the first set of coordinates for this area is by a line extending in a clockwise direction from these coordinates along the shoreline at mean lower-low water to the first set of coordinates.
[4]The connection of these coordinates to the first set of coordinates for this area is by a line extending in a counter clockwise direction from these coordinates along the shoreline at mean lower-low water to the first set of

coordinates.
[5] The area specified by this set of coordinates is closed to fishing with non-pelagic trawl gear.
[6] This set of coordinates is connected to the first set of coordinates listed for the area by a straight line.
[7]The last coordinate for the donut is connected to the first set of coordinates for the donut by a straight line.

Aleutian Islands Coral Habitat Protection Areas (AICHPAs)

The use of bottom contact gear is prohibited in the AICHPAs. The coordinates for the areas are listed in the table below. Note: Each area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Aleutian Islands Coral Habitat Protection Areas

Area Number	Name	Latitude			Longitude		
1	Great Sitkin Is	52	9.56	N	176	6.14	W
		52	9.56	N	176	12.44	W
		52	4.69	N	176	12.44	W
		52	6.59	N	176	6.12	W
2	Cape Moffett Is	52	0.11	N	176	46.65	W
		52	0.10	N	176	53.00	W
		51	55.69	N	176	53.00	W
		51	55.69	N	176	48.59	W
		51	57.96	N	176	46.52	W
3	Adak Canyon	51	39.00	N	177	0.00	W
		51	39.00	N	177	3.00	W
		51	30.00	N	177	3.00	W
		51	30.00	N	177	0.00	W
4	Bobrof Is	51	57.35	N	177	19.94	W
		51	57.36	N	177	29.11	W
		51	51.65	N	177	29.11	W
		51	51.71	N	177	19.93	W
5	Ulak Is	51	25.85	N	178	59.00	W
		51	25.69	N	179	6.00	W
		51	22.28	N	179	6.00	W
		51	22.28	N	178	58.95	W
6	Semisopochnoi Is	51	53.10	N	179	53.11	E
		51	53.10	N	179	46.55	E
		51	48.84	N	179	46.55	E
		51	48.89	N	179	53.11	E

Bowers Ridge Habitat Conservation Zone (BRHCZ)

The use of mobile bottom contact gear is prohibited in the BRHCZ. The areas are described in the table below.

Bowers Ridge Habitat Conservation Zone

Area number	Name	Latitude			Longitude		
1	Bowers Ridge	55	10.50	N	178	27.25	E
		54	54.50	N	177	55.75	E
		54	5.83	N	179	20.75	E
		52	40.50	N	179	55.00	W
		52	44.50	N	179	26.50	W
		54	15.50	N	179	54.00	W
2	Ulm Plateau	55	5.00	N	177	15.00	E
		55	5.00	N	175	60.00	E
		54	34.00	N	175	60.00	E
		54	34.00	N	177	15.00	E

Note: Each area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Bering Sea Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in Bering Sea Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Latitude			Longitude		
179	19.95	W	59	25.15	N
177	51.76	W	58	28.85	N
175	36.52	W	58	11.78	N
174	32.36	W	58	8.37	N
174	26.33	W	57	31.31	N
174	0.82	W	56	52.83	N
173	0.71	W	56	24.05	N
170	40.32	W	56	1.97	N
168	56.63	W	55	19.30	N
168	0.08	W	54	5.95	N
170	0.00	W	53	18.24	N
170	0.00	W	55	0.00	N
178	46.69	E	55	0.00	N
178	27.25	E	55	10.50	N
178	6.48	E	55	0.00	N
177	15.00	E	55	0.00	N
177	15.00	E	55	5.00	N
176	0.00	E	55	5.00	N
176	0.00	E	55	0.00	N
172	6.35	E	55	0.00	N
173	59.70	E	56	16.96	N

St. Matthew Island Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in St. Matthew Island Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Longitude			Latitude		
172	0.00	W	60	54.00	N
171	59.92	W	60	3.52	N
174	0.50	W	59	42.26	N
174	24.98	W	60	9.98	N
174	1.24	W	60	54.00	N

St. Lawrence Island Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in St. Lawrence Island Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Longitude			Latitude		
168	24.00	W	64	0.00	N
168	24.00	W	62	42.00	N
172	24.00	W	62	42.00	N
172	24.00	W	63	57.03	N
172	17.42	W	64	0.01	N

Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area

Nonpelagic trawl gear fishing is prohibited in Nunivak Island, Etolin Strait, and Kuskokwim Bay Habitat Conservation Area. Coordinates for this habitat conservation area are listed in the table below. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

Longitude			Latitude		
165	1.54	W	60	45.54	N *
162	7.01	W	58	38.27	N
162	10.51	W	58	38.35	N
162	34.31	W	58	38.36	N
162	34.32	W	58	39.16	N
162	34.23	W	58	40.48	N
162	34.09	W	58	41.79	N
162	33.91	W	58	43.08	N
162	33.63	W	58	44.41	N
162	33.32	W	58	45.62	N
162	32.93	W	58	46.80	N
162	32.44	W	58	48.11	N
162	31.95	W	58	49.22	N
162	31.33	W	58	50.43	N
162	30.83	W	58	51.42	N
162	30.57	W	58	51.97	N

163	17.72	W	59	20.16	N
164	11.01	W	59	34.15	N
164	42.00	W	59	41.80	N
165	0.00	W	59	42.60	N
165	1.45	W	59	37.39	N
167	40.20	W	59	24.47	N
168	0.00	W	59	49.13	N
167	59.98	W	60	45.55	N

* The boundary extends in a clockwise direction from this set of geographic coordinates along the shoreline at mean lower-low tide line to the next set of coordinates.

Northern Bering Sea Research Area

Nonpelagic trawl gear fishing in the Northern Bering Sea Research Area is prohibited, except as allowed through exempted fishing permits under 50 CFR 679.6 and described in section 3.5.2.1.12. The area is delineated by connecting the coordinates in the order listed by straight lines. The last set of coordinates for each area is connected to the first set of coordinates for the area by a straight line. The projected coordinate system is North American Datum 1983, Albers.

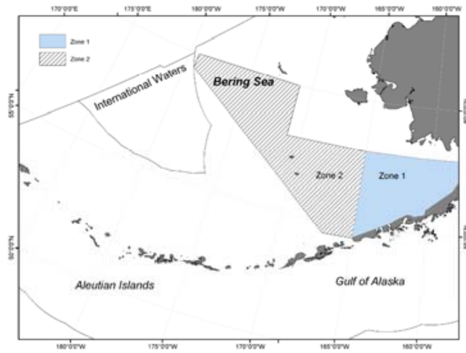
Longitude			Latitude		
168	7.48	W	65	37.48	N*
165	1.54	W	60	45.54	N
167	59.98	W	60	45.55	N
171	59.92	W	60	3.52	N
172	0.00	W	60	54.00	N
174	1.24	W	60	54.00	N
176	13.51	W	62	6.56	N
172	24.00	W	63	57.03	N
172	24.00	W	62	42.00	N
168	24.00	W	62	42.00	N
168	24.00	W	64	0.00	N
172	17.42	W	64	0.01	N
168	58.62	W	65	30.00	N
168	58.62	W	65	37.48	N

* The boundary extends in a clockwise direction from this set of geographic coordinates along the shoreline at mean lower-low tide line to the next set of coordinates.

B.3 PSC Limitation Zones

Specific areas of the management area are closed to some or all fishing during certain times of the year on attainment of a species-specific bycatch cap. These areas are described in Section 3.6.2.2 of the FMP.

Zones 1 and 2



Zones 1 and 2 are closed to directed fishing when the crab bycatch caps are attained in specified fisheries.

Zone 1: area bounded by 165° W. longitude and 58° N. latitude extending east to the shore.

Zone 2: area bounded by 165° W. longitude, north to 58° N., then west to the intersection of 58° N. and 171° W. longitude, then north to 60° N., then west to 179°20' W. longitude, then south to 59°25' N. latitude, then diagonally extending on a straight line southeast to the intersection of 167° W. longitude and 54°30' N. latitude, and then extending eastward along 54°30' N. latitude to 165° W. longitude.

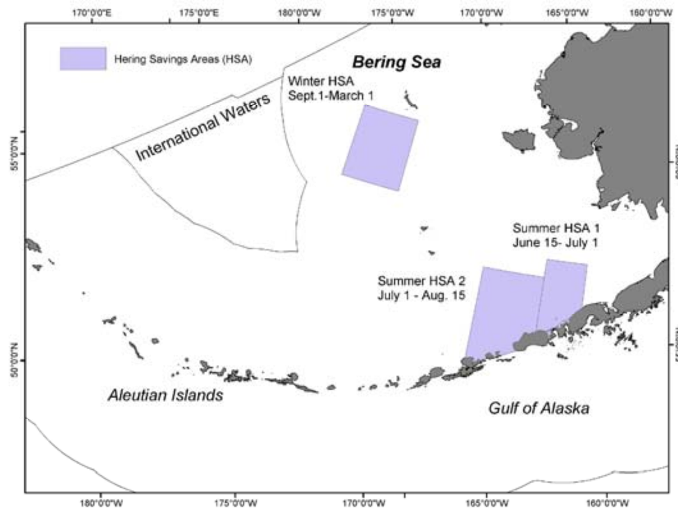
Herring Savings Areas

The herring savings areas are all located within the Bering Sea subarea and are defined as follows:

Summer Herring Savings Area 1: area south of 57° N. latitude and between 162° W. and 164° W. longitude from 12:00 noon Alaska Local Time (ALT) June 15 through 12:00 noon ALT July 1 of a fishing year

Summer Herring Savings Area 2: area south of 56°30' N. latitude and between 164° W. and 167° W. longitude from 12:00 noon ALT July 1 through 12:00 noon ALT August 15 of a fishing year

Winter Herring Savings Area: area between 58° N. and 60° N. latitude and between 172° W. and 175° W. longitude from 12:00 noon ALT September 1 through 12:00 noon ALT March 1 of the succeeding fishing year



Chum Salmon Savings Area

Upon the attainment of the "other salmon" catch limit, trawling is prohibited for the remainder of the period September 1 through October 14 within the area bounded by a straight line connecting the following pairs of coordinates in the order listed:

(56°00' N., 167° W.)

(56°00' N., 165° W.)

(55°30' N., 165° W.)

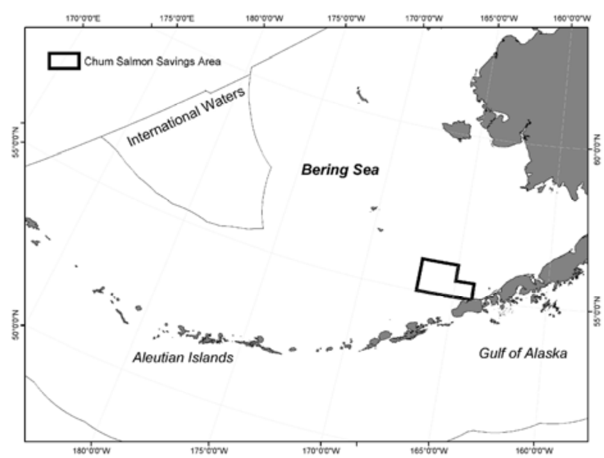
(55°30' N., 164° W.)

(55°00' N., 164° W.)

(55°00' N., 167° W.)

(56°00' N., 167° W.)

Trawling is also prohibited absolutely in the area from August 1 through August 31; see description in Section B.2 above.



Chinook Salmon Savings Areas

Area 1: The area defined by straight lines connecting the following coordinates in the order listed:

(54° N., 171° W.)

(54° N., 170° W.)

(53° N., 170° W.)

(53° N., 171° W.)

(54° N., 171° W.)

Area 2: The area defined by straight lines connecting the following coordinates in the order listed:

(56°00' N., 165° W.)

(56°00' N., 164° W.)

(55°00' N., 164° W.)

(55°00' N., 165° W.)

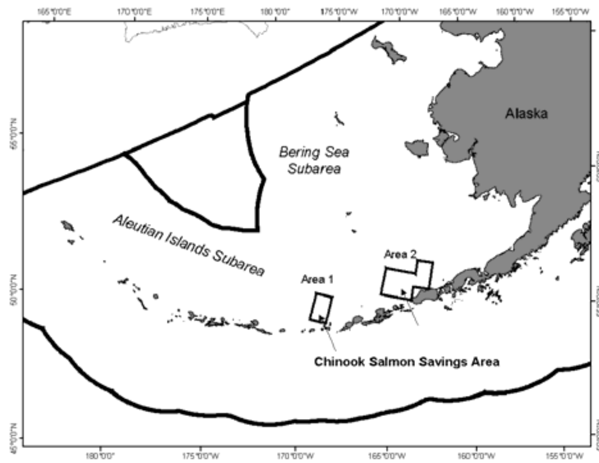
(54°30' N., 165° W.)

(54°30' N., 167° W.)

(55°30' N., 167° W.)

(55°30' N., 165° W.)

(56°00' N., 165° W.)



C. Opilio Bycatch Limitation Zone (COBLZ)

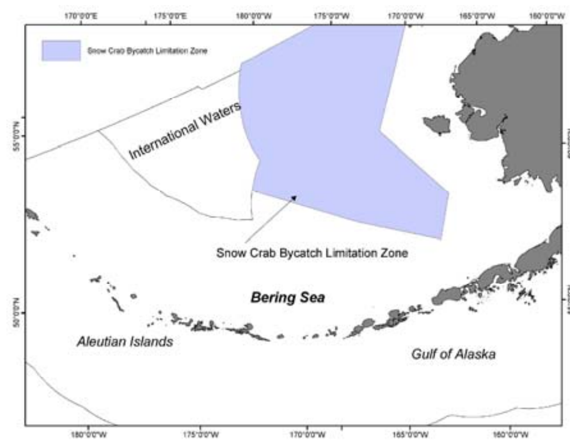
Defined as that portion of the Bering Sea subarea north of 56□30' N. latitude and west of a line connecting the following coordinates in the order listed:

(56°30' N., 165° W.)

(58°00' N., 165° W.)

(59°30' N., 170° W.)

and north along 170° W. longitude to its intersection with the U.S.-Russia boundary.



Upon attainment of the COBLZ bycatch allowance of *C. opilio* crab specified for a particular fishery category, the COBLZ will be closed to directed fishing for each category for the remainder of the year or for the remainder of the season.

Appendix C Summary of the American Fisheries Act and Subtitle II

C.1 Summary of the American Fisheries Act (AFA) Management Measures

On October 21, 1998, the President signed into law the American Fisheries Act (AFA) that superseded the previous inshore/offshore management regime for Bering Sea and Aleutian Islands (BSAI) pollock adopted under Amendment 18 and extended under Amendments 23 and 51. With respect to the fisheries off Alaska, the AFA required several new management measures: 1) regulations that limit access into the fishing and processing sectors of the pollock fishery and that allocate pollock to such sectors, 2) regulations governing the formation and operation of fishery cooperatives in the pollock fishery, 3) regulations to protect other fisheries from spillover effects from the AFA, and 4) regulations governing catch measurement and monitoring in the pollock fishery.

The AFA is a complex piece of legislation with numerous provisions that affect the management of the groundfish and crab fisheries off Alaska. The AFA is divided into two subtitles. *Subtitle I – Fisheries Endorsements* includes nationwide United States (U.S.) ownership and vessel length restrictions for U.S. vessels with fisheries endorsements. These requirements are implemented by the Maritime Administration and the U.S. Coast Guard under the Department of Transportation and Department of Homeland Security, respectively. *Subtitle II – Bering Sea Pollock Fishery* contains measures related to the management of BSAI pollock fishery.

Key provisions of the AFA are listed below.

- A requirement that owners of all U.S. flagged fishing vessels comply with a 75 percent U.S. controlling interest standard.
- A prohibition on the entry of any new fishing vessels into U.S. waters that exceed 165 ft registered length, 750 gross registered tons, or 3,000 shaft horsepower.
- The buyout of nine pollock catcher/processors and the subsequent scrapping of eight of these vessels through a combination of $20 million in federal appropriations and $75 million in direct loan obligations.
- A new allocation scheme for BSAI pollock that allocates 10 percent of the BSAI pollock total allowable catch (TAC) to the Community Development Quota (CDQ) Program, and after allowance for incidental catch of pollock in other fisheries, allocates the remaining TAC as follows: 50 percent to vessels harvesting pollock for processing by inshore processors, 40 percent to vessels harvesting pollock for processing by catcher/processors, and 10 percent to vessels harvesting pollock for processing by motherships.
- A fee of six-tenths (0.6) of one cent for each pound round weight of pollock harvested by catcher vessels delivering to inshore processors for the purpose of repaying the $75 million direct loan obligation.
- A prohibition on entry of new vessels and processors into the BSAI pollock fishery. The AFA lists by name vessels and processors and/or provides qualifying criteria for those vessels and processors eligible to participate in the non-CDQ portion of the BSAI pollock fishery.

- An increase in observer coverage and scale requirements for AFA catcher/processors.
- New standards and limitations for the creation of fishery cooperatives in the catcher/ processor, mothership, and inshore industry sectors.
- A quasi-individual fishing quota program under which National Marine Fisheries Service grants individual allocations of the inshore BSAI pollock TAC to inshore catcher vessel cooperatives that form around a specific inshore processor and agree to deliver at least 90 percent of their pollock catch to that processor.
- The establishment of harvesting and processing restrictions (commonly known as "sideboards") on fishermen and processors who have received exclusive harvesting or processing privileges under the AFA, to protect the interests of fishermen and processors who have not directly benefitted from the AFA.
- A 17.5 percent excessive share harvesting cap for BSAI pollock and a requirement that the Council develop excessive share caps for BSAI pollock processing and for the harvesting and processing of other groundfish.

Certain provisions of the AFA regarding the Aleutian Islands directed pollock fishery were superseded by the Consolidated Appropriations Act of 2004, as further described in section 3.7.3 of the FMP.

C.2 American Fisheries Act: Subtitle II Bering Sea Pollock Fishery

SEC. 205. DEFINITIONS.

As used in this subtitle –

(1) the term "Bering Sea and Aleutian Islands Management Area" has the same meaning as the meaning given for such term in part 679.2 of title 50, Code of Federal Regulations, as in effect on October 1, 1998;

(2) the term "catcher/processor" means a vessel that is used for harvesting fish and processing that fish;

(3) the term "catcher vessel" means a vessel that is used for harvesting fish and that does not process pollock onboard;

(4) the term "directed pollock fishery" means the fishery for the directed fishing allowances allocated under paragraphs (1), (2), and (3) of section 206(b);

(5) the term "harvest" means to commercially engage in the catching, taking, or harvesting of fish or any activity that can reasonably be expected to result in the catching, taking, or harvesting of fish;

(6) the term "inshore component" means the following categories that process groundfish harvested in the Bering Sea and Aleutian Islands Management Area:

(A) shoreside processors, including those eligible under section 208(f); and

(B) vessels less than 125 feet in length overall that process less than 126 metric tons per week in round-weight equivalents of an aggregate amount of pollock and Pacific cod;

(7) the term "Magnuson-Stevens Act" means the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.);

(8) the term "mothership" means a vessel that receives and processes fish from other vessels in the exclusive economic zone of the United States and is not used for, or equipped to be used for, harvesting fish;

(9) the term "North Pacific Council" means the North Pacific Fishery Management Council established under section 302(a)(1)(G) of the Magnuson-Stevens Act (16 U.S.C. 1852(a)(1)(G));

(10) the term "offshore component" means all vessels not included in the definition of inshore component that process groundfish harvested in the Bering Sea and Aleutian Islands Management Area;

(11) the term "Secretary" means the Secretary of Commerce; and

(12) the term "shoreside processor" means any person or vessel that receives unprocessed fish, except catcher/processors, motherships, buying stations, restaurants, or persons receiving fish for personal consumption or bait.

SEC. 206. ALLOCATIONS.

(a) POLLOCK COMMUNITY DEVELOPMENT QUOTA. Effective January 1,1999, 10 percent of the total allowable catch of pollock in the Bering Sea and Aleutian Islands Management Area shall be allocated as a directed fishing allowance to the western Alaska community development quota program established under section 305(i) of the Magnuson-Stevens Act (16 U.S.C. 1855(i)).

(b) INSHORE/OFFSHORE. Effective January 1, 1999, the remainder of the pollock total allowable catch in the Bering Sea and Aleutian Islands Management Area, after the subtraction of the allocation under subsection (a) and the subtraction of allowances for the incidental catch of pollock by vessels harvesting other groundfish species (including under the western Alaska community development quota program) shall be allocated as directed fishing allowances as follows –

(1) 50 percent to catcher vessels harvesting pollock for processing by the inshore component;

(2) 40 percent to catcher/processors and catcher vessels harvesting pollock for processing by catcher/processors in the offshore component; and

(3) 10 percent to catcher vessels harvesting pollock for processing by motherships in the offshore component.

SEC. 207. BUYOUT.

(a) FEDERAL LOAN. Under the authority of sections 1111 and 1112 of title XI of the Merchant Marine Act, 1936 (46 U.S.C. App. 1279f and 1279g) and notwithstanding the requirements of section 312 of the Magnuson-Stevens Act (16 U.S.C. 1861a), the Secretary shall, subject to the availability of appropriations for the cost of the direct loan, provide up to $75,000,000 through a direct loan obligation for the payments required under subsection (d).

(b) INSHORE FEE SYSTEM. Notwithstanding the requirements of section 304(d) or 312 of the Magnuson-Stevens Act (16 U.S.C. 1854(d) and 1861a), the Secretary shall establish a fee for the repayment of such loan obligations which –

(1) shall be six-tenths (0.6) of one cent for each pound round-weight of all pollock harvested from the directed fishing allowance under section 206(b)(1); and

(2) shall begin with such pollock harvested on or after January 1, 2000, and continue without interruption until such loan obligation is fully repaid; and

(3) shall be collected in accordance with section 312(d)(2)(C) of the Magnuson-Stevens Act (16 U.S.C. 1861a(d)(2)(C)) and in accordance with such other conditions as the Secretary establishes.

(c) FEDERAL APPROPRIATION. Under the authority of section 312(c)(1)(B) of the Magnuson-Stevens Act (16 U.S.C. 1861a(c)(1)(B)), there are authorized to be appropriated $20,000,000 for the payments required under subsection (d).

(d) PAYMENTS. Subject to the availability of appropriations for the cost of the direct loan under subsection (a) and funds under subsection (c), the Secretary shall pay by not later than December 31, 1998–

(1) up to $90,000,000 to the owner or owners of the catcher/processors listed in paragraphs (1) through (9) of section 209, in such manner as the owner or owners, with the concurrence of the Secretary, agree, except that –

(A) the portion of such payment with respect to the catcher/processor listed in paragraph (1) of section 209 shall be made only after the owner submits a written certification acceptable to the Secretary that neither the owner nor a purchaser from the owner intends to use such catcher/processor outside the exclusive economic zone of the United States to harvest any stock of fish (as such term is defined in section 3 of the Magnuson-Stevens Act (16 U.S.C. 1802)) that occurs within the exclusive economic zone of the United States; and

(B) the portion of such payment with respect to the catcher/processors listed in paragraphs (2) through (9) of section 209 shall be made only after the owner or owners of such catcher/processors submit a written certification acceptable to the Secretary that such catcher/processors will be scrapped by December 31, 2000 and will not, before that date, be used to harvest or process any fish; and

(2)(A) if a contract has been filed under section 210(a) by the catcher/processors listed in section 208(e), $5,000,000 to the owner or owners of the catcher/processors listed in paragraphs (10) through (14) of such section in such manner as the owner or owners, with the concurrence of the Secretary, agree; or

(B) if such a contract has not been filed by such date, $5,000,000 to the owners of the catcher vessels eligible under section 208(b) and the catcher/processors eligible under paragraphs (1) through (20) of section 208(e), divided based on the amount of the harvest of pollock in the directed pollock fishery by each such vessel in 1997 in such manner as the Secretary deems appropriate,

except that any such payments shall be reduced by any obligation to the federal government that has not been satisfied by such owner or owners of any such vessels.

(e) PENALTY. If the catcher/processor under paragraph (1) of section 209 is used outside the exclusive economic zone of the United States to harvest any stock of fish that occurs within the exclusive economic zone of the United States while the owner who received the payment under subsection (d)(1)(A) has an ownership interest in such vessel, or if the catcher/processors listed in paragraphs (2) through (9) of section 209 are determined by the Secretary not to have been scrapped by December 31, 2000 or to have been used in a manner inconsistent with subsection (d)(1)(B), the Secretary may suspend any or all of the federal permits which allow any vessels owned in whole or in part by the owner or owners who received payments under subsection (d)(1) to harvest or process fish within the exclusive economic zone of the United States until such time as the obligations of such owner or owners under subsection (d)(1) have been fulfilled to the satisfaction of the Secretary.

(f) PROGRAM DEFINED; MATURITY. For the purposes of section 1111 of the Merchant Marine Act, 1936 (46 U.S.C. App. 1279f), the fishing capacity reduction program in this subtitle shall be within the meaning of the term program as defined and used in such section. Notwithstanding section 1111(b)(4) of such Act (46 U.S.C. App. 1279f(b)(4)), the debt obligation under subsection (a) of this section may have a maturity not to exceed 30 years.

(g) FISHERY CAPACITY REDUCTION REGULATIONS. The Secretary of Commerce shall by not later than October 15, 1998 publish proposed regulations to implement subsections (b), (c), (d) and (e) of section 312 of the Magnuson-Stevens Act (16 U.S.C. 1861a) and sections 1111 and 1112 of title XI of the Merchant Marine Act, 1936 (46 U.S.C. App. 1279f and 1279g).

SEC. 208. ELIGIBLE VESSELS AND PROCESSORS.

(a) CATCHER VESSELS ONSHORE. Effective January 1, 2000, only catcher vessels which are –

(1) determined by the Secretary –

(A) to have delivered at least 250 metric tons of pollock; or

(B) to be less than 60 feet in length overall and to have delivered at least 40 metric tons of pollock,

for processing by the inshore component in the directed pollock fishery in any one of the years 1996 or 1997, or between January 1, 1998 and September 1, 1998;

(2) eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary; and

(3) not listed in subsection (b),

shall be eligible to harvest the directed fishing allowance under section 206(b)(1) pursuant to a federal fishing permit.

(b) CATCHER VESSELS TO CATCHER/PROCESSORS. Effective January 1, 1999, only the following catcher vessels shall be eligible to harvest the directed fishing allowance under section 206(b)(2) pursuant to a federal fishing permit:

(1) AMERICAN CHALLENGER (United States official number 633219);

(2) FORUM STAR (United States official number 925863);

(3) MUIR MILACH (United States official number 611524);

(4) NEAHKAHNIE (United States official number 599534);

(5) OCEAN HARVESTER (United States official number 549892);

(6) SEA STORM (United States official number 628959);

(7) TRACY ANNE (United States official number 904859); and

(8) any catcher vessel –

(A) determined by the Secretary to have delivered at least 250 metric tons and at least 75 percent of the pollock it harvested in the directed pollock fishery in 1997 to catcher/processors for processing by the offshore component; and

(B) eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary.

(c) CATCHERS VESSELS TO MOTHERSHIPS. Effective January 1, 2000, only the following catcher vessels shall be eligible to harvest the directed fishing allowance under section 206(b)(3) pursuant to a federal fishing permit:

(1) ALEUTIAN CHALLENGER (United States official number 603820);

(2) ALYESKA (United States official number 560237);

(3) AMBER DAWN (United States official number 529425);

(4) AMERICAN BEAUTY (United States official number 613847);

(5) CALIFORNIA HORIZON (United States official number 590758);

(6) MAR-GUN (United States official number 525608);

(7) MARGARET LYN (United States official number 615563);

(8) MARK I (United States official number 509552);

(9) MISTY DAWN (United States official number 926647);

(10) NORDIC FURY (United States official number 542651);

(11) OCEAN LEADER (United States official number 561518);

(12) OCEANIC (United States official number 602279);

(13) PACIFIC ALLIANCE (United States official number 612084);

(14) PACIFIC CHALLENGER (United States official number 618937);

(15) PACIFIC FURY (United States official number 561934);

(16) PAPADO II (United States official number 536161);

(17) TRAVELER (United States official number 929356);

(18) VESTERAALEN (United States official number 611642);

(19) WESTERN DAWN (United States official number 524423);

(20) any vessel –

(A) determined by the Secretary to have delivered at least 250 metric tons of pollock for processing by motherships in the offshore component of the directed pollock fishery in any one of the years 1996 or 1997, or between January 1, 1998 and September 1, 1998;

(B) eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary; and

(C) not listed in subsection (b).

(d) MOTHERSHIPS. Effective January 1, 2000, only the following motherships shall be eligible to process the directed fishing allowance under section 206(b)(3) pursuant to a federal fishing permit:

(1) EXCELLENCE (United States official number 967502);

(2) GOLDEN ALASKA (United States official number 651041);

(3) OCEAN PHOENIX (United States official number 296779).

(e) CATCHER/PROCESSORS. Effective January 1, 1999, only the following catcher/processors shall be eligible to harvest the directed fishing allowance under section 206(b)(2) pursuant to a federal fishing permit:

(1) AMERICAN DYNASTY (United States official number 951307);

(2) KATIE ANN (United States official number 518441);

(3) AMERICAN TRIUMPH (United States official number 646737);

(4) NORTHERN EAGLE (United States official number 506694);

(5) NORTHERN HAWK (United States official number 643771);

(6) NORTHERN JAEGER (United States official number 521069);

(7) OCEAN ROVER (United States official number 552100);

(8) ALASKA OCEAN (United States official number 637856);

(9) ENDURANCE (United States official number 592206);

(10) AMERICAN ENTERPRISE (United States official number 594803);

(11) ISLAND ENTERPRISE (United States official number 610290);

(12) KODIAK ENTERPRISE (United States official number 579450);

(13) SEATTLE ENTERPRISE (United States official number 904767);

(14) US ENTERPRISE (United States official number 921112);

(15) ARCTIC STORM (United States official number 903511);

(16) ARCTIC FJORD (United States official number 940866);

(17) NORTHERN GLACIER (United States official number 663457);

(18) PACIFIC GLACIER (United States official number 933627);

(19) HIGHLAND LIGHT (United States official number 577044);

(20) STARBOUND (United States official number 944658); and

(21) any catcher/processor not listed in this subsection and determined by the Secretary to have harvested more than 2,000 metric tons of the pollock in the 1997 directed pollock fishery and determined to be eligible to harvest pollock in the directed pollock fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary, except that catcher/processors eligible under this paragraph shall be prohibited from harvesting in the aggregate a total of more than one-half (0.5) of a percent of the pollock apportioned for the directed pollock fishery under section 206(b)(2).

Notwithstanding section 213(a), failure to satisfy the requirements of section 4(a) of the Commercial Fishing Industry Vessel Anti-Reflagging Act of 1987 (Public Law 100-239; 46 U.S.C. 12108 note) shall not make a catcher/processor listed under this subsection ineligible for a fishery endorsement.

(f) SHORESIDE PROCESSORS. (1) Effective January 1, 2000 and except as provided in paragraph (2), the catcher vessels eligible under subsection (a) may deliver pollock harvested from the directed fishing allowance under section 206(b)(1) only to –

(A) shoreside processors (including vessels in a single geographic location in Alaska State waters) determined by the Secretary to have processed more than 2,000 metric tons round-weight of pollock in the inshore component of the directed pollock fishery during each of 1996 and 1997; and

(B) shoreside processors determined by the Secretary to have processed pollock in the inshore component of the directed pollock fishery in 1996 and 1997, but to have processed less than 2,000 metric tons round-weight of such pollock in each year, except that effective January 1, 2000, each such shoreside processor may not process more than 2,000 metric tons round-weight from such directed fishing allowance in any year;

(2) Upon recommendation by the North Pacific Council, the Secretary may approve measures to allow catcher vessels eligible under subsection (a) to deliver pollock harvested from the directed fishing allowance under section 206(b)(1) to shoreside processors not eligible under paragraph (1) if the total allowable catch for pollock in the Bering Sea and Aleutian Islands Management Area increases by more than 10 percent above the total allowable catch in such fishery in 1997, or in the event of the actual total loss or constructive total loss of a shoreside processor eligible under paragraph (1)(A).

(g) REPLACEMENT VESSELS. In the event of the actual total loss or constructive total loss of a vessel eligible under subsections (a), (b), (c), (d), or (e), the owner of such vessel may replace such vessel with a vessel which shall be eligible in the same manner under that subsection as the eligible vessel, provided that–

(1) such loss was caused by an act of God, an act of war, a collision, an act or omission of a party other than the owner or agent of the vessel, or any other event not caused by the willful misconduct of the owner or agent;

(2) the replacement vessel was built in the United States and if ever rebuilt, was rebuilt in the United States;

(3) the fishery endorsement for the replacement vessel is issued within 36 months of the end of the last year in which the eligible vessel harvested or processed pollock in the directed pollock fishery;

(4) if the eligible vessel is greater than 165 feet in registered length, of more than 750 gross registered tons (as measured under chapter 145 of title 46) or 1,900 gross registered tons as measured under chapter 143 of that title, or has engines capable of producing more than 3,000 shaft horsepower, the replacement vessel is of the same or lesser registered length, gross registered tons, and shaft horsepower;

(5) if the eligible vessel is less than 165 feet in registered length, of fewer than 750 gross registered tons, and has engines incapable of producing more than 3,000 shaft horsepower, the replacement vessel is less than each of such thresholds and does not exceed by more than 10 percent the registered length, gross registered tons or shaft horsepower of the eligible vessel; and

(6) the replacement vessel otherwise qualifies under federal law for a fishery endorsement, including under section 12102(c) of title 46, United States Code, as amended by this Act.

(h) ELIGIBILITY DURING IMPLEMENTATION. In the event the Secretary is unable to make a final determination about the eligibility of a vessel under subsection (b)(8) or subsection (e)(21) before January 1, 1999, or a vessel or shoreside processor under subsection (a), subsection (c)(21), or subsection (f) before January 1, 2000, such vessel or shoreside processor, upon the filing of an application for eligibility, shall be eligible to participate in the directed pollock fishery pending final determination by the Secretary with respect to such vessel or shoreside processor.

(i) ELIGIBILITY NOT A RIGHT. Eligibility under this section shall not be construed –

(1) to confer any right of compensation, monetary or otherwise, to the owner of any catcher vessel, catcher/processor, mothership, or shoreside processor if such eligibility is revoked or limited in any way, including through the revocation or limitation of a fishery endorsement or any federal permit or license;

(2) to create any right, title, or interest in or to any fish in any fishery; or

(3) to waive any provision of law otherwise applicable to such catcher vessel, catcher/processor, mothership, or shoreside processor.

SEC. 209. LIST OF INELIGIBLE VESSELS.

Effective December 31, 1998, the following vessels shall be permanently ineligible for fishery endorsements, and any claims (including relating to catch history) associated with such vessels that could qualify any owners of such vessels for any present or future limited access system permit in any fishery within the exclusive economic zone of the United States (including a vessel moratorium permit or license limitation program permit in fisheries under the authority of the North Pacific Council) are hereby extinguished:

(1) AMERICAN EMPRESS (United States official number 942347);

(2) PACIFIC SCOUT (United States official number 934772);

(3) PACIFIC EXPLOYER (United States official number 942592);

(4) PACIFIC NAVIGATOR (United States official number 592204);

(5) VICTORIA ANN (United States official number 592207);

(6) ELIZABETH ANN (United States official number 534721);

(7) CHRISTINA ANN (United States official number 653045);

(8) REBECCA ANN (United States official number 592205);

(9) BROWNS POINT (United States official number 587440).

SEC. 210. FISHERY COOPERATIVE LIMITATIONS.

(a) PUBLIC NOTICE. (1) Any contract implementing a fishery cooperative under section 1 of the Act of June 25, 1934 (15 U.S.C. 521) in the directed pollock fishery and any material modifications to any such contract shall be filed not less than 30 days prior to the start of fishing under the contract with the North Pacific Council and with the Secretary, together with a copy of a letter from a party to the contract requesting a business review letter on the fishery cooperative from the Department of Justice and any response to such request. Notwithstanding section 402 of the Magnuson-Stevens Act (16 U.S.C. 1881a) or any other provision of law, but taking into account the interest of parties to any such contract in protecting the confidentiality of proprietary information, the North Pacific Council and Secretary shall –

(A) make available to the public such information about the contract, contract modifications, or fishery cooperative the North Pacific Council and Secretary deem appropriate, which at a minimum shall include a list of the parties to the contract, a list of the vessels involved, and the amount of pollock and other fish to be harvested by each party to such contract; and

(B) make available to the public in such manner as the North Pacific Council and Secretary deem appropriate information about the harvest by vessels under a fishery cooperative of all species (including by catch) in the directed pollock fishery on a vessel-by-vessel basis.

(b) CATCHER VESSELS ONSHORE

(1) CATCHER VESSEL COOPERATIVES. Effective January 1, 2000, upon the filing of a contract implementing a fishery cooperative under subsection (a) which –

(A) is signed by the owners of 80 percent or more of the qualified catcher vessels that delivered pollock for processing by a shoreside processor in the directed pollock fishery in the year prior to the year in which the fishery cooperative will be in effect; and

(B) specifies, except as provided in paragraph (6), that such catcher vessels will deliver pollock in the directed pollock fishery only to such shoreside processor during the year in which the fishery cooperative will be in effect and that such shoreside processor has agreed to process such pollock,

the Secretary shall allow only such catcher vessels (and catcher vessels whose owners voluntarily participate pursuant to paragraph (2)) to harvest the aggregate percentage of the directed fishing allowance under section 206(b)(1) in the year in which the fishery cooperative will be in effect that is equivalent to the aggregate total amount of pollock harvested by such catcher vessels (and by such catcher vessels whose owners voluntarily participate pursuant to paragraph (2)) in the directed pollock fishery for processing by the inshore component during 1995, 1996, and 1997 relative to the aggregate total amount of pollock harvested in the directed pollock fishery for processing by the inshore component during such years and shall prevent such catcher vessels (and catcher vessels whose owners voluntarily participate pursuant to paragraph (2)) from harvesting in aggregate in excess of such percentage of such directed fishing allowance.

(2) VOLUNTARY PARTICIPATION. Any contract implementing a fishery cooperative under paragraph (1) must allow the owners of other qualified catcher vessels to enter into such contract

after it is filed and before the calendar year in which fishing will begin under the same terms and conditions as the owners of the qualified catcher vessels who entered into such contract upon filing.

(3) QUALIFIED CATCHER VESSEL. For the purposes of this subsection, a catcher vessel shall be considered a qualified catcher vessel if, during the year prior to the year in which the fishery cooperative will be in effect, it delivered more pollock to the shoreside processor to which it will deliver pollock under the fishery cooperative in paragraph (1) than to any other shoreside processor.

(4) CONSIDERATION OF CERTAIN VESSELS. Any contract implementing a fishery cooperative under paragraph (1) which has been entered into by the owner of a qualified catcher vessel eligible under section 208(a) that harvested pollock for processing by catcher/processors or motherships in the directed pollock fishery during 1995, 1996, and 1997 shall, to the extent practicable, provide fair and equitable terms and conditions for the owner of such qualified catcher vessel.

(5) OPEN ACCESS. A catcher vessel eligible under section 208(a) the catch history of which has not been attributed to a fishery cooperative under paragraph (1) may be used to deliver pollock harvested by such vessel from the directed fishing allowance under section 206(b)(1) (other than pollock reserved under paragraph (1) for a fishery cooperative) to any of the shoreside processors eligible under section 208(f). A catcher vessel eligible under section 208(a) the catch history of which has been attributed to a fishery cooperative under paragraph (1) during any calendar year may not harvest any pollock apportioned under section 206(b)(1) in such calendar year other than the pollock reserved under paragraph (1) for such fishery cooperative.

(6) TRANSFER OF COOPERATIVE HARVEST. A contract implementing a fishery cooperative under paragraph (1) may, notwithstanding the other provisions of this subsection, provide for up to 10 percent of the pollock harvested under such cooperative to be processed by a shoreside processor eligible under section 208(f) other than the shoreside processor to which pollock will be delivered under paragraph (1).

(c) CATCHER VESSELS TO CATCHER/PROCESSORS. Effective January 1, 1999, not less than 8.5 percent of the directed fishing allowance under section 206(b)(2) shall be available for harvest only by the catcher vessels eligible under section 208(b). The owners of such catcher vessels may participate in a fishery cooperative with the owners of the catcher/ processors eligible under paragraphs (1) through (20) of the section 208(e). The owners of such catcher vessels may participate in a fishery cooperative that will be in effect during 1999 only if the contract implementing such cooperative establishes penalties to prevent such vessels from exceeding in 1999 the traditional levels harvested by such vessels in all other fisheries in the exclusive economic zone of the United States.

(d) CATCHER VESSELS TO MOTHERSHIPS

(1) PROCESSING. Effective January 1, 2000, the authority in section 1 of the Act of June 25, 1934 (48 STAT. 1213 and 1214; 15 U.S.C. 521 et seq.) shall extend to processing by motherships eligible under section 208(d) solely for the purposes of forming or participating in a fishery cooperative in the directed pollock fishery upon the filing of a contract to implement a fishery cooperative under subsection (a) which has been entered into by the owners of 80 percent or more of the catcher vessels eligible under section 208(c) for the duration of such contract, provided that such owners agree to the terms of the fishery cooperative involving processing by the motherships.

(2) VOLUNTARY PARTICIPATION. Any contract implementing a fishery cooperative described in paragraph (1) must allow the owners of any other catcher vessels eligible under section 208(c) to enter such contract after it is filed and before the calendar year in which fishing will begin under the

same terms and conditions as the owners of the catcher vessels who entered into such contract upon filing.

(e) EXCESSIVE SHARES.

(1) HARVESTING. No particular individual, corporation, or other entity may harvest, through a fishery cooperative or otherwise, a total of more than 17.5 percent of the pollock available to be harvested in the directed pollock fishery.

(2) PROCESSING. Under the authority of section 301(a)(4) of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(4)), the North Pacific Council is directed to recommend for approval by the Secretary conservation and management measures to prevent any particular individual or entity from processing an excessive share of the pollock available to be harvested in the directed pollock fishery. In the event the North Pacific Council recommends and the Secretary approves an excessive processing share that is lower than 17.5 percent, any individual or entity that previously processed a percentage greater than such share shall be allowed to continue to process such percentage, except that their percentage may not exceed 17.5 percent (excluding pollock processed by catcher/processors that was harvested in the directed pollock fishery by catcher vessels eligible under section 208(b)) and shall be reduced if their percentage decreases, until their percentage is below such share. In recommending the excessive processing share, the North Pacific Council shall consider the need of catcher vessels in the directed pollock fishery to have competitive buyers for the pollock harvested by such vessels.

(3) REVIEW BY MARITIME ADMINISTRATION. At the request of the North Pacific Council or the Secretary, any individual or entity believed by such Council or the Secretary to have exceeded the percentage in either paragraph (1) or (2) shall submit such information to the Administrator of the Maritime Administration as the Administrator deems appropriate to allow the Administrator to determine whether such individual or entity has exceeded either such percentage. The Administrator shall make a finding as soon as practicable upon such request and shall submit such finding to the North Pacific Council and the Secretary. For the purposes of this subsection, any entity in which 10 percent or more of the interest is owned or controlled by another individual or entity shall be considered to be the same entity as the other individual or entity.

(f) LANDING TAX JURISDICTION. Any contract filed under subsection (a) shall include a contract clause under which the parties to the contract agree to make payments to the State of Alaska for any pollock harvested in the directed pollock fishery which is not landed in the State of Alaska, in amounts which would otherwise accrue had the pollock been landed in the State of Alaska subject to any landing taxes established under Alaska law. Failure to include such a contract clause or for such amounts to be paid shall result in a revocation of the authority to form fishery cooperatives under section 1 of the Act of June 25, 1934 (15 U.S.C. 521 et seq.).

(g) PENALTIES. The violation of any of the requirements of this subtitle or any regulation or permit issued pursuant to this subtitle shall be considered the commission of an act prohibited by section 307 of the Magnuson-Stevens Act (16 U.S.C. 1857), and sections 308, 309, 310, and 311 of such Act (16 U.S.C. 1858, 1859, 1860, and 1861) shall apply to any such violation in the same manner as to the commission of an act prohibited by section 307 of such Act (16 U.S.C. 1857). In addition to the civil penalties and permit sanctions applicable to prohibited acts under section 308 of such Act (16 U.S.C. 1858), any person who is found by the Secretary, after notice and an opportunity for a hearing in accordance with section 554 of title 5, United States Code, to have violated a requirement of this section shall be subject to the forfeiture to the Secretary of Commerce of any fish harvested or processed during the commission of such act.

SEC. 211. PROTECTIONS FOR OTHER FISHERIES; CONSERVATION MEASURES.

(a) GENERAL. The North Pacific Council shall recommend for approval by the Secretary such conservation and management measures as it determines necessary to protect other fisheries under its jurisdiction and the participants in those fisheries, including processors, from adverse impacts caused by this Act or fishery cooperatives in the directed pollock fishery.

(b) CATCHER/PROCESSOR RESTRICTIONS.

(1) GENERAL. The restrictions in this subsection shall take effect on January 1, 1999 and shall remain in effect thereafter except that they may be superseded (with the exception of paragraph (4)) by conservation and management measures recommended after the date of the enactment of this Act by the North Pacific Council and approved by the Secretary in accordance with the Magnuson-Stevens Act.

(2) BERING SEA FISHING. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) are hereby prohibited from, in the aggregate –

(A) exceeding the percentage of the harvest available in the offshore component of any Bering Sea and Aleutian Islands groundfish fishery (other than the pollock fishery) that is equivalent to the total harvest by such catcher/processors and the catcher/processors listed in section 209 in the fishery in 1995, 1996, and 1997 relative to the total amount available to be harvested by the offshore component in the fishery in 1995, 1996, and 1997;

(B) exceeding the percentage of the prohibited species available in the offshore component of any Bering Sea and Aleutian Islands groundfish fishery (other than the pollock fishery) that is equivalent to the total of the prohibited species harvested by such catcher/processors and the catcher/processors listed in section 209 in the fishery in 1995, 1996, and 1997 relative to the total amount of prohibited species available to be harvested by the offshore component in the fishery in 1995, 1996, and 1997.

(C) fishing for Atka mackerel in the eastern area of the Bering Sea and Aleutian Islands and from exceeding the following percentages of the directed harvest available in the Bering Sea and Aleutian Islands Atka mackerel fishery –

(i) 11.5 percent in the central area; and

(ii) 20 percent in the western area.

(3) BERING SEA PROCESSING. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) are hereby prohibited from –

(A) processing any of the directed fishing allowances under paragraphs (1) or (3) of section 206(b); and

(B) processing any species of crab harvested in the Bering Sea and Aleutian Islands Management Area.

(4) GULF OF ALASKA. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) are hereby prohibited from –

(A) harvesting any fish in the Gulf of Alaska;

(B) processing any groundfish harvested from the portion of the exclusive economic zone off Alaska known as area 630 under the fishery management plan for Gulf of Alaska groundfish; or

(C) processing any pollock in the Gulf of Alaska (other than as by catch in non-pollock groundfish fisheries) or processing, in the aggregate, a total of more than 10 percent of the cod harvested from areas 610, 620, and 640 of the Gulf of Alaska under the fishery management plan for Gulf of Alaska groundfish.

(5) FISHERIES OTHER THAN NORTH PACIFIC. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) and motherships eligible under section 208(d) are hereby prohibited from harvesting fish in any fishery under the authority of any regional fishery management council established under section 302(a) of the Magnuson-Stevens Act (16 U.S.C. 1852(a)) other than the North Pacific Council, except for the Pacific whiting fishery, and from processing fish in any fishery under the authority of any such regional fishery management council other than the North Pacific Council, except in the Pacific whiting fishery, unless the catcher/processor or mothership is authorized to harvest or process fish under a fishery management plan recommended by the regional fishery management council of jurisdiction and approved by the Secretary.

(6) OBSERVERS AND SCALES. The catcher/processors eligible under paragraphs (1) through (20) of section 208(e) shall –

(A) have two observers onboard at all times while groundfish is being harvested, processed, or received from another vessel in any fishery under the authority of the North Pacific Council; and

(B) weight its catch on a scale onboard approved by the National Marine Fisheries Service while harvesting groundfish in fisheries under the authority of the North Pacific Council.

This paragraph shall take effect on January 1, 1999 for catcher/processors eligible under paragraphs (1) through (20) of section 208(e) that will harvest pollock allocated under section 206(a) in 1999, and shall take effect on January 1, 2000 for all other catcher/processors eligible under such paragraphs of section 208(e).

(c) CATCHER VESSEL AND SHORESIDE PROCESSOR RESTRICTIONS.

(1) REQUIRED COUNCIL RECOMMENDATIONS. By not later than July 1, 1999, the North Pacific Council shall recommend for approval by the Secretary conservation and management measures to –

(A) prevent the catcher vessels eligible under subsections (a), (b), and (c) of section 208 from exceeding in the aggregate the traditional harvest levels of such vessels in other fisheries under the authority of the North Pacific Council as a result of fishery cooperatives in the directed pollock fisheries; and

(B) protect processors not eligible to participate in the directed pollock fishery from adverse effects as a result of this Act or fishery cooperatives in the directed pollock fishery.

If the North Pacific Council does not recommend such conservation and management measures by such date, or if the Secretary determines that such conservation and management measures recommended by the North Pacific Council are not adequate to fulfill the purposes of this paragraph, the Secretary may by regulation restrict or change the authority in section 210(b) to the extent the Secretary deems appropriate, including by preventing fishery cooperatives from being formed pursuant to such section and by providing greater flexibility with respect to the shoreside processor *or shoreside processors to which catcher vessels in a fishery cooperative under section 210(b) may deliver pollock.*

(2) BERING SEA CRAB AND GROUNDFISH.

(A) Effective January 1, 2000, the owners of the motherships eligible under section 208(d) and the shoreside processors eligible under section 208(f) that receive pollock from the directed pollock fishery under a fishery cooperative are hereby prohibited from processing, in the aggregate for each calendar year, more than the percentage of the total catch of each species of crab in directed fisheries under the jurisdiction of the North Pacific Council than facilities operated by such owners processed of each such species in the aggregate, on average, in 1995, 1996, and 1997. For the purposes of this subparagraph, the term facilities means any processing plant, catcher/processor, mothership, floating processor, or any other operation that processes fish. Any entity in which 10 percent or more of the interest is owned or controlled by another individual or entity shall be considered to be the same entity as the other individual or entity for the purposes of this subparagraph.

(B) Under the authority of section 301(a)(4) of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(4)), the North Pacific Council is directed to recommend for approval by the Secretary conservation and management measures to prevent any particular individual or entity from harvesting or processing an excessive share of crab or of groundfish in fisheries in the Bering Sea and Aleutian Islands Management Area.

(C) The catcher vessels eligible under section 208(b) are hereby prohibited from participating in a directed fishery for any species of crab in the Bering Sea and Aleutian Islands Management Area unless the catcher vessel harvested crab in the directed fishery for that species of crab in such Area during 1997 and is eligible to harvest such crab in such directed fishery under the license limitation program recommended by the North Pacific Council and approved by the Secretary. The North Pacific Council is directed to recommend measures for approval by the Secretary to eliminate latent licenses under such program, and nothing in this subparagraph shall preclude the Council from recommending measures more restrictive than under this paragraph.

(3) FISHERIES OTHER THAN NORTH PACIFIC.

(A) By not later than July 1, 2000, the Pacific Fishery Management Council established under section 302(a)(1)(F) of the Magnuson-Stevens Act (16 U.S.C. 1852 (a)(1)(F)) shall recommended for approval by the Secretary conservation and management measures to protect fisheries under its jurisdiction and the participants in those fisheries from adverse impacts caused by this Act or by any fishery cooperatives in the directed pollock fishery.

(B) If the Pacific Council does not recommend such conservation and management measures by such date, or if the Secretary determines that such conservation and management measures recommended by the Pacific Council are not adequate to fulfill the purposes of this paragraph, the Secretary may by regulation implement adequate measures including, but not limited to, restrictions on vessels which harvest pollock under a fishery cooperative which will prevent such vessels from harvesting Pacific groundfish, and restrictions on the number of processors eligible to process Pacific groundfish.

(d) BYCATCH INFORMATION. Notwithstanding section 402 of the Magnuson-Stevens Act (16 U.S.C. 1881a), the North Pacific Council may recommend and the Secretary may approve, under such terms and conditions as the North Pacific Council and Secretary deem appropriate, the public disclosure of any

information from the groundfish fisheries under the authority of such Council that would be beneficial in the implementation of section 301(a)(9) or section 303(a)(11) of the Magnuson-Stevens Act (16 U.S.C. 1851(a)(9) and 1853(a)(11)).

(e) COMMUNITY DEVELOPMENT LOAN PROGRAM. Under the authority of title XI of the Merchant Marine Act, 1936 (46 U.S.C. App. 1271 et seq.), and subject to the availability of appropriations, the Secretary is authorized to provide direct loan obligations to communities eligible to participate in the western Alaska community development quota program established under section 304(i) of the Magnuson-Stevens Act (16 U.S.C. 1855(i)) for the purposes of purchasing all or part of an ownership interest in vessels and shoreside processors eligible under subsections (a), (b), (c), (d), (e), or (f) of section 208. Notwithstanding the eligibility criteria in section 208(a) and section 208(c), the LISA MARIE (United States official number 1038717) shall be eligible under such sections in the same manner as other vessels eligible under such sections.

SEC. 212. RESTRICTION ON FEDERAL LOANS.

Section 302(b) of the Fisheries Financing Act (46 U.S.C. 1274 note) is amended –

(1) by inserting "(1)" before "Until October 1, 2001" ; and

(2) by inserting at the end the following new paragraph:

"(2) No loans may be provided or guaranteed by the Federal Government for the construction or rebuilding of a vessel intended for use as a fishing vessel (as defined in section 2101 of title 46, United States Code), if such vessel will be greater than 165 feet in registered length, of more than 750 gross registered tons (as measured under chapter 145 of title 46) or 1,900 gross registered tons as measured under chapter 143 of that title, or have an engine or engines capable of producing a total of more than 3,000 shaft horsepower, after such construction or rebuilding is completed. This prohibition shall not apply to vessels to be used in the menhaden fishery or in tuna purse seine fisheries outside the exclusive economic zone of the United States or the area of the South Pacific Regional Fisheries Treaty.".

SEC. 213. DURATION.

(a) GENERAL. Except as otherwise provided in this title, the provisions of this title shall take effect upon the date of the enactment of this Act. There are authorized to be appropriated $6,700,000 per year to carry out the provisions of this Act through fiscal year 2004.

(b) EXISTING AUTHORITY. Except for the measures required by this subtitle, nothing in this subtitle shall be construed to limit the authority of the North Pacific Council or the Secretary under the Magnuson-Stevens Act.

(c) CHANGES TO FISHERY COOPERATIVE LIMITATIONS AND POLLOCK CDQ ALLOCATION. The North Pacific Council may recommend and the Secretary may approve conservation and management measures in accordance with the Magnuson-Stevens Act –

(1) that supersede the provisions of this subtitle, except for section 206 and 208, for conservation purposes or to mitigate adverse effects in fisheries or on owners of fewer than three vessels in the directed pollock fishery caused by this title or fishery cooperatives in the directed pollock fishery, provided such measures take into account all factors affecting the fisheries and are imposed fairly and equitably to the extent practicable among and within the sectors in the directed pollock fishery;

(2) that supersede the allocation in section 206(a) for any of the years 2002, 2003, and 2004, upon the finding by such Council that the western Alaska community development quota program for pollock has been adversely affected by the amendments in this subtitle; or

(3) that supersede the criteria required in paragraph (1) of section 210(b) to be used by the Secretary to set the percentage allowed to be harvested by catcher vessels pursuant to a fishery cooperative under such paragraph.

(d) REPORT TO CONGRESS. Not later than October 1, 2000, the North Pacific Council shall submit a report to the Secretary and to Congress on the implementation and effects of this Act, including the effects on fishery conservation and management, on bycatch levels, on fishing communities, on business and employment practices of participants in any fishery cooperatives, on the western Alaska community development quota program, on any fisheries outside of the authority of the North Pacific Council, and such other matters as the North Pacific Council deems appropriate.

(e) REPORT ON FILLET PRODUCTION. Not later than June 1, 2000, the General Accounting Office shall submit a report to the North Pacific Council, the Secretary, and the Congress on whether this Act has negatively affected the market for fillets and fillet blocks, including through the reduction in the supply of such fillets and fillet blocks. If the report determines that such market has been negatively affected, the North Pacific Council shall recommend measures for the Secretary's approval to mitigate any negative effects.

(f) SEVERABILITY. If any provision of this title, an amendment made by this title, or the application of such provision or amendment to any person or circumstance is held to be unconstitutional, the remainder of this title, the amendments made by this title, and the application of the provisions of such to any person or circumstance shall not be affected thereby.

(g) INTERNATIONAL AGREEMENTS. In the event that any provision of section 12102(c) or section 31322(a) of title 46, United States Code, as amended by this Act, is determined to be inconsistent with an existing international agreement relating to foreign investment to which the United States is a party with respect to the owner or mortgagee on October 1, 2001 of a vessel with a fishery endorsement, such provision shall not apply to that owner or mortgagee with respect to such vessel to the extent of any such inconsistency. The provisions of section 12102(c) and section 31322(a) of title 46, United States Code, as amended by this Act, shall apply to all subsequent owners and mortgagees of such vessel, and shall apply, notwithstanding the preceding sentence, to the owner on October 1, 2001 of such vessel if any ownership interest in that owner is transferred to or otherwise acquired by a foreign individual or entity after such date.

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Appendix D Life History Features and Habitat Requirements of Fishery Management Plan Species

This appendix describes habitat requirements and life histories of the groundfish species managed by this FMP. Each species or species group is described individually, however, summary tables that denote habitat associations (Table D-1), reproductive traits (Table D-2), and predator and prey associations (Table D-3) are also provided.

In each individual section, a species-specific table summarizes habitat. The following abbreviations are used in these habitat tables to specify location, position in the water column, bottom type, and other oceanographic features.

Location

BCH = beach (intertidal)
ICS = inner continental shelf (1-50 m)
MCS = middle continental shelf (50-100 m)
OCS = outer continental shelf (100-200 m)
USP = upper slope (200-1000 m)
LSP = lower slope (1000-3000 m)
BSN = basin (>3000 m)
BAY = nearshore bays, with depth if appropriate (e.g., fjords)
IP = island passes (areas of high current), with depth if appropriate

Water column

D = demersal (found on bottom)
SD/SP = semi-demersal or semi-pelagic, if slightly greater or less than 50% on or off bottom
P = pelagic (found off bottom, not necessarily associated with a particular bottom type)
N = neustonic (found near surface)

General

U = unknown
NA = not applicable

Bottom Type

M = mud
S = sand
MS = muddy sand
R = rock
SM = sandy mud
CB = cobble
G = gravel
C = coral
K = kelp
SAV = subaquatic vegetation (e.g., eelgrass, not kelp)

Oceanographic Features

UP = upwelling
G = gyres
F = fronts
CL = thermo- or pycnocline
E = edges

Table D.1 Summary of habitat associations for BSAI groundfish.

BSAI Groundfish — Predator to

Species	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Rockfish	Salmon	Pacific cod	Pollock	Halibut
Walleye Pollock	M				X			X			X			X						X	X	X	X	X		X			X	X	X
	LJ				X			X			X			X						X	X	X	X	X		X			X	X	X
	EJ				X			X			X									X	X	X									
	L				X			X			X																				
	E																														
Pacific Cod	M							X		X			X							X										X	
	LJ							X		X			X							X										X	
	EJ							X		X			X							X											
	L			X	X						X																				
	E																														
Atka Mackerel	M							X			X													X							
	J							X			X																				
	L										X																				
	E																														
Sablefish	M							X	X	X	X		X	X				X		X		X	X		X	X		X	X	X	
	LJ							X	X	X	X		X	X				X		X		X	X		X	X		X	X	X	
	EJ							X		X	X		X	X	X			X		X			X					X			
	L				X						X																				
	E																														
Pacifc Ocean Perch	M							X																							
	LJ							X			X																				
	EJ																														
	L			X	X																										
Flathead Sole	M							X		X	X		X			X	X	X	X		X	X								X	
	LJ							X		X	X		X			X	X	X	X											X	
	EJ				X								X			X			X											X	
	L	X		X																											
	E																														
Yellowfin Sole	M							X		X			X			X		X		X					X					X	
	LJ							X		X			X			X		X		X					X					X	
	EJ				X																										
	L	X		X																											
	E																														
Arrowtooth Flounder	M												X	X				X	X	X			X	X						X	
	LJ												X					X	X	X			X	X						X	
	EJ				X																										
	L	X		X																											
	E																														
Rock Sole	M									X			X			X	X														
	LJ									X			X			X	X														
	EJ				X																										
	L	X		X																											
	E																														

BSAI Groundfish — Prey of

Species	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pacific cod	Ling cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Hailbut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Terrerstrial Mammals
Walleye Pollock	M								X						X	X	X	X	X	X										
	LJ							X	X						X	X		X	X	X				X		X	X	X		
	EJ							X	X						X	X		X	X	X				X		X	X	X		
	L							X	X						X	X								X		X	X	X		
	E																													
Pacific Cod	M															X	X	X		X		X	X	X						
	LJ															X	X	X		X		X	X	X						
	EJ															X	X	X				X	X	X			X			
	L																													
	E																													
Atka Mackerel	M								X						X	X			X	X	X			X						
	J																			X						X	X			
	L																													
	E																													
Sablefish	M																													
	LJ						X									X														
	EJ																													
	L																													
	E																													
Pacifc Ocean Perch	M															X														
	LJ																													
	EJ						X																							
	L																													
Flathead Sole	M								X				X		X	X														
	LJ																													
	EJ																													
	L																													
	E																													
Yellowfin Sole	M																													
	LJ								X							X														
	EJ								X							X														
	L																													
	E																													
Arrowtooth Flounder	M																													
	LJ							X	X																					
	EJ																													
	L																													
	E																													
Rock Sole	M																													
	LJ							X	X					X		X														
	EJ																													
	L																													
	E																													

Table D.2 Summary of biological associations for BSAI groundfish.

Predator to

BSAI Groundfish: Species	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Rockfish	Salmon	Pacific cod	Pollock	Halibut
Dover Sole	M												x				x	x													
	LJ												x				x	x													
	EJ																														
	L	x		x																											
	E																														
Rex Sole	M							x		x			x					x													
	LJ							x		x			x					x													
	EJ																														
	L	x		x																											
	E																														
Greenland Turbot	M												x					x	x	x			x	x						x	
	LJ																														
	EJ				x																										
	L	x		x																											
	E																														
Shortraker/Rougheye Rockfish	M													x						x				x							
	LJ																														
	EJ																														
	L																														
Northern Rockfish	M							x			x																				
	LJ																														
	EJ																														
	L																														
Thornyhead Rockfish	M																			x					x						
	LJ																														
	EJ																														
	L																														
	E																														
Light Dusky Rockfish	M							x																							
	LJ																														
	EJ																														
	L																														

Prey of

BSAI Groundfish: Species	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pacific cod	Ling cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Halibut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Terrestrial Mammals
Dover Sole	M								x						x															
	LJ								x						x															
	EJ																													
	L																													
	E																													
Rex Sole	M								x						x															
	LJ								x						x															
	EJ																													
	L																													
	E																													
Greenland Turbot	M																													
	LJ																													
	EJ							x	x					x																
	L																													
	E																													
Shortraker/Rougheye Rockfish	M																													
	LJ																													
	EJ																													
	L																													
Northern Rockfish	M																													
	LJ																													
	EJ																													
	L																													
Thornyhead Rockfish	M																													
	LJ																													
	EJ																													
	L																													
	E																													
Light Dusky Rockfish	M																													
	LJ																													
	EJ																													
	L																													

Table D.3 Summary of biological associations for BSAI groundfish

Predator to

BSAI Groundfish Species	Life Stage	Algae	Plants	Plankton	Zooplankton	Diatoms	Sponges	Eusphausiid	Hydroids	Amphipoda	Copepods	Starfish	Polychaetes	Squid	Philodae (gunnels)	Bi-valves	Mollusks	Crustaceans	Ophiuroids (brittle stars)	Shrimps, mysidacae	Sand lance	Osmerid (eulachon)	Herring	Myctophid (lantern fishes)	Cottidae (sculpins)	Arrowtooth	Rockfish	Salmon	Pacific cod	Pollock	Halibut
Sculpins	M				x			x	x	x	x	x	x		x	x	x	x	x	x	x	x	x		x	x		x	x		
	LJ																														
	EJ																														
	L																														
	E																														
Skates	M									x		x	x					x		x	x		x		x	x	x	x	x	x	x
	LJ																														
	EJ																														
	L																														
	E																														
Sharks	M													x				x		x							x	x		x	x
	LJ																														
	EJ																														
	L																														
	E																														
Squid	M							x			x									x	x	x	x								
	LJ																														
	EJ																														
	L																														
	E																														
Octopus	M																x	x	x												
	LJ																														
	EJ																														
	L																														
	E																														
Eulachon	M				X			X			X																				
	LJ				X			X			X																				
	EJ				X			X			X																				
	L			X	X	X		X			X																				
	E																														
Capelin	M				X			X			X		X							X											
	LJ				X			X			X																				
	EJ				X			X			X																				
	L			X	X	X		X			X																				
	E																														
Sand Lance	M				X			X		X	X																				
	LJ				X			X		X	X																				
	EJ				X			X		X	X																				
	L			X	X	X		X		X	X																				
	E																														

Prey of

BSAI Groundfish Species	Life Stage	Jellyfish	Starfish	Chaetognaths (arrowworms)	Crab	Herring	Salmon	Pollock	Pacific cod	Ling cod	Rockfish	Rock Sole	Flathead Sole	Yellowfin sole	Arrowtooth flounder	Halibut	Salmon Shark	Northern Fur Seal	Harbor Seal	Steller sea lion	Dalls Porpoise	Beluga whale	Killer Whale	Minke whale	Eagles	Murres	Puffin	Kittiwake	Gull	Terrerstrial Mammals
Sculpins	M										x		x		x	x		x	x	x	x	x								
	LJ																													
	EJ																													
	L																													
	E																													
Skates	M																													
	LJ																													
	EJ																													
	L																													
	E																													
Sharks	M																													
	LJ																													
	EJ																													
	L																													
	E																													
Squid	M	x					x	x	x	x	x	x	x			x		x	x	x	x	x		x		x	x	x		
	LJ																													
	EJ																													
	L																													
	E																													
Octopus	M									x			x	x		x		x	x	x		x								
	LJ																													
	EJ																													
	L																													
	E																													
Eulachon	M						X	X	X							X		X	X	X	X					X	X			X
	LJ						X	X	X							X		X	X	X	X					X	X			
	EJ					X	X	X	X							X														
	L					X	X	X	X							X														
	E																													
Capelin	M						X	X	X						X	X		X	X	X	X					X	X			
	LJ						X	X	X						X	X		X	X	X	X					X	X			
	EJ					X	X	X	X						X	X														
	L					X	X	X	X						X	X														
	E																													
Sand Lance	M						X	X	X						X	X		X	X	X	X					X	X			
	LJ						X	X	X						X	X		X	X	X	X					X	X			
	EJ					X	X	X	X						X	X														
	L					X	X	X	X						X	X														
	E																													

D.1 Walleye pollock (*Theragra calcogramma*)

The Eastern Bering Sea (EBS) and Aleutian Islands pollock stocks are managed under the BSAI groundfish fisheries management plan. Pollock occur throughout the area covered by the FMP and straddle into the Canadian and Russian EEZ, international waters of the central Bering Sea, and into the Chukchi Sea.

D.1.1 Life History and General Distribution

Pollock is the most abundant species within the eastern Bering Sea comprising 75-80% of the catch and 60% of the biomass. In the Gulf of Alaska, pollock is the second most abundant groundfish stock comprising 25-50% of the catch and 20% of the biomass.

Four stocks of pollock are recognized for management purposes: Gulf of Alaska, eastern Bering Sea, Aleutian Islands, and Aleutian Basin. There appears to be a high degree of interrelationship among the eastern Bering Sea, Aleutian Islands, and Aleutian Basin stocks with suggestions of movement from one area to the others. There appears to be stock separation between the Gulf of Alaska stocks and stocks to the north.

The most abundant stock of pollock is the eastern Bering Sea stock which is primarily distributed over the eastern Bering Sea outer continental shelf between approximately 70-200 m. Information on pollock distribution in the eastern Bering Sea comes from commercial fishing locations, annual bottom trawl surveys and triennial acoustic surveys.

The Aleutian Islands stock extends through the Aleutian Islands from 170° W to the end of the Aleutian Islands (Attu Island), with the greatest abundance in the eastern Aleutians (170° W to Seguam Pass). Most of the information on pollock distribution in the Aleutian Islands comes from triennial bottom trawl surveys. These surveys indicate that pollock are primarily located on the Bering Sea side of the Aleutian Islands, and have a spotty distribution throughout the Aleutian Islands chain. The bottom trawl data may not provide an accurate view of pollock distribution because a significant portion of the pollock biomass is likely to be unavailable to bottom trawls. Also, many areas of the Aleutian Islands shelf are untrawlable due to rough bottom.

The third stock, Aleutian Basin, appears to be distributed throughout the Aleutian Basin which encompasses the U.S. EEZ, Russian EEZ, and international waters in the central Bering Sea. This stock appears to move throughout the Basin for feeding, but concentrate in deepwater near the continental shelf for spawning. The principal spawning location is near Bogoslof Island in the eastern Aleutian Islands, but data from pollock fisheries in the first quarter of the year indicate that there are other concentrations of deepwater spawning concentrations in the western Aleutian Islands. The Aleutian Basin spawning stock appears to be derived from migrants from the eastern Bering Sea shelf stock, and possibly some western Bering Sea pollock. Recruitment to the stock occurs generally around age 5, very few pollock younger than age 5 have been found in the Aleutian Basin. Most of the pollock in the Aleutian Basin appear to originate from strong year classes.

The Gulf of Alaska stock extends from southeast Alaska to the Aleutian Islands (170° W), with the greatest abundance in the western and central regulatory areas (147° W to 170° W). Most of the information on pollock distribution in the Gulf of Alaska comes from triennial bottom trawl surveys. These surveys indicate that pollock are distributed throughout the shelf regions of the Gulf of Alaska at depths less than 300 m. The bottom trawl data may not provide an accurate view of pollock distribution because a significant portion of the pollock biomass may be pelagic and not available to bottom trawls. The principal spawning location is in Shelikof Strait, but data from pollock fisheries and exploratory surveys indicate that there are other concentrations of spawning in the Shumagin Islands, the east side of Kodiak Island and near Prince William Sound.

Peak pollock spawning occurs on the southeastern Bering Sea and eastern Aleutian Islands along the outer continental shelf around mid-March. North of the Pribilof Islands spawning occurs later (April-May) in smaller spawning aggregations. The deep spawning pollock of the Aleutian Basin appear to spawn slightly earlier, late February-early March. In the Gulf of Alaska, peak spawning occurs in late March in Shelikof Strait. Peak spawning in the Shumagin area appears to 2-3 weeks earlier than in Shelikof Strait.

Spawning occurs in the pelagic zone and eggs develop throughout the water column (70-80 m in the Bering Sea shelf, 150-200 m in Shelikof Strait). Development is dependent on water temperature. In the Bering Sea, eggs take about 17-20 days to develop at 4 degrees in the Bogoslof area and 25.5 days at 2 degrees on the shelf. In the Gulf of Alaska, development takes approximately 2 weeks at ambient temperature (5 degrees C). Larvae are also distributed in the upper water column. In the Bering Sea the larval period lasts approximately 60 days. The larvae eat progressively larger naupliar stages of copepods as they grow and then small euphausiids as they approach transformation to juveniles (~25 mm standard length). In the Gulf of Alaska, larvae are distributed in the upper 40 m of the water column and the diet is similar to Bering Sea larvae. FOCI survey data indicate larval pollock may utilize the stratified warmer upper waters of the mid-shelf to avoid predation by adult pollock which reside in the colder bottom water.

At age 1 pollock are found throughout the eastern Bering Sea both in the water column and on bottom. Age 1 pollock from strong year-classes appear to be found in great numbers on the inner shelf, and further north on the shelf than weak year classes which appear to be more concentrated on the outer continental shelf. From age 2-3 pollock are primarily pelagic and then to be most abundant on the outer and mid-shelf northwest of the Pribilof Islands. As pollock reach maturity (age 4) in the Bering Sea, they appear to move from the northwest to the southeast shelf to recruit to the adult spawning population. Strong year-classes of pollock persist in the population in significant numbers until about age 12, and very few pollock survive beyond age 16. The oldest recorded pollock was age 31.

Growth varies by area with the largest pollock occurring on the southeastern shelf. On the northwest shelf the growth rate is slower. A newly maturing pollock is around 40 cm.

The upper size limit for juvenile pollock in the eastern Bering Sea and Gulf of Alaska is about 38-42 cm. This is the size of 50% maturity. There is some evidence that this has changed over time.

D.1.2 Fishery

The eastern Bering Sea pollock fishery has, since 1990 been divided into two fishing periods; an “A season” occurring in January-March, and a “B season” occurring in August-October. The A season concentrates fishing effort on prespawning pollock in the southeastern Bering Sea. During the B season fishing is still primarily in the southeastern Bering Sea, but some fishing also occurs on the northwestern shelf. Also during the B season catcher processor vessels are required to fish north of 56° N latitude because the area to the south is reserved for catcher vessels delivering to shoreside processing plants on Unalaska and Akutan.

Since 1992, the Gulf of Alaska pollock TAC has been apportioned spatially and temporally to reduce impacts on Steller sea lions. Although the details of the apportionment scheme have evolved over time, the general objective is to allocate the TAC to management areas based on the distribution of surveyed biomass, and to establish three or four seasons between mid-January and autumn during which some fraction of the TAC can be taken. The Steller Sea Lion Protection Measures implemented in 2001 establish four seasons in the Central and Western GOA beginning January 20, March 10, August 25, and October 1, with 25% of the total TAC allocated to each season. Allocations to management areas 610, 620 and 630 are based on the seasonal biomass distribution as estimated by groundfish surveys. In addition, a new harvest control rule was implemented that requires a cessation of fishing when spawning biomass declines below 20% of unfished stock biomass.

In the Gulf of Alaska approximately 90% of the pollock catch is taken using pelagic trawls. During winter, fishing effort usually targeted primarily on pre-spawning aggregations in Shelikof Strait and near the

Shumagin Islands. The pollock fishery has a very low bycatch rate with discards averaging about 2% since 1998 (with the 1991-1997 average around 9%). Most of the discards in the pollock fishery are juvenile pollock, or pollock too large to fit filleting machines. In the pelagic trawl fishery the catch is almost exclusively pollock.

The eastern Bering Sea pollock fishery primarily harvests mature pollock. The age where fish are selected by the fishery roughly corresponds to the age at maturity (management guidelines are oriented towards conserving spawning biomass). Fishery selectivity increases to a maximum around age 6-8 and declines slightly. The reduced selectivity for older ages is due to pollock becoming increasingly demersal with age. Younger pollock form large schools and are semi-demersal, thereby being easier to locate by fishing vessels. Immature fish (ages 2 and 3) are usually caught in low numbers. Generally the catch of immature pollock increases when strong year-classes occur and the abundance of juveniles increase sharply. This occurred with the 1989 year-class, the second largest year-class on record. Juvenile bycatch increased sharply in 1991 and 1992 when this year-class was age 2 and 3. A secondary problem is that strong to moderate year-classes may reside in the Russian EEZ adjacent to the U. S. EEZ as juveniles. Russian catch-age data and anecdotal information suggest that juveniles may comprise a major portion of the catch. There is a potential for the Russian fishery to reduce subsequent abundance in the U. S. fishery.

The Gulf of Alaska pollock fishery also targets mature pollock. Fishery selectivity increases to a maximum around age 5-7 and then declines. In both the EBS and GOA, the selectivity pattern varies between years due to shifts in fishing strategy and changes in the availability of different age groups over time.

In response to continuing concerns over the possible impacts groundfish fisheries may have on rebuilding populations of Steller sea lions, NMFS and the NPFMC have made changes to the Atka mackerel (mackerel) and pollock fisheries in the Bering Sea/Aleutian Islands and Gulf of Alaska. These have been designed to reduce the possibility of competitive interactions with Steller sea lions. For the pollock fisheries, comparisons of seasonal fishery catch and pollock biomass distributions (from surveys) by area in the eastern Bering Sea led to the conclusion that the pollock fishery had disproportionately high seasonal harvest rates within critical habitat which *could* lead to reduced sea lion prey densities. Consequently, the management measures were designed to redistribute the fishery both temporally and spatially according to pollock biomass distributions. The underlying assumption in this approach was that the independently derived area-wide and annual exploitation rate for pollock would not reduce local prey densities for sea lions. Here we examine the temporal and spatial dispersion of the fishery to evaluate the potential effectiveness of the measures.

Three types of measures were implemented in the pollock fisheries:

- Additional pollock fishery exclusion zones around sea lion rookery or haulout sites,
- Phased-in reductions in the seasonal proportions of TAC that can be taken from critical habitat, and
- Additional seasonal TAC releases to disperse the fishery in time.

Prior to the management measures, the pollock fishery occurred in each of the three major fishery management regions of the north Pacific ocean managed by the NPFMC: the Aleutian Islands (1,001,780 km^2 inside the EEZ), the eastern Bering Sea (968,600 km^2), and the Gulf of Alaska (1,156,100 km^2). The marine portion of Steller sea lion critical habitat in Alaska west of 150°W encompasses 386,770 km^2 of ocean surface, or 12% of the fishery management regions.

Prior to 1999, a total of 84,100 km^2, or 22% of critical habitat, was closed to the pollock fishery. Most of this closure consisted of the 10 and 20 nm radius all-trawl fishery exclusion zones around sea lion rookeries (48,920 km^2 or 13% of critical habitat). The remainder was largely management area 518 (35,180 km^2, or 9% of critical habitat) which was closed pursuant to an international agreement to protect spawning stocks of central Bering Sea pollock.

In 1999, an additional 83,080 km^2 (21%) of critical habitat in the Aleutian Islands was closed to pollock fishing along with 43,170 km^2 (11%) around sea lion haulouts in the GOA and eastern Bering Sea. Consequently, a total of 210,350 km^2 (54%) of critical habitat was closed to the pollock fishery. The portion of critical habitat that remained open to the pollock fishery consisted primarily of the area between 10 and 20 nm from rookeries and haulouts in the GOA and parts of the eastern Bering Sea foraging area.

The Bering Sea/Aleutian Islands pollock fishery was also subject to changes in total catch and catch distribution. Disentangling the specific changes in the temporal and spatial dispersion of the EBS pollock fishery resulting from the sea lion management measures from those resulting from implementation of the 1999 American Fisheries Act (AFA) is difficult. The AFA reduced the capacity of the catcher/processor fleet and permitted the formation of cooperatives in each industry sector by 2000. Both of these changes would be expected to reduce the rate at which the catcher/processor sector (allocated 36% of the EBS pollock TAC) caught pollock beginning in 1999, and the fleet as a whole in 2000. Because of some of its provisions, the AFA gave the industry the ability to respond efficiently to changes mandated for sea lion conservation that otherwise could have been more disruptive to the industry.

In 2000, further reductions in seasonal pollock catches from BSAI sea lion critical habitat were realized by closing the entire Aleutian Islands region to pollock fishing and by phased-in reductions in the proportions of seasonal TAC that could be caught from the Sea Lion Conservation Area, an area which overlaps considerably with sea lion critical habitat. In 1998, over 22,000 t of pollock were caught in the Aleutian Island regions, with over 17,000 t caught in AI critical habitat. Since 1998 directed fishery removals of pollock have been prohibited.

D.1.3 Relevant Trophic Information

Juvenile pollock through newly maturing pollock primarily utilize copepods and euphausiids for food. At maturation and older ages pollock become increasingly piscivorous, with pollock (cannibalism) a major food item in the Bering Sea. Most of the pollock consumed by pollock are age 0 and 1 pollock, and recent research suggests that cannibalism can regulate year-class size. Weak year-classes appear to be those located within the range of adults, while strong year-classes are those that are transported to areas outside the range of adult abundance.

Being the dominant species in the eastern Bering Sea pollock is an important food source for other fish, marine mammals, and birds. On the Pribilof Islands hatching success and fledgling survival of marine birds has been tied to the availability of age 0 pollock to nesting birds.

D.1.4 Habitat and Biological Associations

Egg-Spawning: Pelagic on outer continental shelf generally over 100-200 m depth in Bering Sea. Pelagic on continental shelf over 100-200 m depth in Gulf of Alaska.

Larvae: Pelagic outer to mid-shelf region in Bering Sea. Pelagic throughout the continental shelf within the top 40 m in the Gulf of Alaska.

Juveniles: Age 0 appears to be pelagic, as is age 2 and 3. Age 1 pelagic and demersal with a widespread distribution and no known benthic habitat preference.

Adults: Adults occur both pelagically and demersally on the outer and mid-continental shelf of the Gulf of Alaska, eastern Bering Sea and Aleutian Islands. In the eastern Bering Sea few adult pollock occur in waters shallower than 70 m. Adult pollock also occur pelagically in the Aleutian Basin. Adult pollock range throughout the Bering Sea in both the U.S. and Russian waters, however, the maps provided for this document detail distributions for pollock in the U.S. Exclusive Economic Zone and the basin.

Habitat and Biological Associations: Walleye Pollock

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	14 d. at 5 C	None	Feb-Apr	OCS, UCS	P	N/A	G?	
Larvae	60 days	copepod naupli and small euphausiids	Mar-Jul	MCS, OCS	P	N/A	G? F	pollock larvae with jellyfish
Juveniles	0.4 to 4.5 years	Pelagic crustaceans, copepods and euphausiids	Aug. +	OCS, MCS, ICS	P, SD	N/A	CL, F	
Adults	4.5 - 16 years	Pelagic crustaceans and fish	Spawning Feb-Apr	OCS, BSN	P, SD	UNK	F UP	Increasingly demersal with age.

D.1.5 Additional sources of information

Eggs and Larvae:

Jeff Napp, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA, 206-526-4148.

Shallow water concentrations:

Bill Bechtol, Alaska Department of Fish and Game, 3298 Douglas Place, Homer, Alaska 99603-8027.

D.1.6 Literature

Bailey, K.M. 2000. Shifting control of recruitment of walleye pollock *Theragra chalcogramma* after a major climatic and ecosystem change. Mar. Ecol. Prog. Ser 198:215-224.

Bailey, K.M., P.J. Stabeno, and D.A. Powers. 1997. The role of larval retention and transport features in mortality and potential gene flow of walleye pollock. J. Fish. Biol. 51(Suppl. A):135-154.

Bailey, K.M., S.J. Picquelle, and S.M. Spring. 1996. Mortality of larval walleye pollock (*Theragra chalcogramma*) in the western Gulf of Alaska, 1988-91. Fish. Oceanogr. 5 (Suppl. 1):124-136.

Bailey, K.M., T.J. Quinn II, P. Bentzen, and W.S. Grant. 1999. Population structure and dynamics of walleye pollock, *Theragra chalcogramma*. Advances in Mar. Biol. 37: 179-255.

Bakkala, R.G., V.G. Wespestad and L.L. Low. 1987. Historical trends in abundance and current condition of walleye pollock in the eastern Bering Sea. Fish. Res.,5:199-215.

Bates, R.D. 1987. Ichthyoplankton of the Gulf of Alaska near Kodiak Island, April-May 1984. NWAFC Proc. Rep. 87-11, 53 pp.

Brodeur, R.D. and M.T. Wilson. 1996. A review of the distribution, ecology and population dynamics of age-0 walleye pollock in the Gulf of Alaska. Fish. Oceanogr. 5 (Suppl. 1):148-166.

Brown, A.L. and K.M. Bailey. 1992. Otolith analysis of juvenile walleye pollock *Theragra chalcogramma* from the western Gulf of Alaska. Mar. Bio. 112:23-30.

Dorn, M., S. Barbeaux, M. Guttormsen, B. Megrey, A. Hollowed, E. Brown, and K. Spalinger. 2002. Assessment of Walleye Pollock in the Gulf of Alaska. In Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, 2002. North Pacific Fishery Management Council, Box 103136, Anchorage, AK 99510. 88p.

Grant, W.S. and F.M. Utter. 1980. Biochemical variation in walleye pollock *Theragra chalcogramma*: population structure in the southeastern Bering Sea and Gulf of Alaska. Can. J. Fish. Aquat. Sci. 37:1093-1100.

Guttormsen , M. A., C. D. Wilson, and S. Stienessen. 2001. Echo integration-trawl survey results for walleye pollock in the Gulf of Alaska during 2001. In Stock Assessment and Fishery Evaluation Report for Gulf of Alaska. Prepared by the Gulf of Alaska Groundfish Plan Team, North Pacific Fishery Management Council, P.O. Box 103136, Anchorage, AK 99510. North Pacific Fisheries Management Council, Anchorage, AK.

Hinckley, S. 1987. The reproductive biology of walleye pollock, *Theragra chalcogramma*, in the Bering Sea, with reference to spawning stock structure. Fish. Bull. 85:481-498.

Hollowed, A.B., J.N. Ianelli, P. Livingston. 2000. Including predation mortality in stock assessments: a case study for Gulf of Alaska pollock. ICES J. Mar. Sci. 57:279-293.Hughes, S. E. and G. Hirschhorn. 1979. Biology of walleye pollock, *Theragra chalcogramma*, in Western Gulf of Alaska. Fish. Bull., U.S. 77:263-274.Ianelli, J.N. 2002. Bering Sea walleye pollock stock structure using morphometric methods. Tech. Report Hokkaido National Fisheries Research Inst. No. 5, 53-58.

Ianelli, J.N., S. Barbeaux, T. Honkalehto, G. Walters, and N. Williamson. 2002. Bering Sea-Aleutian Islands Walleye Pollock Assessment for 2003. In Stock assessment and fishery evaluation report for the groundfish resources of the Eastern Bering Sea and Aleutian Island Region, 2002. North Pacific Fishery Management Council, Box 103136, Anchorage, AK 99510. 88p.

Kendall, A.W., Jr. and S.J. Picquelle. 1990. Egg and larval distributions of walleye pollock *Theragra chalcogramma* in Shelikof Strait, Gulf of Alaska. U.S. Fish. Bull. 88(1):133-154.

Kim, S. and A.W. Kendall, Jr. 1989. Distribution and transport of larval walleye pollock (*Theragra chalcogramma*) in Shelikof Strait, Gulf of Alaska, in relation to water movement. Rapp. P.-v. Reun. Cons. int. Explor. Mer 191:127-136.

Livingston, P.A. 1991. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1884-1986. U. S. Dept. Commerce, NOAA Tech Memo. NMFS F/NWC-207.

Meuter, F.J. and B.L. Norcross. 2002. Spatial and temporal patterns in the demersal fish community on the shelf and upper slope regions of the Gulf of Alaska. Fish. Bull. 100:559-581.

Mulligan, T.J., Chapman, R.W. and B.L. Brown. 1992. Mitochondrial DNA analysis of walleye pollock, *Theragra chalcogramma*, from the eastern Bering Sea and Shelikof Strait, Gulf of Alaska. Can. J. Fish. Aquat. Sci. 49:319-326.

Olsen, J.B., S.E. Merkouris, and J.E. Seeb. 2002. An examination of spatial and temporal genetic variation in walleye pollock (*Theragra chalcogramma*) using allozyme, mitochondrial DNA, and microsatellite data. Fish. Bull. 100:752-764.

Rugen, W.C. 1990. Spatial and temporal distribution of larval fish in the western Gulf of Alaska, with emphasis on the period of peak abundance of walleye pollock (*Theragra chalcogramma*) larvae. NWAFC Proc. Rep. 90-01, 162 pp.

Shima, M. 1996. A study of the interaction between walleye pollock and Steller sea lions in the Gulf of Alaska. Ph.D. dissertation, University of Washington, Seattle, WA 98195.

Stabeno, P.J., J.D. Schumacher, K.M. Bailey, R.D. Brodeur, and E.D. Cokelet. 1996. Observed patches of walleye pollock eggs and larvae in Shelikof Strait, Alaska: their characteristics, formation and persistence. Fish. Oceanogr. 5 (Suppl. 1): 81-91.

Wespestad V.G. and T.J. Quinn. II. 1997. Importance of cannibalism in the population dynamics of walleye pollock. In: Ecology of Juvenile Walleye Pollock, *Theragra chalcogramma*. NOAA Technical Report, NMFS 126.

Wespestad, V.G. 1993. The status of Bering Sea pollock and the effect of the “Donut Hole” fishery. Fisheries 18(3)18-25.

Wolotira, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-84. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-6, 184 pp.

D.2 Pacific cod (Gadus macrocephalus)

D.2.1 Life History and General Distribution

Pacific cod is a transoceanic species, occurring at depths from shoreline to 500 m. The southern limit of the species’ distribution is about 34° N latitude, with a northern limit of about 63° N latitude. Adults are demersal and form aggregations during the peak spawning season, which extends approximately from January through May. Pacific cod eggs are demersal and adhesive. Eggs hatch in about 15-20 days. Little is known about the distribution of Pacific cod larvae, which undergo metamorphosis at about 25-35 mm. Juvenile Pacific cod start appearing in trawl surveys at a fairly small size, as small as 10 cm in the eastern Bering Sea. Pacific cod can grow to be more than a meter in length, with weights in excess of 10 kg. Natural mortality is believed to be somewhere between 0.3 and 0.4. Approximately 50% of Pacific cod are mature by ages 5-6. The maximum recorded age of a Pacific cod from the Bering Sea/Aleutian Islands (BSAI) or Gulf of Alaska (GOA) is 19 years.

The estimated size at 50% maturity is 67 cm.

D.2.2 Fishery

The fishery is conducted with bottom trawl, longline, pot, and jig gear. The age at 50% recruitment varies between gear types and regions. In the BSAI, the age at 50% recruitment is 6 years for trawl gear, 4 years for longline and 5 years for pot gear. In the GOA, the age at 50% recruitment is 5 years for trawl gear and 6 years for longline and pot gear. More than 100 vessels participate in each of the three largest fisheries (trawl, longline, pot). The trawl fishery is typically concentrated during the first few months of the year, whereas fixed-gear fisheries may sometimes run, intermittently, at least, throughout the year. Bycatch of crab and halibut sometimes causes the Pacific cod fisheries to close prior to reaching the total allowable catch. In the BSAI, trawl fishing is concentrated immediately north of Unimak Island, whereas the longline fishery is distributed along the shelf edge to the north and west of the Pribilof Islands. In the GOA, the trawl fishery has centers of activity around the Shumagin Islands and south of Kodiak Island, while the longline fishery is located primarily in the vicinity of the Shumagin.

D.2.3 Relevant Trophic Information

Pacific cod are omnivorous. In terms of percent occurrence, the most important items in the diet of Pacific cod in the BSAI and GOA are polychaete, amphipods, and crangonid shrimp. In terms of numbers of individual organisms consumed, the most important dietary items are euphausiids, miscellaneous fishes, and amphipods. In terms of weight of organisms consumed, the most important dietary items are walleye pollock, fishery discards, and yellowfin sole. Small Pacific cod feed mostly on invertebrates, while large Pacific cod are mainly piscivorous. Predators of Pacific cod include halibut, salmon shark, northern fur seals, sea lions, harbor porpoises, various whale species, and tufted puffin.

D.2.4 Habitat and Biological Associations

Egg/Spawning: Spawning takes place in the sublittoral-bathyal zone (40-290 m) near bottom. Eggs sink to the bottom after fertilization, and are somewhat adhesive. Optimal temperature for incubation is 3-6° C, optimal salinity is 13-23 ppt, and optimal oxygen concentration is from 2-3 ppm to saturation. Little is known about the optimal substrate type for egg incubation.

Larvae: Larvae are epipelagic, occurring primarily in the upper 45 m of the water column shortly after hatching, moving downward in the water column as they grow.

Juveniles: Juveniles occur mostly over the inner continental shelf at depths of 60-150 m.

Adults: Adults occur in depths from the shoreline to 500 m. Average depth of occurrence tends to vary directly with age for at least the first few years of life, with mature fish concentrated on the outer continental shelf. Preferred substrate is soft sediment, from mud and clay to sand.

Habitat and Biological Associations: Pacific cod

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	15-20 d	NA	winter-spring	ICS, MCS, OCS	D	M, SM, MS ,S	U	optimum 3-6°C optimum salinity 13-23 ppt
Larvae	U	copepods (?)	winter-spring	U	P (?), N (?)	U	U	
Early Juveniles	to 2 yrs	small invertebrates (mysids, euphausiids, shrimp)	all year	ICS, MCS	D	M, SM, MS, S	U	
Late Juveniles	to 5 yrs	pollock, flatfish, fishery discards, crab	all year	ICS, MCS, OCS	D	M, SM, MS, S	U	
Adults	5+ yr	pollock, flatfish, fishery discards, crab	Spawning (Jan-May)	ICS, MCS, OCS	D	M, SM, MS, S,G	U	
			non-spawning (Jun-Dec)	ICS, MCS, OCS				

D.2.5 Additional sources of information

Larvae/juveniles

NMFS, Alaska Fisheries Science Center, FOCI Program, Ann Matarese 206-526-4111

D.2.6 Literature

Albers, W.D., and P.J. Anderson. 1985. Diet of Pacific cod, *Gadus macrocephalus*, and predation on the northern pink shrimp, *Pandalus borealis*, in Pavlof Bay, Alaska. Fish. Bull., U.S. 83:601-610.

Alderdice, D.F., and C.R. Forrester. 1971. Effects of salinity, temperature, and dissolved oxygen on early development of the Pacific cod (*Gadus macrocephalus*). J. Fish. Res. Board Can. 28:883-902.

Bakkala, R.G. 1984. Pacific cod of the eastern Bering Sea. Int. N. Pac. Fish. Comm. Bull. 42:157-179.

Dunn, J.R., and A.C. Matarese. 1987. A review of the early life history of northeast Pacific gadoid fishes. Fish. Res. 5:163-184.

Forrester, C.R., and D.F. Alderdice. 1966. Effects of salinity and temperature on embryonic development of Pacific cod (*Gadus macrocephalus*). J. Fish. Res. Board Can. 23:319-340.

Hirschberger, W.A., and G.B. Smith. 1983. Spawning of twelve groundfish species in Alaska and Pacific Coast regions, 1975-81. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS F/NWC-44. 50 p.

Ketchen, K.S. 1961. Observations on the ecology of the Pacific cod (*Gadus macrocephalus*) in Canadian waters. J. Fish. Res. Board Can. 18:513-558.

Livingston, P.A. 1989. Interannual trends in Pacific cod, *Gadus macrocephalus*, predation on three commercially important crab species in the eastern Bering Sea. Fish. Bull., U.S. 87:807-827.

Livingston, P.A. 1991. Pacific cod. *In* P.A. Livingston (editor), Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1984 to 1986, p. 31-88. U.S. Dept. Commerce., NOAA Tech. Memo. NMFS F/NWC-207.

Matarese, A.C., A.W. Kendall Jr., D.M. Blood, and B.M. Vinter. 1989. Laboratory guide to early life history stages of northeast Pacific fishes. U.S. Dept. Commerce, NOAA Tech. Rep. NMFS 80. 652 p.

Moiseev, P.A. 1953. Cod and flounders of far eastern waters. Izv. Tikhookean. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. 40. 287 p. (Transl. from Russian: Fish. Res. Board Can. Transl. Ser. 119.)

National Oceanic and Atmospheric Administration (NOAA). 1987. Bering, Chukchi, and Beaufort Seas--Coastal and ocean zones strategic assessment: Data Atlas. U.S. Dept. Commerce, NOAA, National Ocean Service.

National Oceanic and Atmospheric Administration (NOAA). 1990. West coast of North America--Coastal and ocean zones strategic assessment: Data Atlas. U.S. Dept. Commerce, NOAA, National Ocean Service and National Marine Fisheries Service.

Phillips, A.C., and J.C. Mason. 1986. A towed, self-adjusting sled sampler for demersal fish eggs and larvae. Fish. Res. 4:235-242.

Rugen, W.C., and A.C. Matarese. 1988. Spatial and temporal distribution and relative abundance of Pacific cod (*Gadus macrocephalus*) larvae in the western Gulf of Alaska. NWAFC Proc. Rep. 88-18. Available from Alaska Fish. Sci. Center, 7600 Sand Point Way NE., Seattle, WA 98115-0070.

Thompson, G.G., and M.W. Dorn. 2002. Assessment of the Pacific cod stock in the eastern Bering Sea and Aleutian Islands area. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions, Plan Team for the Groundfish Fisheries of the Bering Sea and Aleutian Islands (editor), p. 121-205. Available from North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Thompson, G.G., H.H. Zenger, and M.W. Dorn. 2002. Assessment of the Pacific cod stock in the Gulf of Alaska. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, Plan Team for the Gulf of Alaska (editor), p. 89-167. Available from North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Westrheim, S.J. 1996. On the Pacific cod (*Gadus macrocephalus*) in British Columbia waters, and a comparison with Pacific cod elsewhere, and Atlantic cod (*G. morhua*). Can. Tech. Rep. Fish. Aquat. Sci. 2092. 390 p.

D.3 Sablefish (Anoplopoma fimbria)

D.3.1 Life History and General Distribution

Distributed from Mexico through the Gulf of Alaska to the Aleutian Chain, Bering Sea; along the Asian coast from Sagami Bay, and along the Pacific sides of Honshu and Hokkaido Islands and the Kamchatkan Peninsula. Adult sablefish occur along the continental slope, shelf gulleys, and in deep fjords such as Prince William Sound and Southeastern Alaska, at depths generally greater than 200 m. Adults are assumed to be demersal. Spawning or very ripe sablefish are observed in late winter or early spring along the continental slope. Eggs are apparently released near the bottom where they incubate. After hatching and yolk adsorption the larvae rise to the surface where they have been collected with neuston nets. Larvae are oceanic through the spring and by late summer, small pelagic juveniles (10-15 cm) have been observed along the outer coasts of Southeast Alaska, where they apparently move into shallow waters to spend their first winter. During most years, there are only a few places where juveniles have been found during their first winter and second summer. It is not clear if the juvenile distribution is highly specific or appears so because sampling is highly inefficient and sparse. During the occasional times of large year-classes the juveniles are easily found in many inshore areas during their second summer. They are typically 30-40 cm in length during their second summer, after which they apparently leave the nearshore bays. One or two years later they begin appearing on the continental shelf and move to their adult distribution as they mature.

Size of 50% maturity: Bering Sea: males 65 cm, females 67 cm; Aleutian Islands: males 61 cm, females 65 cm; Gulf of Alaska: males 57 cm, females 65 cm. At the end of the second summer (~1.5 years old) they are 35-40 cm in length. Provide source (agency, name and phone number, or literature reference) for any possible additional distribution data (do not include AFSC groundfish surveys or fishery observer data)

D.3.2 Fishery

The major fishery for sablefish in Alaska uses longlines, however sablefish are valuable in the trawl fishery as well. Sablefish enter the longline fishery at 4-5 years of age, perhaps slightly younger in the trawl fishery. The longline fishery takes place March 1 and November 15. The take of the trawl share of sablefish occurs primarily in association with openings for other species, such as the July rockfish openings, where they are taken as allowed bycatch. Deeper dwelling rockfish, such as Shortraker, Rougheye, and Thornyhead rockfish are the primary bycatch in the longline sablefish fishery. Halibut and rattails (Albatrossia pectoralis and Corphaenoides acrolepis) also are taken. By regulation, there is no directed trawl fishery for sablefish, however, directed fishing standards have allowed some trawl hauls to target sablefish, where the bycatch is similar to the longline fishery, in addition perhaps to some deep dwelling flatfish.

D.3.3 Relevant Trophic Information

Larval sablefish feed on a variety of small zooplankton ranging from copepod naupli to small amphipods. The epipelagic juveniles feed primarily on macrozooplankton and micronekton (i.e., euphausiids).

The older demersal juveniles and adults appear to be opportunistic feeders, with food ranging from variety of benthic invertebrates, benthic fishes, as well as squid, mesopelagic fishes, jellyfish and fishery discards. Gadid fish (mainly pollock) comprise a large part of the sablefish diet. Nearshore residence during their second year provide the opportunity to feed on salmon fry and smolts during the summer months.

Young of the year sablefish are commonly found in the stomachs of salmon taken in the southeast (SE) troll fishery during the late summer.

D.3.4 Habitat and Biological Associations

Egg/Spawning

Larvae

Juveniles

Adults - other than depth, none is noted.

Habitat and Biological Associations: Sablefish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	14-20 days	NA	late winter-early spring: Dec-Apr	USP, LSP, BSN	P, 200-3000 m	NA	U	
Larvae	up to 3 months	copepod nauplii, small copepodites, etc	spring-summer: Apr-July	MCS, OCS, USP, LSP, BSN	N, neustonic near surface	NA	U	
Early Juveniles	to 3 yrs	small prey fish, sandlance, salmon, herring, etc		OCS, MCS, ICS, during first summer, then obs in BAY, IP, till end of 2nd summer; not obs'd till found on shelf	P when offshore during first summer, then D, SD/SP when inshore	NA when pelagic. The bays where observed were soft bottomed, but not enough obs. to assume typical.	U	
Late Juveniles	3-5 yrs	opportunistic: other fish, shellfish, worms, jellyfish, fishery discards	all year	continental slope, and deep shelf gulleys and fjords.	caught with bottom tending gear. presumably D	varies	U	
Adults	5 yrs to 35+	opportunistic: other fish, shellfish, worms, jellyfish, fishery discards	apparently year around, spawning movements (if any) are undescribed	continental slope, and deep shelf gulleys and fjords.	caught with bottom tending gear. presumably D	varies	U	

D.3.5 Additional Sources of information

Eggs and Larvae:

NMFS, Alaska Fisheries Science Center, FOCI Program, Art Kendall 206-526-4108, NMFS Auke Bay Lab, Bruce Wing 907-789-????

Juveniles:

ADFG groundfish surveys: Jim Blackburn, ADFG, Kodiak AK 907-486-186, Paul Anderson, NMFS/RACE, Kodiak AK 907-487-4961

Kendall, A.W. and A.C. Materese. Biology of eggs, larvae, and epipelagic juveniles of sablefish, Anoplopoma fimbria, in relation to their potential use in management. Mar. Fish. Rev. 49(1)1-13.

Smith, G.B., G.E. Walters, P.A. Raymore, Jr., and W.A, Hischberger. 1984. Studies of the distribution and abundance of juvenile groundfish in the northwestern Gulf of Alaska, 1980-82: Part I, Three-year comparisons. NOAA Tech. Memo. NMFS F/NWC-59. 100p.

Walters, G.E., G.B. Smith, P.A. Raymore, and W.A. Hirschberger. 1985. Studies of the distribution and abundance of juvenile groundfish in the northwestern Gulf of Alaska, 1980-82: Part II, Biological characteristics in the extended region. NOAA Tech. Memo. NMFS F/NWC-77. 95 p.

Wing, B.L. and D.J. Kamikawa. 1995. Distribution of neustonic sablefish larvae and associated ichthyoplankton in the eastern Gulf of Alaska, May 1990. NOAA Tech. Memo. NMFS-AFSC-53.

D.3.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and Zoogeography of common fishes in the Bering Sea and northeastern Pacific. U.S. Dep. Commer., NOAAS Tech. Rept. NMFS 66, 151 p.

Boehlert, G.W., and M.M. Yoklavich. 1985. Larval and juvenile growth of sablefish, Anoplopoma fimbria, as determined from otolith increments. Fish. Bull. 83:475-481.

Grover, J.J., and B.L. Olla. 1986. Morphological evidence for starvation and prey size selection of sea-caught larval sablefish, Anoplopoma fimbria. Fish. Bull. 84:484-489.

Grover, J.J., and B.L. Olla. 1987. Effects of and El Niño event on the food habits of larval sablefish, Anoplopoma fimbria, off Oregon and Washington. Fish. Bull. 85: 71-79.

Grover, J.J., and B.L. Olla. 1990. Food habits of larval sablefish, Anoplopoma fimbria from the Bering Sea. Fish Bull. 88:811-814.

Hunter, J.R., B.J. Macewiccz, and C.A. Kimbrell. 1989. Fecundity and other aspects of the reproduction of Sablefish, Anoplopoma fimbria, in Central California Waters. Calif. Coop. Fish. Invst. Rep. 30: 61-72.

Kendall, A.W., Jr., and A.C. Matarese. 1984. Biology of eggs, larvae, and epipelagic juveniles of sablefish, Anoplopoma fimbria, in relation to their potential use in management. Mar. Fish. Rev. 49(1):1-13.

Mason, J.C. , R.J. Beamish, and G.A. McFralen. 1983. Sexual maturity, fecundity, spawning, and early life history of sablefish (Anoplopoma fimbria) off the Pacific coast of Canada. Can. J. Fish. Aquat. Sci. 40:2121-2134.

McFarlane, G.A., and R.J. Beamish. 1992. Climatic influence linking copepod production with strong year-classes in sablefish, Anoplopoma fimbria. Can J. Fish. Aquat. Sci. 49:743-753.

Moser, H.G., R.L. Charter, P.E. Smith, N.C.H. Lo., D.A. Ambrose, C.A. Meyer, E.M. Sanknop, and W. Watson. 1994. Early life history of sablefish, Anoplopoma fimbria, off Washington, Oregon, and California with application to biomass estimation. Calif. Coop. Oceanic Fish. Invest. Rep. 35:144-159.

Rutecki, T.L. and E.R. Varosi. 1993. Distribution, age, and growth of juvenile sablefish in Southeast Alaska. Paper presented at International Symposium on the Biology and Management of Sablefish. Seattle, Wash. April 1993.

Rutecki, T.L. and E.R. Varosi. 1993. Migrations of Juvenile Sablefish in Southeast Alaska. Paper presented at International Symposium on the Biology and Management of Sablefish. Seattle, Wash. April 1993.

Sasaki, T. 1985. Studies on the sablefish resources in the North Pacific Ocean. Bulletin 22, (1-108), Far Seas Fishery Laboratory. Shimizu, 424, Japan.

Sigler, M.F., E.R. Varosi, and T.R. Rutecki. 1993. Recruitment curve for sablefish in Alaska based on recoveries of fish tagged as juveniles. Paper presented at International Symposium on the Biology and Management of Sablefish. Seattle, Wash. April 1993.

Sigler, M. F., T. L. Rutecki, D. L. Courtney, J. F. Karinen, and M.-S.Yang. 2001. Young-of-the-year sablefish abundance, growth, and diet. Alaska Fisheries Research Bulletin 8(1): 57-70.

NOAA (National Oceanic and Atmospheric Administration). 1990. Sablefish, Anoplopoma fimbria. Pl 3.2.22. In: West Coast of North America Coastal and Ocean Zones Strategic Assessment Data Atlas. Invertebrate and Fish Volume. U.S. Dep. Commer. NOAA. OMA/NOS, Ocean Assessment Division, Strategic Assessment Branch.

Wing, B.L. 1985. Salmon Stomach contents from the Alaska Troll Logbook Program, 1977-84. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-91, 41 p.

Wing, B.L. 1997. Distribution of sablefish, Anoplopoma fimbria, larvae in the eastern Gulf of Alaska: Neuston-net tows versus oblique tows. In: M. Wilkins and M. Saunders (editors), Proc. Int. Sablefish Symp., April 3-4, 1993, p. 13-25.. U.S. Dep. Commer., NOAA Tech. Rep. 130.

Wing, B.L. and D.J. Kamikawa. 1995. Distribution of neustonic sablefish larvae and associated ichthyoplankton in the eastern Gulf of Alaska, May 1990. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-AFSC-53, 48 p.

Wing, B.L., C. Derrah, and V. O'Connell. 1997. Ichthyoplankton in the eastern Gulf of Alaska, May 1990. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-AFSC-376, 42 p.

Wolotera, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-6, 184 p.

Yang, M-S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. NOAA Tech. Memo. NMFS-AFSC-22. 150 p.

D.4 Yellowfin sole *(Limanda aspera)*

D.4.1 Life History and General Distribution

Distributed in North American waters from off British Columbia, Canada, (approx. lat. 49° N) to the Chukchi Sea (about lat. 70° N) and south along the Asian coast to about lat. 35° N off the South Korean coast in the Sea of Japan. Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins, adults begin a migration onto the inner shelf in April or early May each year for spawning and feeding. A protracted and variable spawning period may range from as early as late May through August occurring primarily in shallow water. Fecundity varies with size and was reported to range from 1.3 to 3.3 million eggs for fish 25-45 cm long. Eggs have been found to the limits of inshore ichthyoplankton sampling over a widespread area to at least as far north as Nunivak Island. Larvae have been measured at 2.2-5.5 mm in July and 2.5-12.3 mm in late August - early September. The age or size at metamorphosis is unknown. Upon settlement in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and burrowing for protection. Juveniles are separate from the adult population, remaining in shallow areas until they reach approximately 15 cm. The estimated age of 50% maturity is 10.5 yrs (approx. 29 cm) for females based on samples collected in 1992 and 1993. Natural mortality rate is believed to range from 0.12-0.16.

The approximate upper size limit of juvenile fish is 27cm.

D.4.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 6 and they are fully selected at age 13. Historically, the fishery has occurred throughout the mid and inner Bering Sea shelf during ice-free conditions although much effort has been directed at the spawning concentrations in nearshore northern Bristol Bay. They are caught as bycatch in Pacific cod, bottom pollock and other flatfish fisheries and are caught with these species and Pacific halibut in yellowfin sole directed fisheries.

D.4.3 Relevant Trophic Information

Groundfish predators include Pacific cod, skates and Pacific halibut, mostly on fish ranging from 7 to 25 cm standard length.

D.4.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for at least 2-3 months until metamorphosis occurs, usually inhabiting shallow areas.

Adults: Summertime spawning and feeding on sandy substrates of the eastern Bering Sea shelf. Widespread distribution mainly on the middle and inner portion of the shelf, feeding mainly on bivalves, polychaete, amphipods and echiurids. Wintertime migration to deeper waters of the shelf margin to avoid extreme cold water temperatures, feeding diminishes.

Habitat and Biological Associations: Yellowfin sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	summer	BAY, BCH	P			
Larvae	2-3 months?	U phyto/zoo plankton?	summer autumn?	BAY, BCH ICS	P			
Early Juveniles	to 5.5 yrs	polychaete bivalves amphipods echiurids	all year	BAY, ICS OCS	D	S[1]		
Late Juveniles	5.5 to 10 yrs	polychaete bivalves amphipods echiurids	all year	BAY, ICS OCS	D	S[1]		
Adults	10+ years	polychaete bivalves amphipods echiurids	spawning/ feeding May-August non-spawning Nov.-April	BAY BEACH ICS, MCS OCS	D	S[1]	ice edge	

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D.4.5 Literature

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Bakkala, R.G., V.G. Wespestad, and L.L. Low. 1982. The yellowfin sole (*Limanda aspera*) resource of the eastern Bering Sea--Its current and future potential for commercial fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-33, 43 p.

Fadeev, N.W. 1965. Comparative outline of the biology of fishes in the southeastern part of the Bering Sea and condition of their resources. [In Russ.] Tr. Vses. Nauchno-issled. Inst.Morsk. Rybn. Khoz. Okeanogr. 58 (Izv. Tikhookean. Nauchno-issled Inst. Morsk. Rybn. Khoz. Okeanogr. 53):121-138. (Trans. By Isr. Prog. Sci. Transl., 1968), p 112-129. In P.A. Moiseev (Editor), Soviet Fisheries Investigations in the northeastern Pacific, Pt. IV. Avail. Natl. Tech. Inf. Serv., Springfield, VA as TT 67-51206.

Kashkina, A.A. 1965. Reproduction of yellowfin sole (*Limanda aspera*) and changes in its spawning stocks in the eastern Bering Sea. Tr. Vses. Nauchno-issled, Inst. Morsk. Rybn. Khoz. Okeanogr. 58 (Izv. Tikhookean. Nauchno-issled. Inst. Rbn. Khoz. Okeanogr. 53):191-199. [In Russ.] Transl. By Isr. Prog. Sci. Transl., 1968, p. 182-190. In P.A. Moiseev (Editor), Soviet fisheries investigations in the northeastern Pacific, Part IV. Avail. Natl. Tech. Inf. Serv., Springfield, VA., as TT67-51206.

Livingston, P.A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992. AFSC processed Rep. 96-04, 51 p.

Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115.

Moles, A., and B. L. Norcross. 1995. Sediment preference in juvenile Pacific flatfishes. Netherlands J. Sea Res. 34(1-3):177-182 (1995).

Musienko, L.N. 1963. Ichthyoplankton of the Bering Sea (data of the Bering Sea expedition of 1958-59). Tr. Vses Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 48 (Izv. Tikhookean. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. 50)239-269. [In Russ.] Transl. By Isr. Prog. Sci. Transl., 1968, p. 251-286. In P.A. Moiseev (Editor), Soviet fisheries investigations in the northeastern Pacific, Part I. Avail. Natl. Tech. Inf. Serv., Springfield, VA, as TT67-51203.

Musienko, L.N. 1970. Reproduction and Development of Bering Sea. Tr. Vses Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 70 (Izv. Tikhookean. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. 72)161-224. [In Russ.] Transl. By Isr. Prog. Sci. Transl., 1972, p. 161-224. In P.A. Moiseev (Editor), Soviet fisheries investigations in the northeastern Pacific, Part V. Avail. Natl. Tech. Inf. Serv., Springfield, VA., as TT71-50127.

Nichol, D.G. 1994. Maturation and Spawning of female yellowfin sole in the Eastern Bering Sea. Preceding of the International North Pacific Flatfish Symposium, Oct. 26-28, 1994, Anchorage, AK. Alaska Sea Grant Program.

Wakabayashi, K. 1986. Interspecific feeding relationships on the continental shelf of the eastern Bering Sea, with special reference to yellowfin sole. Int. N. Pac. Fish. Comm. Bull. 47:3-30.

Waldron, K.D. 1981. Ichthyoplankton. In D.W. Hood and J.A. Calder (Editors), The eastern Bering Sea shelf: Oceanography and resources, Vol. 1, p. 471-493. U.S. Dep. Commer., NOAA, Off. Mar. Poll. Asess., U.S. Gov. Print. Off., Wash., D.C.

Wilderbuer, T.K., G.E. Walters, and R.G. Bakkala. 1992. Yellowfin sole, Pleuronectes asper, of the Eastern Bering Sea: Biological Characteristics, History of Exploitation, and Management. Mar. Fish. Rev. 54(4) p 1-18.

D.5 Greenland turbot (*Reinhardtius* hippoglossoides)

D.5.1 Life History and General Distribution

Greenland turbot has an amphiboreal distribution, occurring in the North Atlantic and North Pacific, but not in the intervening Arctic Ocean. In the North Pacific, species abundance is centered in the eastern Bering Sea and, secondly, in the Aleutians. On the Asian side, they occur in the Gulf of Anadyr along the Bering Sea coast of Russia, in the Okhotsk Sea, around the Kurile Islands, and south to the east coast of Japan to northern Honshu Island (Hubbs and Wilimovsky 1964, Mikawa 1963, Shuntov 1965). Adults exhibit a benthic lifestyle, living in deep waters of the continental slope but are known to have a tendency to feed off the sea bottom. During their first few years as immature fish, they inhabit relatively shallow continental shelf waters (<200 m) until about age 4 or 5 before joining the adult population (200 - 1,000 m or more, Templeman 1973). Adults appear to undergo seasonal shifts in depth distribution moving deeper in winter and shallower in summer (Chumakov 1970, Shuntov 1965). Spawning is reported to occur in winter in the eastern Bering Sea and may be protracted starting in September or October and continuing until March with an apparent peak period in November to February (Shuntov 1970, Bulatov 1983). Females spawn relatively small numbers of eggs with fecundity ranging from 23,900 to 149,300 for fish 83 cm and smaller in the Bering Sea (D’yakov 1982).

Eggs and early larval stages are benthypelagic (Musienko 1970). In the Atlantic Ocean, larvae (10-18 cm) have been found in benthypelagic waters which gradually rise to the pelagic zone in correspondence to absorption of the yolk sac which is reported to occur at 15-18 mm with the onset of feeding (Pertseva-Ostroumova 1961 and Smidt 1969). The period of larval development extends from April to as late as August or September (Jensen 1935) which results in an extensive larval drift and broad dispersal from the spawning waters of the continental slope. Metamorphosis occurs in August or September at about 7-8 cm in length at which time the demersal life begins. Juveniles are reported to be quite tolerant of cold temperatures to less than zero degrees Celsius (Hognestad 1969) and have been found on the northern part of the Bering Sea shelf in summer trawl surveys (Alton et al. 1988).

The age of 50% maturity is estimated to range from 5-10 yrs (D'yakov 1982, 60 cm used in stock assessment) and a natural mortality rate of 0.18 has been used in the most recent stock assessments (Ianelli et al. 2002). The approximate upper size limit of juvenile fish is 59cm.

D.5.2 Fishery

Caught in bottom trawls and on longlines both as a directed fishery and in the pursuit of other bottom-dwelling species (primarily sablefish). Recruitment begins at about 50 and 60 cm in the trawl and longline fisheries, respectively. The fishery operates on the continental slope throughout the eastern Bering Sea and on both sides of the Aleutian Islands. Bycatch primarily occurs in the sablefish directed fisheries and also to a smaller extent in the Pacific cod fishery.

D.5.3 Relevant Trophic Information

Groundfish predators include Pacific cod, pollock and yellowfin sole, mostly on fish ranging from 2 to 5 cm standard length (probably age 0).

D.5.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for up to 9 months until metamorphosis occurs, usually with a widespread distribution inhabiting shallow waters. Juveniles live on continental shelf until about age 4 or 5 feeding primarily on euphausiids, polychaete and small walleye pollock..

Adults: Inhabit continental slope waters with annual spring/fall migrations from deeper to shallower waters. Diet consists of walleye pollock and other miscellaneous fish species.

Habitat and Biological Associations: Greenland turbot

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter	OCS, MCS	SD, SP			
Larvae	8-9 months	U phyto/zoo plankton?	Spring summer	OCS, ICS MCS	P			
Juveniles	1-5 yrs	euphausiids polychaetes small pollock	all year	ICS, MCS OCS, USP	D, SD	M/S+M[1]		
Adults	5+ years	pollock small fish	Spawning Nov-February	OCS, USP LSP	D, SD	M/S+M[1]		
			non-spawning March-October	USP, LSP				

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D.5.5 Literature

Alton, M.S., R.G. Bakkala, G.E. Walters and P.T. Munro. 1988. Greenland turbot, Reinhardtius hippoglossoides, of the Eastern Bering Sea and Aleutian Islands. U.S. Dept. Commer., NOAA Tech. Rpt. NMFS 71, 31 pages.

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Bulatov, O.A. 1983. Distribution of eggs and larvae of Greenland halibut, Reinhardtius hippoglossoides, (Pleuronectidae) in the eastern Bering Sea. J. Ichthyol. [Engl. Transl. Vopr. Ikhtiol.] 23(1):157-159.

Chumakov, A.K. 1970. The Greenland halibut, Reinhardtius hippoglossoides, in the Iceland area-The halibut fisheries and tagging. Tr. Polyarn. Nauchno-Issled. Proektn. Inst. Morsk. Rybn. Khoz. 1970:909-912.

D'yakov, Yu. P. 1982. The fecundity of the Greenland halibut, Reinhardtius hippoglossoides (Pleuronectidae), from the Bering Sea. J. Ichthyol. [Engl. Trans. Vopr. Ikhtiol.] 22(5):59-64.

Hognestad, P.T. 1969. Notes on Greenland halibut, Reinhardtius hippoglossoides, in the eastern Norwegian Sea. Fiskeridir. Skr. Ser. Havunders. 15(3):139-144.

Hubbs, C.L., and N.J. Wilimovsky. 1964. Distribution and synonymy in the Pacific Ocean and variation of the Greenland halibut, Reinhardtius hippoglossoides (Walbaum). J. Fish. Res. Board Can. 21:1129-1154.

Ianelli, J.N., C. Minte-Vera, T.K. Wilderbuer, and T. M. Sample. 2002. Greenland turbot. In Appendix A Stock Assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands Regions. Pages 255-282. North Pacific Fishery Management Council, 605 West 4th Ave., Suite 306, Anchorage, AK 99501.

Jensen, A.S. 1935. (Reinhardtius hippoglossoides) its development and migrations. K. dan. Vidensk. Selsk. Skr. 9 Rk., 6:1-32.

Livingston, P.A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992. AFSC processed Rep. 96-04, 51 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way, NE., Seattle, WA 98115.

Mikawa, M. 1963. Ecology of the lesser halibut, Reinhardtius hippoglossoides matsuurae Jordan and Snyder. Bull. Tohoku Reg. Fish. Res. Lab. 29:1-41.

Musienko, L.N. 1970. Reproduction and Development of Bering Sea. Tr. Vses Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 70 (Izv. Tikhookean. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. 72)161-224. [In Russ.] Transl. By Isr. Prog. Sci. Transl., 1972, p. 161-224. In P. A. Moiseev (Editor), Soviet fisheries investigations in the northeastern Pacific, Part V. Avail. Natl. Tech. Inf. Serv., Springfield, VA., as TT71-50127.

Pertseva-Ostroumova, T.A. 1961. The reproduction and development of far eastern flounders. Izdatel'stvo Akad. Nauk. SSSR, 483 p. [Transl. By Fish. Res. Board Can., 1967, Transl. Ser. 856, 1003 p.]

Shuntov, V.P. 1965. Distribution of the Greenland halibut and arrowtooth halibuts in the North Pacific. Tr. Vses. Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 58 (Izv. Tikhookean. Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 53):155-163. [Transl. In Soviet Fisheries Investigation in the Northeastern Pacific, Part IV, p. 147-156, by Israel Prog. Sci. Transl., 1972, avail. Natl. Tech. Inf. Serv., Springfield, VA as TT71-50127.]

Templeman, W. 1973. Distribution and abundance of the Greenland halibut, Reinhardtius hippoglossoides (Walbaum), in the Northwest Atlantic. Int. Comm. Northwest Atl. Fish. Res. Bull. 10:82-98.

D.6 Arrowtooth flounder (*Atheresthes stomias*)

D.6.1 Life History and General Distribution

Distributed in North American waters from central California to the eastern Bering Sea on the continental shelf and upper slope.

Adults exhibit a benthic lifestyle and occupy separate winter and summer distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins and upper slope areas, adults begin a migration onto the middle and outer shelf in April or early May each year with the onset of warmer water temperatures. A protracted and variable spawning period may range from as early as September through March (Rickey 1994, Hosie 1976). Little is known of the fecundity of arrowtooth flounder. Larvae have been found from ichthyoplankton sampling over a widespread area of the eastern Bering Sea shelf in April and May and also on the continental shelf east of Kodiak Island during winter and spring (Waldron and Vinter 1978, Kendall and Dunn 1985). The age or size at metamorphosis is unknown. Juveniles are separate from the adult population, remaining in shallow areas until they reach the 10-15 cm range (Martin and Clausen 1995). The estimated length at 50% maturity is 28 cm for males (4 years) and 37 cm for females (5 years) from samples collected off the Washington coast (Rickey 1994). The natural mortality rate used in stock assessments differs by sex and is estimated at 0.2 for females and 0.35 - 0.37 for females (Turnock et. al 2002, Wilderbuer and Sample 2002).

The approximate upper size limit of juvenile fish is 27cm for males and 37cm for females.

D.6.2 Fishery

Caught in bottom trawls usually in pursuit of other higher value bottom-dwelling species. Historically have been undesirable to harvest due to a flesh softening condition caused by protease enzyme activity. Recruitment begins at about age 3 and females are fully selected at age 10. They are caught as bycatch in Pacific cod, bottom Pollock, sablefish and other flatfish fisheries by both trawls and longline.

D.6.3 Relevant Trophic Information

Very important as a large, aggressive and abundant predator of other groundfish species. Groundfish predators include Pacific cod and pollock, mostly on small fish.

D.6.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for at least 2-3 months until metamorphosis occurs, juveniles usually inhabit shallow areas until about 10 cm in length.

Adults: Widespread distribution mainly on the middle and outer portions of the continental shelf, feeding mainly on walleye pollock and other miscellaneous fish species when arrowtooth flounder attain lengths greater than 30 cm. Wintertime migration to deeper waters of the shelf margin and upper continental slope to avoid extreme cold water temperatures and for spawning.

Habitat and Biological Associations: Arrowtooth flounder

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter, spring?	ICS, MCS, OCS	P			
Larvae	2-3 months?	U phyto/zoo plankton?	Spring summer?	BAY, ICS, MCS, OCS	P			
Early Juveniles	to 2 yrs	euphausiids crustaceans amphipods pollock	all year	ICS, MCS	D	GMS[1]		
Late Juveniles	males 2-4 yrs females 2-5 yrs	euphausiids crustaceans amphipods pollock	all year	ICS, MCS, OCS, USP	D	GMS[1]		
Adults	males - 4+ yrs females- 5+ yrs	pollock misc. fish Gadidae sp. Euphausiids	Spawning Nov-March non-spawning April-Oct	MCS, OCS, USP	D	GMS[1]	ice edge (EBS)	

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D.6.5 Literature

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Board Can. Bull. 180, 740 p.

Hosie, M.J. 1976. The arrowtooth flounder. Oregon Dep. Fish. Wildl. Info. Rep. 76-3, 4 p.

Kendall, A.W. Jr. and J.R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. NOAA Tech. Rep. NMFS 20, U. S. Dep. Commer, NOAA, Natl. Mar. Fish. Serv.

Livingston, P.A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992. AFSC processed Rep. 96-04, 51 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115.

Martin, M.H. and D.M. Clausen. 1995. Data report: 1993 Gulf of Alaska Bottom Trawl Survey. U.S. Dept. Commer., NOAA, Natl. Mar. Fish. Serv., NOAA Tech. Mem. NMFS-AFSC-59, 217 p.

Rickey, M.H. 1994. Maturity, spawning, and seasonal movement of arrowtooth flounder, *Atheresthes stomias*, off Washington. Fish. Bull. 93:127-138 (1995).

Turnock, B.J., T.K. Wilderbuer and E.S. Brown 2002. Arrowtooth flounder. *In Appendix B* Stock Assessment and Fishery Evaluation Report for the groundfish resources of the Gulf of Alaska, Pages 199-228. North Pacific Fishery Management Council, 605 W. 4th Ave., Suite 306, Anchorage, AK 99501.

Waldron, K.D. and B.M. Vinter 1978. Ichthyoplankton of the eastern Bering Sea. U. S. Dep. Commer., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv. Seattle, WA, Processed rep., 88 p.

Wilderbuer, T.K. and T.M. Sample 2002. Arrowtooth flounder. *In* Appendix A Stock Assessment and Fishery Evaluation Report for the groundfish resources of the Bering Sea/Aleutian Islands, Pages 283-320. North Pacific Fishery Management Council, 605 W. 4th Ave., Suite 306, Anchorage, AK 99501.

D.7 Rock sole (*Lepidopsetta bilineatus*)

D.7.1 Life History and General Distribution

Distributed from California waters north into the Gulf of Alaska and Bering Sea to as far north as the Gulf of Anadyr. The distribution continues along the Aleutian Islands westward to the Kamchatka Peninsula and then southward through the Okhotsk Sea to the Kurile Islands, Sea of Japan, and off Korea. Centers of abundance occur off the Kamchatka Peninsula (Shubnikov and Lisovenko 1964), British Columbia (Forrester and Thompson 1969), the central Gulf of Alaska, and in the southeastern Bering Sea (Alton and Sample 1975). Two forms were recently found to exist in Alaska by Orr and Matarese (2000), a southern rock sole (*L. bilineatus*) and a northern rock sole (*L. polyxystra*). Adults exhibit a benthic lifestyle and, in the eastern Bering Sea, occupy separate winter (spawning) and summertime feeding distributions on the continental shelf. Rock sole spawn during the winter-early spring period of December-March. Soviet investigations in the early 1960s established two spawning concentrations: an eastern concentration north of Unimak Island at the mouth of Bristol Bay and a western concentration eastward of the Pribilof Islands between 55°30' and 55°0' N and approximately 165°2' W (Shubnikov and Lisovenko, 1964). Rock sole spawning in the eastern and western Bering Sea was found to occur at depths of 125-250 m, close to the shelf/slope break. Spawning females deposit a mass of eggs which are demersal and adhesive (Alton and Sample 1975). Fertilization is believed to be external. Incubation time is temperature dependent and may range from 6.4 days at 11 degrees C to about 25 days at 2.9 degrees C (Forrester 1964). Newly hatched larvae are pelagic and have occurred sporadically in eastern Bering Sea plankton surveys (Waldron and Vinter, 1978). Kamchatka larvae are reportedly 20 mm in length when they assume their side-swimming, bottom-dwelling form (Alton and Sample 1975). Norcross et al. (1996) found newly settled larvae in the 40-50 mm size range. Forrester and Thompson (1969) report that by age 1 they are found with adults on the continental shelf during summer.

In the springtime, after spawning, rock sole begin actively feeding and commence a migration to the shallow waters of the continental shelf. This migration has been observed on both the eastern (Alton and Sample, 1975) and western (Shvetsov 1978) areas of the Bering Sea. During this time they spread out and form much less dense concentrations than during the spawning period . Summertime trawl surveys indicate most of the population can be found at depths from 50-100 m (Armistead and Nichol 1993). The movement from winter/spring to summer grounds is in response to warmer temperatures in the shallow waters and the distribution of prey on the shelf seafloor (Shvetsov 1978). In September, with the onset of cooling in the northern latitudes, rock sole begin the return migration to the deeper wintering grounds. Fecundity varies with size and was reported to be 450,00 eggs for fish 42 cm long. Larvae are pelagic but their occurrence in plankton surveys in the eastern Bering Sea are rare (Musienko 1963). Juveniles are separate from the adult population, remaining in shallow areas until they reach age 1 (Forrester 1969). The estimated age of 50% maturity is 9 yrs (approx. 35 cm) for southern rock sole females and 7 years for northern rock sole females (Stark and Somerton 2002). Natural mortality rate is believed to range from 0.18 - 0.20.

The approximate upper size limit of juvenile fish is 34cm.

D.7.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 4 and they are fully selected at age 11. Historically, the fishery has occurred throughout the mid and inner Bering Sea shelf during ice-free conditions and on spawning concentrations north of the Alaska Peninsula during winter for their high-value roe. They are caught as bycatch in Pacific cod, bottom Pollock, yellowfin sole and other flatfish fisheries and are caught with these species and Pacific halibut in rock sole directed fisheries.

D.7.3 Relevant Trophic Information

Groundfish predators include Pacific cod, walleye pollock, skates, Pacific halibut and yellowfin sole, mostly on fish ranging from 5 to 15 cm standard length.

D.7.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for at least 2-3 months until metamorphosis occurs, juveniles inhabit shallow areas at least until age 1.

Adults: Summertime feeding on primarily sandy substrates of the eastern Bering Sea shelf. Widespread distribution mainly on the middle and inner portion of the shelf, feeding on bivalves, polychaete, amphipods and miscellaneous crustaceans. Wintertime migration to deeper waters of the shelf margin for spawning and to avoid extreme cold water temperatures, feeding diminishes.

Habitat and Biological Associations: Rock sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter	OCS	D			
Larvae	2-3 months?	U phyto/zoo plankton?	winter/spring	OCS, MCS, ICS	P			
Early Juveniles	to 3.5 yrs	polychaete bivalves amphipods misc. crust.	all year	BAY, ICS	D	S[1] G		
Late Juveniles	to 9 years	polychaete bivalves amphipods misc. crust.	all year	BAY, ICS, MCS, OCS	D	S[1] G		
Adults	9+ years	polychaete bivalves amphipods misc. crust.	Feeding May-September Spawning Dec.-April	MCS, ICS OCS	D	S[1] G	ice edge	

[1]Pers. Comm. Dr. Robert McConnaughey (206) 526-4150

D.7.5 Literature

Alton, M.S. and Terry M. Sample 1976. Rock sole (Family Pleuronectidae) p. 461-474. *In*: Demersal fish and shellfish resources in the Bering Sea in the baseline year 1975. Principal investigators Walter T. Pereyra, Jerry E. Reeves, and Richard Bakkala. U.S. Dep. Comm., Natl. Oceanic Atmos. Admin., Natl. Mar. Serv., Northwest and Alaska Fish Center, Seattle, WA. Processed Rep., 619 p.

Armistead, C.E. and D.G. Nichol 1993. 1990 Bottom Trawl Survey of the Eastern Bering Sea Continental Shelf. U.S. Dep. Commer., NOAA Tech. Mem. NMFS-AFSC-7, 190 p.

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Forrester, C.R. 1964. Demersal Quality of fertilized eggs of rock sole. J. Fish. Res. Bd. Canada, 21(6), 1964. P. 1531.

Forrester, C.R. and J.A. Thompson 1969. Population studies on the rock sole, *Lepidopsetta bilineata*, of northern Hecate Strait British Columbia. Fish. Res. Bd. Canada, Tech. Rep. No. 108, 1969. 104 p.

Livingston, P.A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992. AFSC processed Rep. 96-04, 51 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115.

Musienko, L.N. 1963. Ichthyoplankton of the Bering Sea (data of the Bering Sea expedition of 1958-59). Tr. Vses Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 48 (Izv. Tikhookean. Nauchno-issled. Inst. Rybn. Khoz. Okeanogr. 50)239-269. [In Russ.] Transl. By Isr. Prog. Sci. Transl., 1968, p. 251-286. In P. A. Moiseev (Editor), Soviet fisheries investigations in the northeastern Pacific, Part I. Avail. Natl. Tech. Inf. Serv., Springfield, VA., as TT67-51203.

Norcross, B.L., B.A. Holladay, S. C. Dressel, and M. Frandsen. 1996 .Recruitment of juvenile flatfishes in Alaska: habitat preference near Kodiak Island. U. Alaska, Coastal Marine Institute, OCS study MMS 96-003. Vol. 1.

Orr, J. M. and A. C. Matarese. 2000. Revision of the genus *Lepidipsetta* Gill, 1862 (Teleostei: Pleuronectidae) based on larval and adult morphology, with a description of a new species from the North Pacific Ocean and Bering Sea. Fish. Bull.98:539-582 (2000).

Shubnikov, D.A. and L.A. Lisovenko 1964. Data on the biology of rock sole in the southeastern Bering Sea. Tr. Vses. Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 49 (Izv. Tikookean. Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 51) : 209-214. (Transl. In Soviet Fisheries Investigations in the Northeast Pacific, Part II, p. 220-226, by Israel Program Sci. Transl., 1968, available Natl. Tech. Inf. Serv., Springfield, VA, as TT 67-51204).

Shvetsov, F.G. 1978. Distribution and migrations of the rock sole, *Lepidopsetta bilineata*, in the regions of the Okhotsk Sea coast of Paramushir and Shumshu Islands. J. Ichthol., 18 (1), 56-62, 1978.

Stark, J. W. and D. A. Somerton. 2002. Maturation, spawning and growth of rock sole off Kodiak Island in the Gulf of Alaska. J. Fish. Biology (2002)61, 417-431.

Waldron, K.D. And B. M. Vinter 1978. Ichthyoplankton of the eastern Bering Sea. U. S. Dep. Commer., Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv. Seattle, WA, Processed rep., 88 p.

D.8 Alaska Plaice (Pleuronectes quadrituberculatus)

Formerly a constituent of the "other flatfish" management category, Alaska plaice were split out in recent years and are managed as a separate stock.

D.8.1 Life History and General Distribution

Alaska plaice inhabit continental shelf waters of the North Pacific ranging from the Gulf of Alaska to the Bering and Chukchi Seas and in Asian waters as far south as Peter the Great Bay (Pertseva-Ostroumova 1961; Quast and Hall 1972). Adults exhibit a benthic lifestyle and live year round on the shelf and move seasonally within its limits (Fadeev 1965). From over-winter grounds near the shelf margins, adults begin a migration onto the central and northern shelf of the eastern Bering Sea, primarily at depths of less than 100 m. Spawning usually occurs in March and April on hard sandy ground (Zhang 1987). The eggs and larvae are pelagic and transparent and have been found in ichthyoplankton sampling in late spring and early summer over a widespread area of the continental shelf (Waldron and Favorite 1977).

Fecundity estimates (Fadeev 1965) indicate female fish produce an average of 56 thousand eggs at lengths of 28 to 30 cm and 313 thousand eggs at lengths of 48 to 50 cm. The age or size at metamorphosis is unknown. The estimated length of 50% maturity is 32 cm from collections made in March and 28 cm from April, which corresponds to an age of 6 to 7 years. Natural mortality rate estimates range from 0.19 to 0.22 (Wilderbuer and Zhang 1999).

The approximate upper size limit of juvenile fish is 27cm.

D.8.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 6 and they are fully selected at age 12. The fishery occurs throughout the mid and inner Bering Sea shelf during ice-free conditions .In recent years catches have been low due to a lack of targeting and they are now primarily caught as bycatch in Pacific cod, bottom pollock, yellowfin sole and other flatfish fisheries and are caught with these species and Pacific halibut the directed fishery.

D.8.3 Relevant Trophic Information

Groundfish predators include Pacific halibut (Novikov, 1964) yellowfin sole, beluga whales and fur seals (Salveson 1976).

D.8.4 Habitat and Biological Associations

<u>Larvae/Juveniles</u>: Planktonic larvae for at least 2-3 months until metamorphosis occurs, usually inhabiting shallow areas.

<u>Adults</u>: Summertime feeding on sandy substrates of the eastern Bering Sea shelf. Wide-spread distribution mainly on the middle, northern portion of the shelf, feeding on polychaete, amphipods and echiurids (Livingston and DeReynier 1996). Wintertime migration to deeper waters of the shelf margin to avoid extreme cold water temperatures. Feeding diminishes until spring after spawning.

Habitat and Biological Associations: Alaska plaice

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	spring and summer	ICS, MCS OCS	P			
Larvae	2-4 months?	U phyto/zoo plankton?	spring and summer	ICS, MCS	P			
Juveniles	up to 7 years	polychaete amphipods echiurids	all year	ICS, MCS	D	S+M[1]		
Adults	7+ years	polychaete amphipods echiurids	Spawning March-May Non-spawning and feeding June.-February	ICS, MCS ICS, MCS	D	S+M[1]	ice edge	

[1]Pers. Comm. Dr. Robert McConnaughey (206) 526-4150

D.8.5 Literature

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Fadeev, N.W. 1965. Comparative outline of the biology of fishes in the southeastern part of the Bering Sea and condition of their resources. [In Russ.] Tr. Vses. Nauchno-issled. Inst.Morsk. Rybn. Khoz. Okeanogr. 58 (Izv.Tikhookean. Nauchno-issled Inst. Morsk. Rybn. Khoz. Okeanogr. 53):121-138. (Trans. By Isr. Prog. Sci. Transl., 1968), p 112-129. In P.A. Moiseev (Editor), Soviet Fisheries Investigations in the northeastern Pacific, Pt. IV. Avail. Natl. Tech. Inf. Serv., Springfield, Va. As TT 67-51206.

Livingston, P.A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992. AFSC processed Rep. 96-04, 51 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115.

Novikov, N.P. 1964. Basic elements of the biology of the Pacific Halibut (*Hippoglossoides stenolepis* Schmidt) in the Bering Sea. Tr. Vses. Nauchno-issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 49 (Izv. Tikhookean. Nauchno-isslled. Inst. Morsk. Rybn. Khoz. Okeanogr. 51):167-204. (Transl. In Soviet Fisheries Investigations in the Northeast Pacific, Part II, p.175-219, by Israel Program Sci. Transl., 1968, avail. Natl. Tech. Inf. Serv. Springfield, VA, as TT67-51204.)

Pertseva-Ostroumova, T.A. 1961. The reproduction and development of far eastern flounders. (Transl. By Fish. Res. Bd. Can. 1967. Transl. Ser. 856, 1003 p.).

Quast, J.C. and E.L. Hall. 1972. List of fishes of Alaska and adjacent waters with a guide to some of their literature. U.S. Dep. Commer. NOAA, Tech. Rep. NMFS SSRF-658, 48p.

Salveson, S.J. 1976. Alaska plaice. In Demersal fish and shellfish resources of the eastern Bering Sea in the baseline year 1975 (eds. W.T. Pereyra, J.E. Reeves, and R.G. Bakkala). Processed Rep., 619 p. NWAFC, NMFS, NOAA, 2725 Montlake Blvd. E., Seattle, WA 98112.

Waldron, K.D. and F. Favorite. 1977. Ichthyoplankton of the eastern Bering Sea. In Environmental assessment of the Alaskan continental shelf, Annual reports of principal investigators for the year ending March 1977, Vol. IX. Receptors-Fish, littoral, benthos, p. 628-682. U.S. Dep. Comm., NOAA, and U.S. Dep. Int., Bur. Land. Manage.

Wilderbuer, T.K. and C.I. Zhang. 1999. Evaluation of the population dynamics and yield characteristics of Alaska plaice (Pleuronectes quadrituberculatus) in the eastern Bering Sea Fisheries Research 41 (1999) 183-200.

Zhang, C.I. 1987. Biology and Population Dynamics of Alaska plaice, Pleuronectes quadriterculatus, in the Eastern Bering Sea. PhD. dissertation, University of Washington: p.1-225.

D.9 Rex sole (Glyptocephalus zachirus)

Rex sole are a constituent of the “other flatfish” management category in the BSAI where they are less abundant than in the Gulf of Alaska.

Other members of the “other flatfish” category include:

Dover sole (*Microstomus pacificus*)

Starry flounder (*Platichthys stellatus*)

Longhead dab (*Pleuronectes proboscidea*)

Butter sole (*Pleuronectes isolepis*)

D.9.1 Life History and General Distribution

Distributed from Baja California to the Bering Sea and western Aleutian Islands (Hart 1973, Miller and Lea 1972), and are widely distributed throughout the Gulf of Alaska. Adults exhibit a benthic lifestyle and are generally found in water deeper than 300 meters. From over-winter grounds near the shelf margins, adults begin a migration onto the mid and outer continental shelf in April or May each year. The spawning period off Oregon is reported to range from January through June with a peak in March and April (Hosie and Horton 1977). Spawning in the Gulf of Alaska was observed from February through July, with a peak period in April and May (Hirschberger and Smith 1983). Eggs have been collected in neuston and bongo nets mainly in the summer, east of Kodiak Island (Kendall and Dunn 1985), but the duration of the incubation period is unknown.. Larvae were captured in bongo nets only in summer over midshelf and slope areas (Kendall and Dunn 1985). Fecundity estimates from samples collected off the Oregon coast ranged from 3,900 to 238,100 ova for fish 24-59 cm (Hosie and Horton 1977). The age or size at metamorphosis is unknown Maturity studies from Oregon indicate that males were 50% mature at 16 cm and females at 24 cm. Juveniles less than 15 cm are rarely found with the adult population. The natural mortality rate used in recent stock assessments is 0.2 (Spencer et al. 2002).

The approximate upper size limit of juvenile fish is 15cm for males and 23cm for females.

D.9.2 Fishery

Caught in bottom trawls mostly in the pursuit of other bottom-dwelling species. Recruitment begins at about age 3 or 4. They are caught as bycatch in the Pacific ocean perch, Pacific cod, bottom pollock and other flatfish fisheries.

D.9.3 Relevant Trophic Information

Groundfish predators include Pacific cod and most likely arrowtooth flounder.

D.9.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for an unknown time period until metamorphosis occurs, juvenile distribution is unknown.

Adults: Spring spawning and summer feeding on a combination of sand, mud and gravel substrates of the continental shelf. Widespread distribution mainly on the middle and outer portion of the shelf, feeding mainly on polychaete, amphipods, euphausids and snow crabs.

Habitat and Biological Associations: Rex sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	Feb - May	ICS? MCS, OCS	P			
Larvae	U	U phyto/zoo plankton?	spring summer	ICS? MCS, OCS	P			
Juveniles	2 years	polychaete amphipods euphausiids Tanner crab	all year	MCS, ICS, OCS	D	G, S, M		
Adults	2+ years	polychaete amphipods euphausiids Tanner crab	Spawning Feb-May Non-spawning May-January	MCS, OCS USP MCS, OCS, USP	D	G, S, M		

D.9.5 Literature

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Board Canada, Bull. No. 180. 740 p.

Hosie, M.J. and H.F. Horton. 1977. Biology of the rex sole, *Glyptocephalus zachirus*, in waters off Oregon. Fish. Bull. Vol. 75, No. 1, 1977, p. 51-60.

Hirschberger, W.A. and G.B. Smith. 1983. Spawning of twelve groundfish species in the Alaska and Pacific coast regions. 50 p. NOAA Tech. Mem. NMFS F/NWC-44. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv.

Kendall, A.W. Jr. and J.R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. NOAA Tech. Rep. NMFS 20, U.S. Dep. Commer, NOAA, Natl. Mar. Fish. Serv.

Livingston, P.A. and B.J. Goiney, Jr. 1983. Food habits literature of North Pacific marine fishes: a review and selected bibliography. NOAA Tech. Mem. NMFS F/NWC-54, U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv.

Miller, D.J. and R.N. Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dep. Fish. Game, Fish. Bull. 157, 235 p.

Spencer, P. D., G. W. Walters and T. K. Wilderbuer. 2002. Other flatfish. *In* Appendix A Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Region. Pages 437-447. North Pacific Fishery Management Council, 605 West 4th Ave., Suite 306, Anchorage, AK 99501.

D.10 Dover sole (Microstomus pacificus)

D.10.1 Life History and General Distribution

Dover sole are distributed in deep waters of the continental shelf and upper slope from northern Baja California to the Bering Sea and the western Aleutian Islands (Hart 1973, Miller and Lea 1972), and exhibit a widespread distribution throughout the Gulf of Alaska. Adults are demersal and are mostly found in water deeper than 300 meters. The spawning period off Oregon is reported to range from January through May (Hunter et al. 1992). Spawning in the Gulf of Alaska has been observed from January through August, with a peak period in May (Hirschberger and Smith 1983). Eggs have been collected in neuston and bongo nets in the summer, east of Kodiak Island (Kendall and Dunn 1985), but the duration of the incubation period is unknown. Larvae were captured in bongo nets only in summer over mid-shelf and slope areas (Kendall and Dunn 1985). The age or size at metamorphosis is unknown but the pelagic larval period is known to be protracted and may last as long as two years (Markle et al. 1992). Pelagic postlarvae as large as 48 mm have been reported and the young may still be pelagic at 10 cm (Hart 1973). Dover sole are batch spawners and Hunter et al. (1992) concluded that the average 1 kg. female spawns its 83,000 advanced yolked oocytes in about nine batches. Maturity studies from Oregon indicate that females were 50% mature at 33 cm total length. Juveniles less than 25 cm are rarely found with the adult population from bottom trawl surveys (Martin and Clausen 1995). The natural mortality rate used in recent stock assessments is 0.2 (Turnock et al. 1996).

The approximate upper size limit of juvenile fish is 32cm.

D.10.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 5. They are caught as bycatch in the rex sole, thornyhead and sablefish fisheries and are caught with these species and Pacific halibut in Dover sole directed fisheries.

D.10.3 Relevant Trophic Information

Groundfish predators include Pacific cod and most likely arrowtooth flounder.

D.10.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for up to 2 years until metamorphosis occurs, juvenile distribution is unknown.

Adults: Winter and spring spawning and summer feeding on soft substrates (combination of sand and mud) of the continental shelf and upper slope. Shallower summer distribution mainly on the middle to outer portion of the shelf and upper slope, feeding mainly on polychaete, annelids, crustaceans and molluscs (Livingston and Goiney 1983).

Habitat and Biological Associations: Dover sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	spring summer	ICS? MCS, OCS, UCS	P			
Larvae	up to 2 years	U phyto/ zooplankton?	all year	ICS? MCS, OCS, UCS	P			
Early Juveniles	to 3 years	polychaetes amphipods annelids	all year	MCS? ICS?	D	S, M		
Late Juveniles	3-5 years	polychaetes amphipods annelids	all year	MCS? ICS?	D	S, M		
Adults	5+ years	polychaetes amphipods annelids molluscs	spawning Jan-August non-spawning July-Jan	MCS, OCS, UCS	D	S, M		

D.10.5 Literature

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on seafloor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Board Canada, Bull. No. 180. 740 p.

Hunter, J.R., B.J. Macewicz, N.C. Lo and C.A. Kimbrell. 1992. Fecundity, spawning, and maturity of female Dove sole *Microstomus pacificus*, with an evaluation of assumptions and precision. Fish. Bull. 90:101-128(1992).

Hirschberger, W.A. and G.B. Smith. 1983. Spawning of twelve groundfish species in the Alaska and Pacific coast regions. 50 p. NOAA Tech. Mem. NMFS F/NWC-44. U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv.

Kendall, A.W. Jr. and J.R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. NOAA Tech. Rep. NMFS 20, U.S. Dep. Commer, NOAA, Natl. Mar. Fish. Serv.

Livingston, P.A. and B.J. Goiney, Jr. 1983. Food habits literature of North Pacific marine fishes: a review and selected bibliography. NOAA Tech. Mem. NMFS F/NWC-54, U.S. Dep. Commer., NOAA, Natl. Mar. Fish. Serv.

Markle, D.F., Harris, P, and Toole, C. 1992. Metamorphosis and an overview of early-life-history stages in Dover sole *Microstomus pacificus*. Fish. Bull. 90:285-301.

Martin, M.H. and D.M. Clausen. 1995. Data report: 1993 Gulf of Alaska Bottom Trawl Survey. U.S. Dept. Commer., NOAA, Natl. Mar. Fish. Serv., NOAA Tech. Mem. NMFS-AFSC-59, 217 p.

Miller, D.J. and R.N. Lea. 1972. Guide to the coastal marine fishes of California. Calif. Dept. Fish. Game, Fish. Bull. 157, 235 p.

Turnock, B.J., T.K. Wilderbuer and E.S. Brown. 1996. Flatfish. In Stock assessment and fishery evaluation Report for the groundfish resources of the Gulf of Alaska. p 279-290. North Pacific Fishery Management Council, 605 West 4th Ave., Suite 306, Anchorage, AK 99501.

D.11 Flathead sole (Hippoglossoides elassodon)

D.11.1 Life History and General Distribution

Distributed from northern California, off Point Reyes, northward along the west coast of North America and throughout the Gulf of Alaska and the Bering Sea, the Kuril Islands and possibly the Okhotsk Sea (Hart 1973).

Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the eastern Bering Sea shelf and in the Gulf of Alaska. From over-winter grounds near the shelf margins, adults begin a migration onto the mid and outer continental shelf in April or May each year for feeding. The spawning period may range from as early as January but is known to occur in March and April, primarily in deeper waters near the margins of the continental shelf. Eggs are large (2.75-3.75 mm) and females have egg counts ranging from about 72,000 (20 cm fish) to almost 600,000 (38 cm fish). Eggs hatch in 9 to 20 days depending on incubation temperatures within the range of 2.4 to 9.8°C (Forrester and Alderdice 1967) and have been found in ichthyoplankton sampling on the southern portion of the Bering Sea shelf in April and May (Waldron 1981). Larvae absorb the yolk sac in 6 to 17 days but the extent of their distribution is unknown. The age or size at metamorphosis is unknown as well as the age at 50% maturity. Juveniles less than age 2 have not been found with the adult population, remaining in shallow areas. The natural mortality rate used in recent stock assessments is 0.2 (Spencer et al. 2002).

D.11.2 Fishery

Caught in bottom trawls both as a directed fishery and in the pursuit of other bottom-dwelling species. Recruitment begins at about age 3. Historically, the fishery has occurred throughout the mid and outer Bering Sea shelf during ice-free conditions (mostly summer and fall). They are caught as bycatch in Pacific cod, bottom pollock and other flatfish fisheries and are caught with these species and Pacific halibut in flathead sole directed fisheries.

D.11.3 Relevant Trophic Information

Groundfish predators include Pacific cod, Pacific halibut, arrowtooth flounder and also cannibalism by large flathead sole, mostly on fish less than 20 cm standard length (Livingston and DeReynier 1996).

D.11.4 Habitat and Biological Associations

Larvae/Juveniles: Planktonic larvae for an unknown time period until metamorphosis occurs, usually inhabiting shallow areas.

Adults: Winter spawning and summer feeding on sand and mud substrates of the continental shelf. Widespread distribution mainly on the middle and outer portion of the shelf, feeding mainly on ophiuroids, tanner crab, osmerids, bivalves and polychaete (Pakunski 1990).

Habitat and Biological Associations: Flathead sole

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs		NA	winter	ICS, MCS, OCS	P			
Larvae	U	U phyto/zoo plankton?	spring summer	ICS, MCS, OCS	P			
Early Juveniles	to 2 yrs	polychaete bivalves ophiuroids	all year	MCS, ICS	D	S+M[1]		
Late	3 yrs	polychaete bivalves ophiuroids pollock and Tanner crab	all year	MCS, ICS, OCS	D	S+M[1]	Juveniles	
Adults	U	polychaete bivalves ophiuroids pollock and Tanner crab	Spawning Jan-April non-spawning May-December	MCS, OCS, ICS	D	S+M[1]	ice edge	

[1]Pers. Comm. Dr. Robert McConnaughey (206) 526-4150

D.11.5 Literature

Auster, P.J., Malatesta, R.J., Langton, R.W., L. Watling, P.C. Valentine, C.S. Donaldson, E.W. Langton, A.N. Shepard, and I.G. Babb. 1996. The impacts of mobile fishing gear on sea floor habitats in the Gulf of Maine (Northwest Atlantic): Implications for conservation of fish populations. Rev. in Fish. Sci. 4(2): 185-202.

Forrester, C.R. and D.F. Alderdice. 1967. Preliminary observations on embryonic development of the flathead sole (*Hippoglossoides elassodon*). Fish. Res. Board Can. Tech. Rep. 100: 20 p

Hart, J.L. 1973. Pacific fishes of Canada. Fish. Res. Board Canada, Bull. No. 180. 740 p.

Livingston, P.A. and Y. DeReynier. 1996. Groundfish food habits and predation on commercially important prey species in the eastern Bering Sea from 1990 to 1992. AFSC processed Rep. 96-04, 51 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., NOAA, 7600 Sand Point Way NE., Seattle, WA 98115.

Miller, B.S. 1969. Life history observations on normal and tumor bearing flathead sole in East Sound, Orcas Island (Washington). Ph.D. Thesis. Univ. Wash. 131 p.

Pacunski, R.E. 1990. Food habits of flathead sole (*Hippoglossoides elassodon*) in the eastern Bering Sea. M.S. Thesis. Univ. Wash. 106 p.

Spencer, P. D., G. W. Walters and T. K. Wilderbuer. 2002. Flathead sole. In Appendix A Stock Assessment and Fishery

Evaluation Document for the Groundfish Resources of the Bering Sea/Aleutian Islands Region. Pages 361-408. North

Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage AK 99501.

Waldron, K.D. 1981. Ichthyoplankton. In D.W. Hood and J.A. Calder (Editors), The eastern Bering Sea shelf: Oceanography and resources, Vol. 1, p. 471-493. U.S. Dep. Commer., NOAA, Off. Mar. Poll. Asess., U.S. Gov. Print. Off., Wash., D.C.

Walters, G.E. and T.K. Wilderbuer 1996. Flathead sole. *In* Stock assessment and fishery evaluation Report for the groundfish resources of the Bering Sea/Aleutian Islands Regions. p 279-290. North Pacific Fishery Management Council, 605 West 4th Ave., Suite 306, Anchorage, AK 99501.

D.12 Pacific ocean perch (*Sebastes alutus*)

D.12.1 Life History and General Distribution

Pacific ocean perch has a wide distribution in the North Pacific from southern California around the Pacific rim to northern Honshu Is., Japan, including the Bering Sea. The species appears to be most abundant in northern British Columbia, the Gulf of Alaska, and the Aleutian Islands. Adults are found primarily offshore along the continental slope in depths 180-420 m. Seasonal differences in depth distribution have been noted by many investigators. In the summer, adults inhabit shallower depths, especially those between 180 and 250 m. In the fall, the fish apparently migrate farther offshore to depths of ~300-420 m. They reside in these deeper depths until about May, when they return to their shallower summer distribution. This seasonal pattern is probably related to summer feeding and winter spawning. Although small numbers of Pacific ocean perch are dispersed throughout their preferred depth range on the continental slope, most of the population occurs in patchy, localized aggregations. At present, the best evidence indicates that Pacific ocean perch is mostly a demersal species. A number of investigators have speculated that there is also a pelagic component to their distribution, especially at night when they may move off-bottom to feed, but hard evidence for this is lacking.

There is much uncertainty about the life history of Pacific ocean perch, although generally more is known than for other rockfish species. The species appears to be viviparous, with internal fertilization and the release of live young. Insemination occurs in the fall, and sperm are retained within the female until fertilization takes place ~2 months later. The eggs develop and hatch internally, and parturition (release of larvae) occurs in April-May. Information on early life history is very sparse, especially for the first year of life. Positive identification of Pacific ocean perch larvae is not possible at present, but the larvae are thought to be pelagic and to drift with the current. Transformation to an adult form and the assumption of a demersal existence may take place within the first year. Small juveniles probably reside inshore in very rocky, high relief areas, and by age 3 begin to migrate to deeper offshore waters of the continental shelf. As they grow, they continue to migrate deeper, eventually reaching the continental slope, where they attain adulthood.

Pacific ocean perch is a very slow growing species, with a low rate of natural mortality (estimated at 0.05), a relatively old age at 50% maturity (10.5 years for females in the Gulf of Alaska), and a very old maximum age of 98 years in Alaska. Despite their viviparous nature, the fish is relatively fecund with number of eggs/female in Alaska ranging from 10,000-300,000, depending upon size of the fish.

For Gulf of Alaska, the approximate upper size limit of juvenile fish is: 38 cm for females; unknown for males, but presumed to be slightly smaller than for females based on what is commonly the case in other species of Sebastes. For Aleutian Islands and Bering Sea: unknown for both sexes.

D.12.2 Fishery

Pacific ocean perch are caught almost exclusively with bottom trawls. Age at 50% recruitment has been estimated to be about 6.6 years. The fishery is concentrated in the summer months due to management regulations and opens in July, when most of the harvest is taken. Harvest data from 2000-2002 indicates that approximately 80% of the POP in the BSAI are harvested during this month; there is no directed fishing for POP in the EBS management area. The harvest of POP is distributed across the Aleutian Islands subareas in proportion to relative biomass. From 2000-2002, approximately 44% of the harvest occurred in area 543, with 23% and 26% in the eastern and central Aleutians, respectively. POP are patchily distributed, and are harvested in relatively few areas within the broad management subareas of the Aleutian Islands.

The 2000-2002 blend data indicates that about 15% of the harvested BSAI POP is obtained as bycatch in the Atka mackerel fishery, with ~80% of the harvest of POP occurring in the POP fishery. Similarly, BSAI POP target fishery consists largely of POP, with percentages ranging from 71% to 91% from 2000 to 2002. Other species obtained as bycatch in the BSAI POP fishery include Atka mackerel, arrowtooth flounder, walleye pollock, northern rockfish, and shortraker/rougheye.

D.12.3 Relevant Trophic Information

All food studies of Pacific Ocean perch have shown them to be overwhelmingly planktivorous. Small juveniles eat mostly calanoid copepods, whereas larger juveniles and adults consume euphausiids as their major prey items. Adults, to a much lesser extent, may also eat small shrimp and squids. It has been suggested that Pacific ocean perch and walleye pollock compete for the same euphausiid prey. Consequently, the large removals of Pacific ocean perch by foreign fishermen in the Gulf of Alaska in the 1960s may have allowed walleye pollock stocks to greatly expand in abundance.

Documented predators of adult Pacific ocean perch include Pacific halibut and sablefish, and it is likely that Pacific cod and arrowtooth flounder also prey on Pacific ocean perch. Pelagic juveniles are consumed by salmon, and benthic juveniles are eaten by lingcod and other large demersal fish.

D.12.4 Habitat and Biological Associations

Egg/Spawning: Little information is known. Insemination is thought to occur after adults move to deeper offshore waters in the fall. Parturition is reported to occur from 20-30 m off bottom at depths of 360-400 m.

Larvae: Little information is known. Earlier information suggested that after parturition, larvae rise quickly to near surface, where they become part of the plankton. More recent data from British Columbia indicates that larvae may remain at depths >175 m for some period of time (perhaps two months), after which they slowly migrate upward in the water column.

Juveniles: Again, information is very sparse, especially for younger juveniles. After metamorphosis from the larval stage, juveniles may reside in a pelagic stage for an unknown length of time. They eventually become demersal, and at age 1-3 probably live in very rocky inshore areas. Afterward, they move to progressively deeper waters of the continental shelf. Older juveniles are often found together with adults at shallower locations of the continental slope in the summer months.

Adults: Commercial fishery data have consistently indicated that adult Pacific ocean perch are found in aggregations over reasonably smooth, trawlable bottom of the continental slope. Generally, they are found in shallower depths (180-250 m) in the summer, and deeper (300-420 m) in the fall, winter, and early spring. In addition, investigators in the 1960s and 1970s speculated that the fish sometimes inhabited the mid-water environment off bottom and also might be found in rough, untrawlable areas. Hard evidence to support these latter two conjectures, however, has been lacking. The best information available at present suggests that adult Pacific ocean perch is mostly a demersal species that prefers a flat, pebbled substrate along the continental slope. More research is needed, however, before definitive conclusions can be drawn as to its habitat preferences.

Habitat and Biological Associations: Pacific ocean perch

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	Internal incubation; ~90 d	NA	Winter	NA	NA	NA	NA	NA
Larvae	U; assumed between 60 and 180 days	U; assumed to be micro-zooplankton	Spring-summer	ICS, MCS, OCS, USP, LSP, BSN	P	NA	U	U
Juveniles	3-6 months to 10 years	Early juv: calanoid copepods; late juv: euphausiids	All year	ICS, MCS, OCS, USP	?P (early juv. only), D	R (<age 3)	U	U
Adults	10-98 years of age	Euphausiids	Insemination (fall); Fertilization, incubation (winter); Larval release (spring); Feeding in shallower depths (summer)	OCS, USP	D	CB, G,?M, ?SM,?MS	U	U

D.12.5 Additional sources of information

Eggs and Larvae: NMFS, Alaska Fisheries Science Center, Auke Bay Laboratory; NMFS, Alaska Fisheries Science Center, FOCI program; Canada Dept. of Fisheries and Oceans, Pacific Biological Station, Nanaimo, B.C.

Juveniles: Carlson, H.R. and R.E. Haight. 1976 . Juvenile life of Pacific ocean perch, *Sebastes alutus*, in coastal fiords of southeastern Alaska: Their environment, growth, food habits, and schooling behavior. Trans. Am, Fish. Soc. 105:191-201.

D.12.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and northeastern Pacific. U.S. Dep. Commer., NOAA Tech. Rept. NMFS 66, 151 p.

Carlson, H.R., and R.E. Haight. 1976. Juvenile life of Pacific ocean perch, *Sebastes alutus*, in coastal fiords of southeastern Alaska: their environment, growth, food habits, and schooling behavior. Trans. Am. Fish. Soc. 105:191-201.

Carlson, H.R., and R.R. Straty. 1981. Habitat and nursery grounds of Pacific rockfish, *Sebastes* spp., in rocky coastal areas of Southeastern Alaska. Mar. Fish. Rev. 43: 13-19.

Doyle, M.J. 1992. Patterns in distribution and abundance of ichthyoplankton off Washington, Oregon, and Northern California (1980-1987). U.S. Dep. Commer. NOAA NMFS AFSC Processed Rept. 92-14, 344 p.

Gillespie, G.E., R.D. Stanley, and B.M. Leaman. 1992. Early life history of rockfishes in British Columbia; preliminary results of the first year of investigation. Proc. 1992 W. Groundfish Conf. Alderbrook Inn Resort, Union, WA, Jan 27-30, 1992.

Gunderson, D.R. 1971. Reproductive patterns of Pacific ocean perch (*Sebatodes alutus*) off Washington and British Columbia and their relation to bathymetric distribution and seasonal abundance. J. Fish. Res. Bd. Can. 28: 417-425.

Gunderson, D.R., and M.O. Nelson. 1977. Preliminary report on an experimental rockfish survey conducted off Monterey, California and in Queen Charlotte Sound, British Columbia during August-September, 1976. Prepared for Feb. 15-16, 1977, Interagency Rockfish Survey Coordinating Committee Meeting, NWAFC, Seattle, WA. Unpubl. manuscr. 82 p.

Harrison, R.C. 1993. Data report: 1991 bottom trawl survey of the Aleutian Islands area. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-12. 144 p.

Heifetz, J., and D. Ackley. 1997. Bycatch in rockfish fisheries in the Gulf of Alaska. Unpubl. Manuscr. 20 p. (Available from NMFS Auke Bay Laboratory, 11305 Glacier Hwy., Juneau, AK 99801.

Heifetz, J., J.N. Ianelli, and D.M. Clausen. 1996. Slope rockfish. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p.229-269. North Pacific Fishery Management Council, 605 W. 4th. Ave., Suite 306, Anchorage, AK 99501-2252.

Ito, D.H. 1982. A cohort analysis of Pacific ocean perch stocks from the Gulf of Alaska and Bering Sea regions. U.S. Dep. Commer., NWAFC Processed Rept. 82-15, 157 p.

Ito, D.H., and J.N. Ianelli. 1996. Pacific ocean perch. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions, p.331-359. North Pacific Fishery Management Council, 605 W. 4th. Ave., Suite 306, Anchorage, AK 99501-2252.

Kendall, A.W., and W.H. Lenarz. 1986. Status of early life history studies of northeast Pacific rockfishes. Proc. Int. Rockfish Symp. Oct. 1986, Anchorage Alaska; p. 99-117.

Krieger, K.J. 1993. Distribution and abundance of rockfish determined from a submersible and by bottom trawling. Fish. Bull., U.S. 91:87-96.

Martin, M.H. and D.M. Clausen. 1995. Data report: 1993 Gulf of Alaska bottom trawl survey. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-59. 217 p.

Matarese, A.C., A.W. Kendall, Jr., D.M. Blood, and B.M. Vinter. 1989. Laboratory guide to early life history stages of northeast Pacific fishes. U.S. Dep. Commer. NOAA Tech. Rept. NMFS 80, 652 p.

Matthews, K.R., J.R. Candy, L.J. Richards, and C.M. Hand. 1989. Experimental gill net fishing on trawlable and untrawlable areas off northwestern Vancouver Island, from the MV Caledonian, August 15-28, 1989. Can. Manuscr. Rep. Fish. Aquat. Sci. 2046, 78 p.

Mattson, C.R., and B.L. Wing. 1978. Ichthyoplankton composition and plankton volumes from inland coastal waters of southeastern Alaska, April-November 1972. U.S. Dep. Commer., NOAA Tech. Rept. NMFS SSRF-723, 11 p.

Moser, H.G., 1996. SCORPAENIDAE: scorpionfishes and rockfishes. *In*: Moser, H.G., editor. The early stages of fishes in the California Current region, p. 733-795. CalCOFI Atlas No.33. 1505 p.

NOAA (National Oceanic and Atmospheric Administration). 1990. Pacific ocean perch, *Sebastes alutus*. *In*: West coast of North America coastal and ocean zones strategic assessment: data atlas. Invertebrate and fish volume, Plate 3.2.20. U.S. Dep. Commer. NOAA. OMA/NOS, Ocean Assessments Division, Strategic Assessment Branch.

Ronholt, L.L., K. Teshima, and D.W. Kessler. 1994. The groundfish resources of the Aleutian Islands region and southern Bering Sea 1980, 1983, and 1986. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-31. 351 p.

Seeb, L.W. 1993. Biochemical identification of larval rockfishes of the genus *Sebastes*. Final Report Contract #43ABNF001082. U.S. Dept. Commer. NOAA/NMFS NWAFC/RACE Division, Seattle, WA. 28 p.

Seeb, L.W., and A.W. Kendall, Jr. 1991. Allozyme polymorphisms permit the identification of larval and juvenile rockfishes of the genus *Sebastes*. Environmental Biology of Fishes 30:191-201.

Stark, J.W., and D.M. Clausen. 1995. Data report: 1990 Gulf of Alaska bottom trawl survey. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-49. 221 p.

Westrheim, S.J. 1970. Survey of rockfishes, especially Pacific ocean perch, in the northeast Pacific Ocean, 1963-66. J. Fish. Res. Bd. Canada 27: 1781-1809.

Westrheim, S.J. 1975. Reproduction, maturation, and identification of larvae of some *Sebastes* (Scorpaenidae) species in the northeast Pacific Ocean. J. Fish. Res. Board Can. 32: 2399-2411.

Wing, B.L. 1985. Salmon stomach contents from the Alaska troll logbook program, 1977-84. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-91. 41 p.

Wing, B.L., C. Derrah, and V. O'Connell. 1997. Ichthyoplankton in the eastern Gulf of Alaska, May 1990. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-AFSC-376, 42 p.

Wolotira, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984. U. S. Dep. Commer., NOAA Tech. Memo. NMFS - AFSC-6, 184 p.

Yang, M-S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-22, 150 p.

Yang, M-S. 1996. Diets of the important groundfishes in the Aleutian Islands in summer 1991. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-60, 105 p.

D.13 Northern Rockfish (*Sebastes polyspinus*)

D.13.1 Life History and General Distribution

Northern rockfish range from northern British Columbia through the Gulf of Alaska and Aleutian Islands to eastern Kamchatka, including the Bering Sea. The species is most abundant from about Portlock Bank in the central Gulf of Alaska to the western end of the Aleutian Islands. Within this range, adult fish appear to be concentrated at discrete, relatively shallow offshore banks of the outer continental shelf. Typically, these banks are separated from land by an intervening stretch of deeper water. The preferred depth range is ~75-125 m in the Gulf of Alaska, and ~100-150 m in the Aleutian Islands. The fish appear to be demersal, although small numbers are occasionally taken in pelagic tows. In common with many other rockfish species, northern rockfish tend to have a localized, patchy distribution, even within their preferred habitat, and most of the population occurs in aggregations. Most of what is known about northern rockfish is based on data collected during the summer months from the commercial fishery or in research surveys. Consequently, there is little information on seasonal movements or changes in distribution for this species.

Life history information on northern rockfish is extremely sparse. The fish are assumed to be viviparous, as are other Sebastes, with internal fertilization and incubation of eggs. Observations during research surveys in the Gulf of Alaska suggest that parturition (larval release) occurs in the spring, and is mostly completed by summer. Pre-extrusion larvae have been described, but field-collected larvae cannot be identified to species at present. Length of the larval stage is unknown, but the fish apparently metamorphose to a pelagic juvenile stage, which also has been described. There is no information on when the juveniles become benthic or what habitat they occupy. Older juveniles are found on the continental shelf, generally at locations inshore of the adult habitat.

Northern rockfish is a slow growing species, with a low rate of natural mortality (estimated at 0.06), a relatively old age at 50% maturity (12.8 years for females in the Gulf of Alaska), and an old maximum age of 57 years in Alaska. No information on fecundity is available.

For Gulf of Alaska: 38 cm for females; unknown for males, but presumed to be slightly smaller than for females based on what is commonly the case in other species of *Sebastes*. For Aleutian Islands and Bering Sea: unknown for both sexes. Because northern rockfish in the Aleutian Islands attain a much smaller size than in the Gulf, the upper size limit of juveniles there is probably much less than in the Gulf.

D.13.2 Fishery

In the BSAI area, there is no directed fishery for northern rockfish. Harvest data from 2000-2002 indicates that approximately 90% of the BSAI northern rockfish are harvested in the Atka mackerel fishery, with a large amount of the catch occurring in September in the western Aleutians (area 543). The distribution of northern rockfish harvest by Aleutian Islands subarea reflects both the spatial regulation of the Atka mackerel fishery and the increased biomass of northern rockfish in the western Aleutian Islands. The average proportion of northern rockfish biomass occurring in the western, central, and eastern Aleutian Islands, based on trawl surveys from 1991-2002, were 72%, 22% and 5%, respectively. Northern rockfish are patchily distributed, and are harvested in relatively few areas within the broad management subareas of the Aleutian Islands, with important fishing grounds being Petral Bank, Sturdevant Rock, south of Amchitka I., and Seguam Pass (Dave Clausen, NMFS-AFSC, personal communication).

D.13.3 Relevant Trophic Information

Although no comprehensive food study of northern rockfish has been done, several smaller studies have all shown euphausiids to be the predominate food item of adults in both the Gulf of Alaska and Bering Sea. Copepods, hermit crabs, and shrimp have also been noted as prey items in much smaller quantities.

Predators of northern rockfish have not been documented, but likely include species that are known to consume rockfish in Alaska, such as Pacific halibut, sablefish, Pacific cod, and arrowtooth founder.

D.13.4 Habitat and Biological Associations

Egg/Spawning: No information known, except that parturition probably occurs in the spring.

Larvae: No information known.

Juveniles: No information known for small juveniles (<20 cm), except that juveniles apparently undergo a pelagic phase immediately after metamorphosis from the larval stage. Larger juveniles have been taken in bottom trawls at various localities of the continental shelf, usually inshore of the adult fishing grounds.

Adults: Commercial fishery and research survey data have consistently indicated that adult northern rockfish are primarily found over reasonably flat, trawlable bottom of offshore banks of the outer continental shelf at depths of 75-150 m. Preferred substrate in this habitat has not been documented, but observations from trawl surveys suggest that large catches of northern rockfish are often associated with hard bottoms. Generally, the fish appear to be demersal, and most of the population occurs in large aggregations. There is no information on seasonal migrations. Northern rockfish often co-occur with dusky rockfish.

Habitat and Biological Associations: Northern Rockfish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	NA	U	NA	NA	NA	NA	NA
Larvae	U	U	?Spring-summer	U	P (assumed)	NA	U	U
Early Juveniles	From end of larval stage to ?	U	All year	ICS, MCS, OCS	?P (early juv. only), D	U (juv.<20 cm); substrate (juv.>20 cm)	U	U
Late Juveniles	to 13 yrs	U	All year	OCS		CB, R	U	U
Adults	13-57 years of age	Euphausiids	U, except that larval release is probably in the spring in the Gulf of Alaska	OCS, USP	SD	CB, R	U	U

D.13.5 Additional sources of information

Eggs and Larvae

None at present

Older juveniles and adults

NMFS, Alaska Fisheries Science Center, Auke Bay Laboratory, David Clausen, (907) 789-6049.

D.13.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Harrison, R.C. 1993. Data report: 1991 bottom trawl survey of the Aleutian Islands area. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-12. 144 p.

Heifetz, J., and D. Ackley. 1997. Bycatch in rockfish fisheries in the Gulf of Alaska. Unpubl. Manuscr. 20 p. (Available from NMFS Auke Bay Laboratory, 11305 Glacier Hwy., Juneau, AK 99801.)

Heifetz, J., J.N. Ianelli, and D.M. Clausen. 1996. Slope rockfish. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p.229-269. North Pacific Fishery Management Council, 605 W. 4th. Ave., Suite 306, Anchorage, AK 99501-2252.

Kendall, A.W. 1989. Additions to knowledge of *Sebastes* larvae through recent rearing. NWAFC Proc.Rept. 89-21. 46 p.

Martin, M.H. and D.M. Clausen. 1995. Data report: 1993 Gulf of Alaska bottom trawl survey. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-59. 217 p.

Matarese, A.C., A.W. Kendall, Jr., D.M. Blood, and B.M. Vinter. 1989. Laboratory guide to early life history stages of Northeast Pacific fishes. U.S. Dep. Commerce NOAA Tech. Rept. NMFS 80, 652 p.

Ronholt, L.L., K. Teshima, and D.W. Kessler. 1994. The groundfish resources of the Aleutian Islands region and southern Bering Sea 1980, 1983, and 1986. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-31. 351 p.

Stark, J.W., and D.M. Clausen. 1995. Data report: 1990 Gulf of Alaska bottom trawl survey. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-49. 221 p.

Westrheim, S.J., and H. Tsuyuki. 1971. Taxonomy, distribution, and biology of the northern rockfish, *Sebastes polyspinis*. J. Fish. Res. Bd. Can. 28: 1621-1627.

D.14 Shortraker Rockfish (*Sebastes borealis*) and Rougheye Rockfish (*Sebastes aleutianus*)

D.14.1 Life History and General Distribution

Shortraker and rougheye rockfishes are found along the northwest slope of the eastern Bering Sea, throughout the Aleutian Islands and south to Point Conception, California. Both species are demersal and can be found at depths ranging from 25 to 875 m; however, commercial concentrations usually occur at depths from 300 to 500 m. Though relatively little is known about their biology and life history, both species appear to be K-selected with late maturation, slow growth, extreme longevity, and low natural mortality. Rougheye rockfish attain maturity relatively late in life, at about 20+ years of age. Both species are among the largest *Sebastes* species in Alaskan waters, attaining sizes of up to 104 cm for shortraker and 96 cm for rougheye rockfish. Shortraker rockfish have been estimated to attain ages in excess of 120 years and rougheye rockfish in excess of 140 years. Natural mortality for both species is low, estimated to be on the order of 0.01 to 0.04.

For shortraker rockfish, length at 50% sexual maturity is about 45 cm and about 44 cm for rougheye rockfish.

D.14.2 Fishery

A directed fishery does not exist for shortraker rockfish or rougheye rockfish in the BSAI area. Harvest data from 2000-2000 indicates that over 90% of the harvest of BSAI shortraker and rougheye rockfish is taken in the Aleutian Islands, with the proportion among the three subareas ranging from 26% to 34%. Rougheye and shortraker rockfish are most commonly caught in July, with 58% of the harvest from 2000-2002, and the bulk of this harvest is obtained as bycatch in the POP trawl fishery. Rougheye and shortraker are also caught in the sablefish longline fishery, particularly in the eastern and central Aleutian Islands, and in the Pacific cod longline fishery, particularly in the central and western Aleutians.

D.14.3 Relevant Trophic Information

Shortraker and rougheye rockfishes prey primarily on shrimps, squids, and myctophids. It is uncertain what are the main predators on both species.

D.14.4 Habitat and Biological Associations

Egg/Spawning: The timing of reproductive events is apparently protracted. One study indicated that vitellogenesis was present for four to five months and lasted from about July until late October and November. Parturition apparently occurs mainly in early spring through summer.

Larvae: No information is available regarding the habitats and biological associations of shortraker and rougheye rockfish larvae.

Juveniles: Very little information is available regarding the habitats and biological associations of shortraker and rougheye rockfish juveniles. It is suspected, however, that the juveniles of both species occupy shallower habitats than that of the adults.

Adults: Adults are demersal and can be found at depths ranging from 25 to 875 m. Submersible observations indicate that adults occur over a wide range of habitats. Soft substrates of sand or mud usually had the highest densities; whereas hard substrates of bedrock, cobble or pebble usually had the lowest adult densities. Habitats with steep slopes and frequent boulders were used at a higher rate than habitats with gradual slopes and few boulders.

Habitat and Biological Associations: Shortraker and Rougheye Rockfish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	U	U	U	U	U	U	
Larvae	U	U	Spawning: Early spring through summer	U	U	U	U	
Early Juveniles	U	U Shrimp & amphipods?	U	U, MCS, OCS?	U	U	U	
Late Juveniles								
Adults	15+ yrs of age	Shrimp Squid Myctophids	Year-round?	OCS, USP	D	M, S, R, SM, CB, MS, G	U	

D.14.5 Additional sources of information

NMFS, Alaska Fisheries Science Center.

D.14.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Archibald, C. P., W. Shaw, and B. M. Leaman. 1981. Growth and mortality estimates of rockfishes (Scorpaenidae) from B.C. coastal waters, 1977-79. Can. Tech. Rep. Fish. Aquat. Sci. 1048, 57 p.

Chilton, D. E., and R. J. Beamish. 1982. Age determination methods for fishes studied by the Groundfish Program at the Pacific Biological Station. Can. Spec. Publ. Fish. Aquat. Sci. 60, 102 p.

Heifetz, J., J.N. Ianelli, and D.M. Clausen. 1996. Slope rockfish. *In* Stock assessment and fishery evaluation report for the 1997 Gulf of Alaska groundfish fishery, p. 230-270. North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501.

Kramer, D.E., and V.M. O'Connell. 1986. Guide to northeast Pacific rockfishes, Genera *Sebastes* and *Sebastolobus*. Marine Advisory Bulletin No. 25: 1-78. Alaska Sea Grant College Program, University of Alaska.

Krieger, K. 1992. Shortraker rockfish, *Sebastes borealis*, observed from a manned submersible. Mar. Fish. Rev., 54(4): 34-37.

Krieger, K.J. 1993. Distribution and abundance of rockfish determined from a submersible and by bottom trawling. Fish. Bull. 91:87-96.

Krieger, K.J., and D.H. Ito. Unpublished. Distribution and abundance of shortraker rockfish, *Sebastes borealis*, and rougheye rockfish, *Sebastes aleutianus*, determined from a submersible. Unpublished manuscript.

McDermott, S.F. 1994. Reproductive biology of rougheye and shortraker rockfish, *Sebastes aleutianus* and *Sebastes borealis*. Masters Thesis. Univ. Washington, Seattle.76 p.

Sigler, M.F., and H.H. Zenger, Jr. 1994. Relative abundance of Gulf of Alaska sablefish and other groundfish based on the domestic longline survey, 1989. NOAA Tech. Memo. NMFS-AFSC-40.

Wolotira, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-84. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-6, 184 p.

Yang, M-S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-22, 150 p.

Yang, M-S. 1996. Diets of the important groundfishes in the Aleutian Islands in summer 1991. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-60, 105 p.

D.15 Thornyhead Rockfish (*Sebastolobus sp.*)

D.15.1 Life History and General Distribution

Thornyheads of the northeastern Pacific Ocean are comprised of two species, the shortspine thornyhead (*Sebastolobus alascanus*) and the longspine thornyhead (*S. altivelis*). The longspine thornyhead is not common in the Gulf of Alaska. The shortspine thornyhead is a demersal species which inhabits deep waters from 93 to 1,460 m from the Bering Sea to Baja California. This species is common throughout the Gulf of Alaska, eastern Bering Sea and Aleutian Islands. The population structure of shortspine thornyheads, however, is not well defined. Thornyheads are slow-growing and long-lived with maximum age in excess of 50 years and maximum size greater than 75 cm and 2 kg. Thornyheads spawn buoyant masses of eggs during the late winter and early spring that resemble bilobate “balloons” which float to the surface (Pearcy 1962). Juvenile shortspine thornyheads have a pelagic period of about 14-15 months and settle out on the shelf (100 m) at about 22 to 27 mm (Moser 1974). Fifty percent of female shortspine thornyheads are sexually mature at about 21 cm and 12-13 years of age.

The approximate upper size limit of juvenile fish is 27 mm at the pelagic stage, and 60 mm at the benthic stage (see Moser 1974). Female shortspine thornyheads appear to be mature at about 21-22 cm (Miller 1985).

D.15.2 Fishery

Trawl and longline gear are the primary methods of harvest. The bulk of the fishery occurs in late winter or early spring through the summer. In the past, this species was seldom the target of a directed fishery. Today thornyheads are one of the most valuable of the rockfish species, with most of the domestic harvest exported to Japan. Thornyheads are taken with some frequency in the longline fishery for sablefish and cod and is often part of the bycatch of trawlers concentrating on pollock and Pacific ocean perch.

D.15.3 Relevant Trophic Information

Shortspine thornyheads prey mainly on epibenthic shrimp and fish. Yang (1996, 2003) showed that shrimp were the top prey item for shortspine thornyheads in the Gulf of Alaska; whereas, cottids were the most important prey item in the Aleutian Islands region. Differences in abundance of the main prey between the two areas might be the main reason for the observed diet differences. Predator size might by another reason for the difference since the average shortspine thornyhead in the Aleutian Islands area was larger than that in the Gulf of Alaska (33.4 cm vs 29.7 cm).

D.15.4 Habitat and Biological Associations

Egg/Spawning: Eggs float in masses of various sizes and shapes. Frequently the masses are bilobed with the lobes 15 cm to 61 cm in length, consisting of hollow conical sheaths containing a single layer of eggs in a gelatinous matrix. The masses are transparent and not readily observed in the daylight. Eggs are 1.2 to 1.4 mm in diameter with a 0.2 mm oil globule. They move freely in the matrix. Complete hatching time is unknown but is probably more than 10 days.

Larvae: Three day-old larvae are about 3 mm long and apparently float to the surface. It is believed that the larvae remain in the water column for about 14-15 months before settling to the bottom.

Juveniles: Very little information is available regarding the habitats and biological associations of juvenile shortspine thornyheads.

Adults: Adults are demersal and can be found at depths ranging from about 90 to 1,500 m. Groundfish species commonly associated with thornyheads include: arrowtooth flounder (*Atheresthes stomias*), Pacific ocean perch (*Sebastes alutus*), sablefish (*Anoplopoma fimbria*), rex sole (*Glyptocephalus zachirus*), Dover sole (*Microstomus pacificus*), shortraker rockfish (*Sebastes borealis*), rougheye rockfish (*Sebastes aleutianus*), and grenadiers (family Macrouridae). Two congeneric thornyhead species, the longspine thornyhead (*Sebastolobus altivelis*) and a species common off of Japan , *S. Macrochir*, are infrequently encountered in the Gulf of Alaska.

Habitat and Biological Associations: Thornyheads

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	U	Spawning: Late winter and early spring	U	P	U	U	
Larvae	<15 Months	U	Early spring through summer	U	P	U	U	
Juveniles	> 15 months when settling to bottom occurs (?)	U Shrimp, Amphipods, Mysids, Euphausiids?	U	MCS, OCS, USP	D	M, S, R, SM, CB, MS, G	U	
Adults	U	Shrimp Fish (cottids), Small crabs	Year-round?	MCS, OCS, USP, LSP	D	M, S, R, SM, CB, MS, G	U	

D.15.5 Additional sources of information

NMFS Alaska Fisheries Science Center

D.15.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Aton, M. 1981. Gulf of Alaska bottomfish and shellfish resources. U.S. Dep. Commerce Tech. Memo. NMFS F/NWC-10, 51 p.

Archibald, C.P., W. Shaw, and B.M. Leaman. 1981. Growth and mortality estimates of rockfishes (Scorpaenidae) from B.C. coastal waters, 1977-79. Can. Tech. Rep. Fish. Aquat. Sci. 1048, 57 p.

Chilton, D.E., and R.J. Beamish. 1982. Age determination methods for fishes studied by the Groundfish Program at the Pacific Biological Station. Can. Spec. Publ. Fish. Aquat. Sci. 60, 102 p.

Heifetz, J., J.N. Ianelli, and D.M. Clausen. 1996. Slope rockfish. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 230-270. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Ianelli, J.N., D.H. Ito, and M. Martin. 1996. Thornyheads (*Sebastolobus sp*.). *In* Stock Assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p. 303-330. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Jacobson, L.D. 1993. Thornyheads. *In* Status of living marine resources off the Pacific coast of the United States for 1993. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-26, 35-37 p.

Kramer, D.E., and V.M. O'Connell. 1986. Guide to northeast Pacific rockfishes, Genera *Sebastes* and *Sebastolobus*. Marine Advisory Bulletin No. 25: 1-78. Alaska Sea Grant College Program, University of Alaska.

Low, L.L. 1994. Thornyheads. *In* Status of living marine resources off Alaska, 1993. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-27, 56-57 p.

Miller, P.P. 1985. Life history study of the shortspine thornyhead, Sebastolobus alascanus, at Cape Ommaney, south-eastern Alaska. M.S. Thesis, Univ. Alaska, Fairbanks, AK, 61p.

Moser, H.G. 1974. Development and distribution of larvae and juveniles of Sebastolobus (Pisces: family Scorpaenidae). Fish. Bull. 72: 865-884.

Pearcy, W.G. 1962. Egg masses and early developmental stages of the scorpaenid fish, Sebastolobus. J. Fish. Res. Board Can.19: 1169-1173.

Sigler, M.F., and H.H. Zenger, Jr. 1994. Relative abundance of Gulf of Alaska sablefish and other groundfish based on the domestic longline survey, 1989. NOAA Tech. Memo. NMFS-AFSC-40.

Wolotira, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-84. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-6, 184 p.

Yang, M-S. 1996. Diets of the important groundfishes in the Aleutian Islands in summer 1991. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-60, 105 p.

Yang, M-S. 2003. Food Habits of the Important Groundfishes in the Aleutian Islands in 1994 and 1997. AFSC processed report 2003-07.

D.16 Light Dusky Rockfish (*Sebastes cilianus*)

Note: The taxonomy of dusky rockfish is unclear. Two varieties occur which are likely distinct species: an inshore, shallow water, dark-colored variety; and a lighter-colored variety found in deeper water offshore. A taxonomic study is in progress that will probably describe the light variety as a new species. To avoid confusion, and because the light variety appears to be more abundant and is the object of a large, directed trawl fishery, this discussion of essential habitat will deal only with "light" dusky rockfish.

D.16.1 Life History and General Distribution

Light dusky rockfish range from Dixon Entrance at the U.S./Canada boundary, around the arc of the Gulf of Alaska, and westward throughout the Aleutian Islands. They are also found in the eastern Bering Sea north to about Zhemchug Canyon west of the Pribilof Is. Their distribution south of Dixon Entrance in Canadian waters is uncertain; dusky rockfish have been reported as far south as Johnstone Strait, Vancouver Is., but it is likely these were of the dark variety. The center of abundance for light dusky rockfish appears to be the Gulf of Alaska (Reuter 1999). The species is much less abundant in the Aleutian Islands and Bering Sea (Reuter and Spencer 2002). Adult light dusky rockfish have a very patchy distribution, and are usually found in large aggregations at specific localities of the outer continental shelf. These localities are often relatively shallow offshore banks. Because the fish are taken with bottom trawls, they are presumed to be mostly demersal. Whether they also have a pelagic distribution is unknown, but there is no evidence of a pelagic tendency based on the information available at present. Most of what is known about light dusky rockfish is based on data collected during the summer months from the commercial fishery or in research surveys. Consequently, there is little information on seasonal movements or changes in distribution for this species.

Life history information on light dusky rockfish is extremely sparse. The fish are assumed to be viviparous, as are other *Sebastes*, with internal fertilization and incubation of eggs. Observations during research surveys in the Gulf of Alaska suggest that parturition (larval release) occurs in the spring, and is probably completed by summer. Another, older source, however, lists parturition as occurring "after May." Pre-extrusion larvae have been described, but field-collected larvae cannot be identified to species at present. Length of the larval stage, and whether a pelagic juvenile stage occurs, are unknown. There is no information on habitat and abundance of young juveniles (<25 cm fork length), as catches of these have been virtually nil in research surveys. Even the occurrence of older juveniles has been very uncommon in surveys, except for one year. In this latter instance, older juveniles were found on the continental shelf, generally at locations inshore of the adult habitat.

Light dusky rockfish is a slow growing species, with a low rate of natural mortality estimated at 0.09. However, it appears to be faster growing than many other rockfish species. Maximum age is 49-59 years. No information on age of maturity or fecundity is available.

The approximate upper size limit for juvenile fish is 47cm for females; unknown for males, but presumed to be slightly smaller than for females based on what is commonly the case in other species of *Sebastes*.

D.16.2 Fishery

Light dusky rockfish are caught almost exclusively with bottom trawls. Age at 50% recruitment is unknown. The fishery in the Gulf of Alaska in recent years has mostly occurred in the summer months, especially July, due to management regulations. Catches are concentrated at a number of relatively shallow, offshore banks of the outer continental shelf, especially the "W" grounds west of Yakutat, and Portlock Bank. Other fishing grounds include Albatross Bank, the "Snakehead" south of Kodiak Island, and Shumagin Bank. Outside of these banks, catches are generally sparse. Catch distribution by depth has not been summarized, but most of the fish are apparently taken at depths of 75-200 m. There is no directed fishery in the Aleutians and Bering Sea, and catches there have been generally sparse.

For NPFMC-managed species, the major bycatch species in the Gulf of Alaska light dusky rockfish trawl fishery in 1993-95 included (in descending order by percent): “other” species of slope rockfish, northern rockfish, and Pacific ocean perch. There is no information available on the bycatch of non-NPFMC-managed species in the Gulf of Alaska light dusky rockfish fishery.

D.16.3 Relevant Trophic Information

Although no comprehensive food study of light dusky rockfish has been done, one smaller study in the Gulf of Alaska showed euphausiids to be the predominate food item of adults. Larvaceans, cephalopods, pandalid shrimp, and hermit crabs were also consumed.

Predators of light dusky rockfish have not been documented, but likely include species that are known to consume rockfish in Alaska, such as Pacific halibut, sablefish, Pacific cod, and arrowtooth founder.

D.16.4 Habitat and Biological Associations

Egg/Spawning: No information known, except that parturition probably occurs in the spring, and may extend into summer.

Larvae: No information known.

Juveniles: No information known for small juveniles <25 cm fork length. Larger juveniles have been taken infrequently in bottom trawls at various localities of the continental shelf, usually inshore of the adult fishing grounds.

Adults: Commercial fishery and research survey data suggest that adult light dusky rockfish are primarily found over reasonably flat, trawlable bottom of offshore banks of the outer continental shelf at depths of 75-200 m. Type of substrate in this habitat has not been documented. During submersible dives on the outer shelf (40-50m) in the eastern Gulf, light dusky rockfish were observed in association with rocky habitats and in areas with extensive sponge beds where adult dusky rockfishes were observed resting in large vase sponges (Pers. Comm., V. O’Connell). Generally, the fish appear to be demersal, and most of the population occurs in large aggregations. Light dusky rockfish are the most highly aggregated of the rockfish species caught in Gulf of Alaska trawl surveys. Outside of these aggregations, the fish are sparsely distributed. Because the fish are taken with bottom trawls, they are presumed to be mostly demersal. Whether they also have a pelagic distribution is unknown, but there is no evidence of a pelagic tendency based on the information available at present. There is no information on seasonal migrations. Light dusky rockfish often co-occur with northern rockfish.

Habitat and Biological Associations: Light Dusky Rockfish

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	NA	U	NA	NA	NA	NA	NA
Larvae	U	U	?Spring-summer	U	P (assumed)	NA	U	U
Early Juveniles	U	U	All year	ICS, MCS, OCS,	U (small juv.< 25 cm): ?D (Larger juv.)	U (juv.<25 cm); ?Trawlable substrate (juv.>25 cm)	U	U
Late Juveniles	U	U	U	U	U	CB, R, G	U	Observed associated with *primnoa* coral
Adults	Up to 49-50 years.	Euphausiids	U, except that larval release may be in the spring in the Gulf of Alaska	OCS, USP	SD, SP	CB, R, G	U	Observed associated with large vase type sponges

D.16.5 Additional sources of information

Eggs, Larvae, and Juveniles:

None at present.

Adults:

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D.16.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and northeastern Pacific. U. S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Clausen, D.M., and J. Heifetz. 1996. Pelagic shelf rockfish. *In* Stock assessment and fishery evaluation report for the groundfish resources of the Gulf of Alaska, p.271-288. North Pacific Fishery Management Council, 605 W. 4th. Ave., Suite 306, Anchorage, AK 99501-2252.

Harrison, R.C. 1993. Data report: 1991 bottom trawl survey of the Aleutian Islands area. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-12. 144 p.

Heifetz, J., and D. Ackley. 1997. Bycatch in rockfish fisheries in the Gulf of Alaska. Unpubl. Manuscr. 20 p. (Available from NMFS Auke Bay Laboratory, 11305 Glacier Hwy., Juneau, AK 99801.

Kendall, A.W. 1989. Additions to knowledge of *Sebastes* larvae through recent rearing. NWAFC Proc.Rept. 89-21. 46 p.

Martin, M.H. and D.M. Clausen. 1995. Data report: 1993 Gulf of Alaska bottom trawl survey. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-59. 217 p.

Matarese, A.C., A.W. Kendall, Jr., D.M. Blood, and B.M. Vinter. 1989. Laboratory guide to early life history stages of northeast Pacific fishes. U.S. Dep. Commerce NOAA Tech. Rept. NMFS 80, 652 p.

Reuter, R.F. 1999. Describing Dusky rockfish (*Sebastes ciliatus*) habitat in the Gulf of Alaska using Historical data. M.S. thesis. California State University, Hayward 83 p.

Reuter, R.F. and P.D. Spencer. 2002. Other rockfish. In Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea and Aleutian Islands, p. 579-608.

Stark, J.W., and D.M. Clausen. 1995. Data report: 1990 Gulf of Alaska bottom trawl survey. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-49. 221 p.

Westrheim, S.J. 1973. Preliminary information on the systematics, distribution, and abundance of the dusky rockfish, *Sebastes ciliatus*. J. Fish. Res. Bd. Can. 30: 1230-1234.

Westrheim, S.J. 1975. Reproduction, maturation, and identification of larvae of some *Sebastes* (Scorpaenidae) species in the northeast Pacific Ocean. J. Fish. Res. Board Can. 32: 2399-2411.

D.17 Atka mackerel (*Pleurogrammus monopterygius*)

D.17.1 Life History and General Distribution

Distributed from the Gulf of Alaska to the Kamchatka Peninsula, most abundant along the Aleutians. Adult Atka mackerel occur in large localized aggregations usually at depths less than 200 m and generally over rough, rocky and uneven bottom near areas where tidal currents are swift. Adults are pelagic during much of the year, but migrate annually to moderately shallow waters where they become demersal during spawning. Spawning peaks in June through September, but may occur intermittently throughout the year. Atka mackerel deposit eggs in nests built and guarded by males on rocky substrates or on kelp in shallow water. Eggs hatch in 40-45 days, releasing planktonic larvae which have been found up to 800 km from shore. Little is known of the distribution of young Atka mackerel prior to their appearance in trawl surveys and the fishery at about age 2-3 years. Atka mackerel exhibit intermediate life history traits. R-traits include young age at maturity (approximately 50% are mature at age 3), fast growth rates, high natural mortality (M=0.3) and young average and maximum ages (about 5 and 14 years, respectively). K-selected traits include low fecundity (only about 30,000 eggs/female/year, large egg diameters (1-2 mm) and male nest-guarding behavior).

The approximate upper size limit of juvenile fish is 35cm.

D.17.2 Fishery

Bottom trawls, some pelagic trawling, recruit at about age 3, conducted in the Aleutian Islands and western GOA at depths between about 70-225 m, in trawlable areas on rocky, uneven bottom, along edges, and in lee of submerged hills during periods of high current. Currently, the fishery occurs on reefs west of Kiska Island, south and west of Amchitka Island, in Tanaga Pass and near the Delarof Islands, and south of Seguam and Umnak Islands. Historically fishery occurred east into the GOA as far as Kodiak Island (through the mid-1980s), but is no longer there. Fishery used to be entirely during summer, during spawning season; now occurs throughout the year. Very “clean” fishery; bycatch of other species is minimal.

D.17.3 Relevant Trophic Information

Important food for Steller sea lions in the Aleutian Islands, particularly during summer, and for other marine mammals (minke whales, Dall's porpoise and northern fur seal). Juveniles eaten by thick billed murres and tufted puffins. Main groundfish predators are Pacific halibut, arrowtooth flounder, and Pacific cod.

D.17.4 Habitat and Biological Associations

Egg/Spawning: Eggs deposited in nests built and guarded by males on rocky substrates or on kelp in shallow water.

Larvae/Juveniles: Planktonic larvae have been found up to 800 km from shore, usually in upper water column (neuston), but little is known of the distribution of Atka mackerel until they are about 2 years old and appear in fishery and surveys.

Adults: Adults occur in localized aggregations usually at depths less than 200 m and generally over rough, rocky and uneven bottom near areas where tidal currents are swift. Adults are semi-demersal/pelagic during much of the year, but migrate annually to moderately shallow waters where the males become demersal during spawning; females move between nesting and offshore feeding areas.

Habitat and Biological Associations: Atka mackerel

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	40-45 d	NA	summer	IP, ICS	D	GR, R, K	U	develop 3-20°C optimum 9-13°C
Larvae	up to 6 mos	U copepods?	fall-winter	U	U, N?	U	U	2-12°C optimum 5-7°C
Juveniles	½-2 yrs of age	U copepods & euphausiids?	all year	U	U	U	U	3-5°C
Adults	3+ yrs of age	copepods euphausiids meso-pelagic fish (myctophids)	Spawning (May-Oct) Non-spawning (Nov-Apr) tidal/diurnal, year-round?	ICS and MCS, IP MCS and OCS, IP ICS, MCS, OCS, IP	D (males) SD females SD/D all sexes D when currents high/day SD slack tides/night	GR, R, K	F, E	3-5°C all stages >17 ppt only

D.17.5 Additional sources of information

NMFS Alaska Fisheries Science Center

D.17.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerc., NOAA Tech. Rept. NMFS 66, 151 p.

Byrd, G.V., J.C. Williams, and R. Walder. 1992. Status and biology of the tufted puffin in the Aleutian Islands, Alaska, after a ban on salmon driftnets. U.S. Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, Aleutian Islands Unit, PSC 486, Box 5251, FPO AP 96506-5251, Adak, Alaska.

Doyle, M.J., W.C. Rugen, and R.D. Brodeur. 1995. Neustonic ichthyoplankton in the western Gulf of Alaska during spring. Fishery Bulletin 93: 231-253.

Fritz, L.W. 1993. Trawl locations of walleye pollock and Atka mackerel fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska from 1977-1992. AFSC Processed Report 93-08, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 162 pp.

Gorbunova, N.N. 1962. Razmnozhenie I razvite ryb semeistva terpugovykh (Hexagrammidae) Spawning and development of greenlings (family Hexagrammidae). Tr. Inst. Okeanol., Akad. Nauk SSSR 59:118-182. In Russian. (Trans. by Isr. Program Sci. Trans., 1970, p. 121-185 in T.S. Rass (editor), Greenlings: taxonomy, biology, interoceanic transplantation; available from the U.S. Dep. Commerce, Natl. Tech. Inf. Serv., Springfield, VA., as TT 69-55097).

Kajimura, H. 1984. Opportunistic feeding of the northern fur seal Callorhinus ursinus, in the eastern north Pacific Ocean and eastern Bering Sea. NOAA Tech. Rept. NMFS SSRF-779. USDOC, NOAA, NMFS, 49 pp.

Kendall, A.W., Jr., and J.R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. U.S. Dep. Commerc., NOAA Tech. Rept NMFS 20, 89 p.

Kendall, A.W., Jr., J.R. Dunn, and R.J. Wolotira, Jr. 1980. Zooplankton, including ichthyoplankton and decapod larvae, of the Kodiak shelf. NWAFC Processed Rept. 80-8, AFSC-NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 393 p.

Lee, J.U. 1985. Studies on the fishery biology of the Atka mackerel *Pleurogrammus monopterygius* (Pallas) in the north Pacific Ocean. Bull. Fish. Res. Dev. Agency, 34, pp.65-125.

Levada, T.P. 1979. Comparative morphological study of Atka mackerel. Pac. Sci. Res. Inst. Fish. Oceanogr. (TINRO), Vladivostok, U.S.S.R., Unpublished manuscript.

Levada, T.P. 1979. Some data on biology and catch of Atka mackerel. Pac. Sci. Res. Inst. Fish. Oceanogr. (TINRO), Vladivostok, U.S.S.R., Unpublished manuscript.

Lowe, S.A. and L.W. Fritz. 1996. Atka mackerel. *In* Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Lowe, S.A. and L.W. Fritz. 1996. Atka mackerel. *In* Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Gulf of Alaska as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

McDermott, S.F. and S.A. Lowe. 1997. The reproductive cycle and sexual maturity of Atka mackerel (*Pleurogrammus monopterygius*) in Alaskan waters. Fishery Bulletin 95: 321-333.

Morris, B.F. 1981. An assessment of the living marine resources of the central Bering Sea and potential resource use conflicts between commercial fisheries and Petroleum development in the Navarin Basin, Proposed sale No. 83. Anchorage, AK: USDOC, NOAA, NMFS, Environmental Assessment Division.

Musienko, L.N. 1970. Razmnozheine I razvitie ryb Beringova morya (Reproduction and development of Bering Sea fishes). Tr. Vses. Nauchno-issled. Inst. Morsk. Rybn. Koz. Okeanogr. 70: 161-224 In P.A. Moiseev (ed.), Soviet fisheries investigations in the northeastern Pacific, Pt. 5, Avail. Natl. Tech. Info. Serv., Springfield, VA as TT 74-50127.

NMFS. 1995. Status review of the Unites States Steller sea lion (*Eumetopias jubatus*) population. National Marine Mammal Laboratory, Alaska Fishery Science Center, National Marine Fisheries Service, 7600 Sand Point Way, NE, Seattle, WA 98115.

Orlov, A.M. 1996. The role of mesopelagic fishes in feeding of Atka mackerel in areas of the North Kuril islands. Publ. Abstract in Role of forage fishes in marine ecosystems. Symposium held Nov 1996, AK Sea Grant, U. Alaska, Fairbanks.

Rugen, W.C. 1990. Spatial and temporal distribution of larval fish in the western Gulf of Alaska, with emphasis on the period of peak abundance of walleye pollock (*Theragra chalcogramma*) larvae. NWAFC Processed Rept 90-01, AFSC-NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 162 p.

Waldron, K.D. 1978. Ichthyoplankton of the eastern Bering Sea, 11 February-16 March 1978. REFM Report, AFSC, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 33 p.

Waldron, K.D., and B.M. Vinter. 1978. Ichthyoplankton of the eastern Bering Sea. Final Report (RU 380), Environmental Assessment of the Alaskan continental shelf, REFM, AFSC, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 88 p.

Wolotira, R.J., Jr., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-84. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-6, 184 p.

Yang, M-S. 1996. Trophic role of Atka mackerel in the Aleutian Islands. Publ. Abstract in Role of forage fishes in marine ecosystems. Symposium held Nov 1996, AK Sea Grant, U. Alaska, Fairbanks.

Zolotov, O.G. 1993. Notes on the reproductive biology of *Pleurogrammus monopterygius* in Kamchatkan waters. J. of Ichthy. 33(4), pp. 25-37.

D.18 Squid (*Cephalopoda*, *Teuthida*)

The species representatives for squid are:

Gonaditae:	Red or magistrate armhook squid (*Berryteuthis magister*)
Onychoteuthidae:	Boreal clubhook squid (*Onychoteuthis banksii borealjaponicus)*
	Giant or robust clubhook squid (*Moroteuthis robusta*)
Sepiolidae:	eastern Pacific bobtail squid (*Rossia pacifica*)

D.18.1 Life History and General Distribution:

Squid are members of the molluscan class Cephalopoda, along with octopus, cuttlefish and nautiloids. In the BSAI and GOA, gonatid and onychoteuthid squids are generally the most common, along with chiroteuthids. All cephalopods are stenohaline, occurring only at salinities > 30 ppt. Fertilization is internal, and development is direct (“larval” stages are only small versions of adults). The eggs of inshore neritic species are often enveloped in a gelatinous matrix attached to rocks, shells or other hard substrates, while the eggs of some offshore oceanic species are extruded as large, sausage-shaped drifting masses. Little is known of the seasonality of reproduction, but most species probably breed in spring-early summer, with eggs hatching during the summer. Most small squid are generally thought to live only 2-3 years, but the giant *Moroteuthis robusta* clearly lives longer.

> ***B magister*** is widely distributed in the boreal north Pacific from California, throughout the Bering Sea, to Japan in waters of depth 30-1500 m; adults most often found at mesopelagic depths or near bottom on shelf, rising to the surface at night; juveniles are widely distributed across shelf, slope and abyssal waters in meso- and epipelagic zones, and rise to surface at night. Migrates seasonally, moving northward and inshore in summer, and southward and offshore in winter, particularly in the western north Pacific. Maximum size: females-50 cm mantle length (ML); males-40 cm ML. Spermatophores transferred into the mantle cavity of female, and eggs are laid on the bottom on the upper slope (200-800 m). Fecundity estimated at 10,000 eggs/female. Spawning of eggs occurs in Feb-Mar in Japan, but apparently all year-round in the Bering Sea. Eggs hatch after 1-2 months of incubation; development is direct. Adults are gregarious prior to, and most die after mating.
>
> ***O. banksii borealjaponicus****,* an active, epipelagic species, is distributed in the north Pacific from the Sea of Japan, throughout the Aleutian Islands and south to California, but is absent from the Sea of Okhotsk and not common in the Bering Sea. Juveniles can be found over shelf waters at all depths and near shore. Adults apparently prefer the upper layers over slope and abyssal waters; diel migrators and gregarious. Development includes a larval stage; maximum size about 55 cm.
>
> ***M. robusta***, a giant squid, lives near the bottom on the slope, and mesopelagically over abyssal waters; rare on the shelf. It is distributed in all oceans, and is found in the Bering Sea, Aleutian Islands and Gulf of Alaska. Mantle length can be up to 2.5 m long; with tentacles, at least 7 m, but most are about 2 m long.
>
> ***R. pacifica*** is a small (maximum length with tentacles of less than 20 cm) demersal, neritic and shelf, boreal species, distributed from Japan to California in the North Pacific and in the Bering Sea in waters of about 20-300 m depth. Other *Rossia* spp. deposit demersal egg masses.

For *B. magister*, the approximate upper size limit of juvenile fish is 20 cm ML for males, 25 cm ML for females; both at approximately 1 year of age.

D.18.2 Fishery

Not currently a target of groundfish fisheries of BSAI or GOA. A Japanese fishery catching up to 9,000 mt of squid annually existed until the early 1980s for *B. magister* in the Bering Sea and *O. banksii borealjaponicus* in the Aleutian Islands. Since 1990, annual squid bycatch has been about 1,000 mt or less in the BSAI, and between 30-150 mt in the GOA; in the BSAI, almost all squid bycatch is in the midwater pollock fishery near the continental shelf break and slope, while in the GOA, trawl fisheries for rockfish and pollock (again mostly near the edge of the shelf and on the upper slope) catch most of the squid bycatch.

D.18.3 Relevant Trophic Information

The principal prey items of squid are small forage fish pelagic crustaceans (e.g., euphausiids and shrimp), and other cephalopods; cannibalism is not uncommon. After hatching, small planktonic zooplankton (copepods) are eaten. Squid are preyed upon by marine mammals, seabirds, and, to a lesser extent by fish, and occupy an important role in marine food webs worldwide. Perez (1990) estimated that squids comprise over 80% of the diets of sperm whales, bottlenose whales and beaked whales, and about half of the diet of Dall's porpoise in the eastern Bering Sea and Aleutian Islands. Seabirds (e.g., kittiwakes, puffins, murres) on island rookeries close to the shelf break (e.g., Buldir Island, Pribilof Islands) are also known to feed heavily on squid (Hatch et al. 1990; Byrd et al. 1992; Springer 1993). In the Gulf of Alaska, only about 5% or less of the diets of most groundfish consisted of squid (Yang 1993). However, squid play a larger role in the diet of salmon (Livingston and Goiney 1983).

D.18.4 Habitat and Biological Associations for B. magister

Egg/Spawning: Eggs are laid on the bottom on the upper slope (200-800 m); incubate for 1-2 months.

Young Juveniles: Distributed epipelagically (top 100 m) from the coast to open ocean.

Old Juveniles and Adults: Distributed mesopelagically (most from 150-500 m) on the shelf (summer only?), but mostly in outer shelf/slope waters (to lesser extent over the open ocean). Migrate to slope waters to mate and spawn demersally.

Habitat and Biological Associations: *Berryteuthis magister* (red squid)

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	1-2 months	NA	varies	USP, LSP	D	M, SM, MS	U	
Young juveniles	4-6 months	zooplankton		All shelf, slope, BSN	P, N	NA	UP, F?	
Older Juveniles and Adults	1-2 years (may be up to 4 yrs)	euphausiids, shrimp, small forage fish, and other cephalopods	summer winter	All shelf, USP, LSP, BSN OS, USP, LSP, BSN	SP SP	U U	UP, F? UP, F?	Euhaline waters, 2-4°C

D.18.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.18.6 Literature

Arkhipkin, A.I., V.A. Bizikov, V.V. Krylov, and K.N. Nesis. 1996. Distribution, stock structure, and growth of the squid *Berryteuthis magister* (Berry, 1913) (Cephalopoda, Gonatidae) during summer and fall in the western Bering Sea. Fish. Bull. 94: 1-30.

Akimushkin, I.I. 1963. Cephalopods of the seas of the U.S.S.R. Academy of Sciences of the U.S.S.R., Institute of Oceanology, Moscow. Translated from Russian by Israel Program for Scientific Translations, Jerusalem 1965. 223 p.

Byrd, G.V., J.C. Williams, and R. Walder. 1992. Status and biology of the tufted puffin in the Aleutian Islands, Alaska, after a ban on salmon driftnets. U. S. Fish and Wildlife Service, Alaska Maritime National Wildlife Refuge, Aleutian Islands Unit, PSC 486, Box 5251, FPO AP 96506-5251, Adak, Alaska.

Fritz, L.W. 1996. Other species *In* Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK.

Hatch, S.A., G.V. Byrd, D.B. Irons, and G.L. Hunt, Jr. 1990. Status and ecology of kittiwakes in the North Pacific. Proc. Pacific Seabird Group Symposium, Victoria, B.C., 21-25 February 1990.

Livingston, P.A., and B.J. Goiney, Jr. 1983. Food habits literature of North Pacific marine fishes: a review and selected bibliography. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS F/NWC-54, 81 p.

Nesis, K. N. 1987. Cephalopods of the world. TFH Publications, Neptune City, NJ, USA. 351 pp.

Perez, M. 1990. Review of marine mammal population and prey information for Bering Sea ecosystem studies. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS F/NWC-186, 81 p.

Sobolevsky, Ye. I. 1996. Species composition and distribution of squids in the western Bering Sea. Pp. 135-141 *In* O.A. Mathisen and K.O. Coyle (eds.), Ecology of the Bering Sea: a review of Russian literature. Alaska Sea Grant Rept 96-01, U. Alaska, Fairbanks, AK 99775.

Springer, A. 1993. Report of the seabird working group. pp. 14-29 *In* Is it food? Addressing marine mammal and seabird declines: a workshop summary. Alaska Sea Grant Report 93-01, Univ. Alaska, Fairbanks, AK, 99775.

Yang, M.S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-22, 150 p.

D.19 Sculpins (*cottidae*)

The species representatives for sculpins are:

Yellow Irish lord (*Hemilepidotus jordani)*

Red Irish lord (*Hemilepidotus hemilepidotus*)

Butterfly sculpin (*Hemilepidotus papilio*)

Bigmouth sculpin (*Hemitripterus bolini*)

Great sculpin (*Myoxocephalus polyacanthocephalus*)

Plain sculpin (*Myoxocephalus jaok*)

D.19.1 Life History and General Distribution

The Cottidae (sculpins) is a large circumboreal family of demersal fishes inhabiting a wide range of habitats in the north Pacific Ocean and Bering Sea. Most species live in shallow water or in tidepools, but some inhabit the deeper waters (to 1000 m) of the continental shelf and slope. Most species do not attain a large size (generally 10-15 cm), but those that live on the continental shelf and are caught by fisheries can be 30-50 cm; the cabezon is the largest sculpin and can be as long as 100 cm. Most sculpins spawn in the winter. All species lay eggs, but in some genera, fertilization is internal. The female commonly lays demersal eggs amongst rocks where they are guarded by males. Egg incubation duration is unknown; larvae were found across broad areas of the shelf and slope, and were found all year-round, in ichthyoplankton collections from the southeast Bering Sea and Gulf of Alaska. Larvae exhibit diel vertical migration (near surface at night and at depth during the day). Sculpins generally eat small invertebrates (e.g., crabs, barnacles, mussels), but fish are included in the diet of larger species; larvae eat copepods.

Yellow Irish lords: distributed from subtidal areas near shore to the edge of the continental shelf (down to 200 m) throughout the Bering Sea, Aleutian Islands, and eastward into the GOA as far as Sitka, AK; up to 40 cm in length. 12-26 mm larvae collected in spring on the western GOA shelf.

Red Irish lords: distributed from rocky, intertidal areas to about 100 m depth on the middle continental shelf (most shallower than 50 m), from California (Monterey Bay) to Kamchatka; throughout the Bering Sea and Gulf of Alaska; rarely over 30 cm in length. Spawns masses of pink eggs in shallow water or intertidally. Larvae were 7-20 mm long in spring in the western GOA.

Butterfly sculpins: distributed primarily in the western north Pacific and northern Bering Sea, from Hokkaido, Japan, Sea of Okhotsk, Chukchi Sea, to southeast Bering Sea and in Aleutian Islands; depths of 20-250 m, most frequent 50-100 m.

Bigmouth sculpin: distributed in deeper waters offshore, between about 100-300 m in the Bering Sea, Aleutian Islands, and throughout the Gulf of Alaska; up to 70 cm in length.

Great sculpin: distributed from the intertidal to 200 m, but may be most common on sand and muddy/sand bottoms in moderate depths (50-100 m); up to 80 cm in length. Found throughout the Bering Sea, Aleutian Islands, and Gulf of Alaska, but may be less common east of Prince William Sound. *Myoxocephalus* spp. larvae ranged in length from 9-16 mm in spring ichthyoplankton collections in the western GOA.

Plain sculpin: distributed throughout the Bering Sea and Gulf of Alaska (not common in the Aleutian Islands) from intertidal areas to depths of about 100 m, but most common in shallow waters (<50 m); up to 50 cm in length. *Myoxocephalus* spp. larvae ranged in length from 9-16 mm in spring ichthyoplankton collections in the western GOA.

The approximate upper size limit of juvenile fish is unknown.

D.19.2 Fishery

Not a target of groundfish fisheries of BSAI or GOA, but sculpin bycatch (second to skates in weight amongst the Other Species) has ranged from 6,000-11,000 mt per year in the BSAI from 1992-95, and 500-1,400 mt per year in the GOA. Bycatch occurs principally in bottom trawl fisheries for flatfish, Pacific cod and pollock, but also while longlining for Pacific cod; almost all is discarded. Annual sculpin bycatch in the BSAI ranges between 1-4% of annual survey biomass estimates, however little is known of the species distribution of the bycatch.

D.19.3 Relevant Trophic Information

Feed on bottom invertebrates (e.g., crabs, barnacles, mussels and other molluscs); larger species eat fish.

D.19.4 Habitat and Biological Associations

Egg/Spawning: Lay demersal eggs in nests guarded by males; many species in rocky shallow waters near shore.

Larvae: Distributed pelagically and in neuston across broad areas of shelf and slope, but predominantly on inner and middle shelf; have been found all year-round.

Juveniles and Adults: Sculpins are demersal fish, and live in a broad range of habitats from rocky intertidal pools to muddy bottoms of the continental shelf, and rocky, upper slope areas. Most commercial bycatch occurs on middle and outer shelf areas used by bottom trawlers for Pacific cod and flatfish.

Habitat and Biological Associations: Sculpins

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U	na	winter?	BCH, ICS (MSC, OSC?)	D	R (others?)	U	
Larvae	U	copepods	all year?	ICS, MSC, OCS, US	N, P	na?	U	
Juveniles and Adults	U	bottom invertebrates (crabs, molluscs, barnacles) and small fish	all year	BCH, ICS, MSC, OSC, US	D	R, S, M, SM	U	

D.19.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.19.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Doyle, M.J., W.C. Rugen, and R.D. Brodeur. 1995. Neustonic ichthyoplankton in the western Gulf of Alaska during spring. Fishery Bulletin 93: 231-253.

Eschmyer, W.N., and E.S. Herald. 1983. A field guide to Pacific coast fishes, North America. Houghton Mifflin Co., Boston. 336 p.

Fritz, L.W. 1996. Other species *In* Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Res. Bd. Canada Bull. 180. Ottawa. 740 p.

Kendall, A.W., Jr., and J.R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. U.S. Dep. Commerce, NOAA Tech. Rept NMFS 20, 89 p.

Kendall, A.W., Jr., J.R. Dunn, and R.J. Wolotira, Jr. 1980. Zooplankton, including ichthyoplankton and decapod larvae, of the Kodiak shelf. NWAFC Processed Rept. 80-8, AFSC-NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 393 p.

Rugen, W.C. 1990. Spatial and temporal distribution of larval fish in the western Gulf of Alaska, with emphasis on the period of peak abundance of walleye pollock (*Theragra chalcogramma*) larvae. NWAFC Processed Rept 90-01, AFSC-NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 162 p.

Waldron, K.D. 1978. Ichthyoplankton of the eastern Bering Sea, 11 February-16 March 1978. REFM Report, AFSC, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 33 p.

Waldron, K.D., and B.M. Vinter. 1978. Ichthyoplankton of the eastern Bering Sea. Final Report (RU 380), Environmental Assessment of the Alaskan continental shelf, REFM, AFSC, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 88 p.

D.20 Sharks

The species representatives for sharks are:

Lamnidae:	Salmon shark (*Lamna ditropis*)
Squalidae:	Sleeper shark (*Somniosus pacificus*)
	Spiny dogfish (*Squalus acanthias*)

D.20.1 Life History and General Distribution

Sharks of the order Squaliformes (which includes the two families Lamnidae and Squalidae) are the higher sharks with five gill slits and two dorsal fins. The Lamnidae are large, ovoviviparous (with small litters, 1-4; embryos nourished by intrauterine cannibalism), widely migrating sharks which are highly aggressive predators (salmon and white sharks). The Lamnidae are partly warm-blooded; the heavy trunk muscles are warmer than water for greater power and efficiency. Salmon sharks are distributed epipelagically along the shelf (can be found in shallow waters) from California through the Gulf of Alaska (where they occur all year and are probably most abundant in our area), the Bering Sea and off Japan. In groundfish fishery and survey data, occur chiefly on outer shelf/upper slope areas in the Bering Sea, but near coast to the outer shelf in the Gulf of Alaska, particularly near Kodiak Island. Not commonly seen in Aleutian Islands. They are believed to eat primarily fish, including salmon, sculpins and gadids, and can be up to 3 m in length.

The Pacific sleeper shark is distributed from California around the Pacific rim to Japan and in the Bering Sea principally on the outer shelf and upper slope (but has been observed nearshore), generally demersal (but also seen near surface). Other members of the Squalidae are ovoviviparous, but fertilization and development of sleeper sharks are not known; adults up to 8 m in length. Voracious, omnivorous predator of flatfish, cephalopods, rockfish, crabs, seals, salmon; may also prey on pinnipeds. In groundfish fishery and survey data, occur chiefly on outer shelf/upper slope areas in the Bering Sea, but near coast to the outer shelf in the Gulf of Alaska, particularly near Kodiak Island.

Spiny dogfish (or closely related species?) are widely distributed through the Atlantic, Pacific and Indian Oceans. In the north Pacific, may be most abundant in the Gulf of Alaska, but also common in the Bering Sea. Pelagic species, found at surface and to depths of 700 m; mostly 200 m or less on shelf and neritic; often found in aggregations. Ovoviviparous, with litter size proportional to size of female, from 2-9; gestation may be 22-24 months. Young are 24-30 cm at birth, with growth initially rapid, then slows dramatically. Maximum adult size is about 1.6 m, and 10 kg; maximum age about 40 years. 50% of females are mature at 94 cm and 29 years old; males, 72 cm and 19 years old. Females give birth in shallow coastal waters, usually in Sept-Jan. Dogfish eat a wide variety of foods, including fish (smelts, herring, sand lance, and other small schooling fish), crustaceans (crabs, euphausiids, shrimp), and cephalopods (octopus). Tagging experiments indicate local indigenous populations in some areas and widely migrating groups in others. May move inshore in summer and offshore in winter.

The approximate upper size limit of juvenile fish is unknown for salmon sharks and sleeper sharks; for spiny dogfish, it is 94 cm for females, and 72 cm for males.

D.20.2 Fishery

Not a target of groundfish fisheries of BSAI or GOA, but shark bycatch has ranged from 300-700 mt per year in the BSAI from 1992-95; 500-1,400 mt per year in the GOA) principally by pelagic trawl fishery for pollock, longline fisheries for Pacific cod and sablefish, and bottom trawl fisheries for pollock, flatfish and cod; almost all discarded. Little is known of shark biomass in BSAI or GOA.

D.20.3 Habitat and Biological Associations

Egg/Spawning: Salmon sharks and spiny dogfish are ovoviviparous; reproductive strategy of sleeper sharks is not known. Spiny dogfish give birth in shallow coastal waters, while salmon sharks probably offshore and pelagic.

Juveniles and Adults: Spiny dogfish are widely dispersed throughout the water column on shelf in the GOA, and along outer shelf in the EBS; apparently not as commonly found in the Aleutian Islands and not commonly at depths > 200 m.

Salmon sharks found throughout the GOA, but less common in the EBS and AI; epipelagic, primarily over shelf/slope waters in GOA, and outer shelf in EBS.

Sleeper sharks are widely dispersed on shelf/upper slope in the GOA, and along outer shelf/upper slope only in the EBS; generally demersal, and may be less commonly found in the Aleutian Islands.

Habitat and Biological Associations: Sharks

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs								
Larvae								
Juveniles and Adults								
Salmon shark	U	fish (salmon, sculpins and gadids)	all year	ICS, MSC, OCS, US in GOA; OCS, US in BSAI	P	NA	U	
Sleeper shark	U	omnivorous; flatfish, cephalopods, rockfish, crabs, seals, salmon, pinnipeds	all year	ICS, MSC, OCS, US in GOA; OCS, US in BSAI	D	U	U	
Spiny dogfish	40 years	fish (smelts, herring, sand lance, and other small schooling fish), crustaceans (crabs, euphausiids, shrimp), and cephalopods (octopus)	all year	ICS, MSC, OCS in GOA; OCS in BSAI give birth ICS in fall/winter?	P	U	U	Euhaline 4-16°C

D.20.4 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.20.5 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Eschmyer, W.N., and E.S. Herald. 1983. A field guide to Pacific coast fishes, North America. Houghton Mifflin Co., Boston. 336 p.

Fritz, L.W. 1996. Other species *In* Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Res. Bd. Canada Bull. 180. Ottawa. 740 p.

D.21 Skates (*Rajidae*)

The species representatives for skates are:

Alaska skate (*Bathyraja parmifera*)

Aleutian skate (*Bathyraja aleutica*)

Bering skate (*Bathyraja interrupta*)

D.21.1 Life History and General Distribution:

Skates (Rajidae) that occur in the BSAI and GOA are grouped into two genera: *Bathyraja* sp., or soft-nosed species (rostral cartilage slender and snout soft and flexible), and *Raja* sp., or hard-nosed species (rostral cartilage is thick making the snout rigid). Skates are oviparous; fertilization is internal and eggs (one to five or more in each case) are deposited in horny cases for incubation. Adults and juveniles are demersal, and feed on bottom invertebrates and fish. Adult distributions from survey: Alaska skate: mostly 50-200 m on shelf in eastern Bering Sea (EBS) and Aleutian Islands (AI), less common in the Gulf of Alaska (GOA); Aleutian skate: throughout EBS and AI, but less common in GOA, mostly 100-350 m; Bering Skate: throughout EBS and GOA, less common in AI, mostly 100-350 m. Little is known of their habitat requirements for growth or reproduction, nor of any seasonal movements. BSAI skate biomass estimate more than doubled between 1982-96 from bottom trawl survey; may have decreased in GOA and remained stable in the AI in the 1980s.

The approximate upper size limit of juvenile fish is unknown.

D.21.2 Fishery

Not a target of groundfish fisheries of BSAI or GOA, but caught as bycatch (13,000-17,000 mt per year in the BSAI from 1992-95; 1,000-2,000 mt per year in the GOA) principally by the longline Pacific cod and bottom trawl pollock and flatfish fisheries; almost all discarded. Skate bycatches in the EBS groundfisheries ranged between 1-4% of the annual EBS trawl survey biomass estimates in 1992-95.

D.21.3 Relevant Trophic Information

Feed on bottom invertebrates (crustaceans, molluscs, and polychaetes) and fish.

D.21.4 Habitat and Biological Associations

<u>Egg/Spawning</u>: Deposit eggs in horny cases on shelf and slope.

<u>Juveniles and Adults</u>: After hatching, juveniles probably remain in shelf and slope waters, but distribution is unknown. Adults found across wide areas of shelf and slope; surveys found most skates at depths <500 m in the GOA and EBS, but >500 m in the AI. In the GOA, most skates found between 4-7°C, but data are limited.

Habitat and Biological Associations: Skates

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceanographic Features	Other
Eggs	U	na	U	MCS, OCS, USP	D	U	U	
Larvae	NA	na	na	na	na	na	na	
Juveniles	U	Invertebrates small fish	all year	MCS, OCS, USP	D	U	U	
Adults	U	Invertebrates small fish	all year	MCS, OCS, USP	D	U	U	

D.21.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.21.6 Literature

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Eschmyer, W.N., and E.S. Herald. 1983. A field guide to Pacific coast fishes, North America. Houghton Mifflin Co., Boston. 336 p.

Fritz, L.W. 1996. Other species *In* Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Res. Bd. Canada Bull. 180. Ottawa. 740 p.

Teshima, K., and T.K. Wilderbuer. 1990. Distribution and abundance of skates in the eastern Bering Sea, Aleutian Islands region, and the Gulf of Alaska. Pp. 257-267 *in* H.L. Pratt, Jr., S.H. Gruber, and T. Taniuchi (eds.), Elasmobranchs as living resources: advances in the biology, ecology, systematics and the status of the fisheries. U.S. Dep. Commerce, NOAA Technical Report 90.

D.22 Octopus

The species representatives for octopus are:

Octopoda: Octopus *(Octopus gilbertianus; O. dofleini*)

Vampyromorpha: Pelagic octopus (*Vampyroteuthis infernalis*)

D.22.1 Life History and General Distribution

Octopus are members of the molluscan class Cephalopoda, along with squid, cuttlefish and nautiloids. In the BSAI and GOA, the most commonly encountered octopods are the shelf demersal species *O. gilbertianus* and *O. dofleini*, and the bathypelagic finned species, *V. infernalis*. Octopods, like other cephalopods are dioecious, with fertilization of eggs (usually within the mantle cavity of the female) requiring transfer of spermatophores during copulation. Octopods probably do not live longer than about 2-4 years, and females of some species (e.g., *O. vulgaris*) die after brooding their eggs on the bottom.

O. gilbertianus - Medium sized octopus (up to 2 m in total length) distributed across the shelf (to 500 m depth) in the eastern and western Bering Sea (where it is the most common octopus), Aleutian Islands, and Gulf of Alaska (endemic to the North Pacific). Little is known of its reproductive or trophic ecology, but eggs laid on the bottom and tended by females. Lives mainly among rocks and stones.

O. dofleini - Giant octopus (up to 10 m in total length, though mostly about 3-5 m) distributed in the southern boreal region from Japan and Korea, through the Aleutian Islands, Gulf Alaska, and south along the Pacific coast of North America to California. Inhabits the sublittoral to upper slope. Egg length 6-8 mm; laid on bottom. Copulation may occur in late fall-winter, but oviposition the following spring; each female lays several hundred eggs.

V. infernalis - Relatively small (up to about 40 cm total length) bathypelagic species, living at depths well below the thermocline; may be most commonly found at 700-1500 m. Found throughout the world's oceans. Eggs are large (3-4 mm in diameter) and are shed singly into the water. Hatched juveniles resemble adults, but with different fin arrangements, which change to the adult form with development. Little is known of their food habits, longevity, or abundance.

D.22.2 Fishery

Not currently a target of groundfish fisheries of BSAI or GOA. Bycatch has ranged between 200-1,000 mt in the BSAI and 40-100 mt in the GOA, chiefly in the pot fishery for Pacific cod and bottom trawl fisheries for cod and flatfish, but sometimes in the pelagic trawl pollock fishery. Directed octopus landings have been less than 8 mt/year for 1988-95. Age/size at 50% recruitment is unknown. Most of the bycatch occurs on the outer continental shelf (100-200 m depth), chiefly north of the Alaskan peninsula from Unimak I. to Port Moller and northwest to the Pribilof Islands; also around Kodiak Island and many of the Aleutian Islands.

D.22.3 Relevant Trophic Information

Octopus are eaten by pinnipeds (principally Steller sea lions, and spotted, bearded, and harbor seals) and a variety of fishes, including Pacific halibut and Pacific cod (Yang 1993). When small, octopods eat planktonic and small benthic crustaceans (mysids, amphipods, copepods). As adults, octopus eat benthic crustaceans (crabs) and molluscs (clams).

D.22.4 Habitat and Biological Associations

Egg/Spawning: shelf; eggs laid on bottom, maybe preferentially among rocks and cobble.

Young Juveniles: semi-demersal; widely dispersed on shelf, upper slope

Old Juveniles and Adults: demersal, widely dispersed on shelf and upper slope, preferentially among rocks, cobble, but also on sand/mud.

Habitat and Biological Associations: *Octopus dofleini*, *O. gilbertianus*

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	U (1-2 months?)	NA	spring-summer?	U, ICS, MCS	D	R, G?	U	Euhaline waters
Young juveniles	U	zooplankton	summer-fall?	U, ICS, MCS, OCS, USP	D, SD	U	U	Euhaline waters
Older Juveniles and Adults	U (2-3 yrs? for *O.gilbertianus*; older for *O.dofleini*)	crustaceans, molluscs	all year	ICS, MCS, OCS, USP	D	R, G, S, MS?	U	Euhaline waters

D.22.5 Additional sources of information

Sarah Gaichas, NMFS, Alaska Fisheries Science Center

D.22.6 Literature

Akimushkin, I.I. 1963. Cephalopods of the seas of the U.S.S.R. Academy of Sciences of the U.S.S.R., Institute of Oceanology, Moscow. Translated from Russian by Israel Program for Scientific Translations, Jerusalem 1965. 223 p.

Fritz, L.W. 1996. Other species In Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Nesis, K.N. 1987. Cephalopods of the world. TFH Publications, Neptune City, NJ, USA. 351 pp.

Perez, M. 1990. Review of marine mammal population and prey information for Bering Sea ecosystem studies. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS F/NWC-186, 81 p.

Yang, M.S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. U.S. Dep. Commerce, NOAA Tech. Memo. NMFS-AFSC-22, 150 p.

D.23 Capelin (*osmeridae*)

The species representative for capelin is *Mallotus villosus*.

D.23.1 Life History and General Distribution

Capelin is a short-lived marine (neritic), pelagic, filter-feeding schooling fish distributed along the entire coastline of Alaska and the Bering Sea, and south along British Columbia to the Strait of Juan de Fuca; circumpolar. In the N. Pacific, capelin grow to a maximum of 25 cm and 5 years of age. Spawn at ages 2-4 in spring and summer (May-Aug; earlier in south, later in north) when about 11-17 cm on coarse sand, fine gravel beaches, especially in Norton Sound, northern Bristol Bay, along the Alaska Peninsula and near Kodiak. Age at 50% maturity=2 years. Fecundity: 10,000-15,000 eggs per female. Eggs hatch in 2-3 weeks. Most capelin die after spawning. Larvae and juveniles are distributed on inner-mid shelf in summer (rarely found in waters deeper than about 200 m), and juveniles and adults congregate in fall in mid-shelf waters east of the Pribilof Islands, west of St. Matthew and St. Lawrence Islands, and north into the Gulf of

Anadyr. Distributed along outer shelf and under ice edge in winter. Larvae, juveniles and adults have diurnal vertical migrations following scattering layers - night near surface, at depth during the day. Smelts are captured during trawl surveys, but their patchy distribution both in space and time reduces the validity of biomass estimates.

The approximate upper size limit of juvenile fish is 13cm.

D.23.2 Fishery

Not a target species in groundfish fisheries of BSAI or GOA, but caught as bycatch (up to several hundred tons per year in the 1990s) principally by yellowfin sole trawl fishery in Kuskokwim and Togiak Bays in spring in BSAI; almost all discarded. Small local coastal fisheries occur in spring and summer.

D.23.3 Relevant Trophic Information

Capelin are important prey for marine birds and mammals as well as other fish. Surface feeding (e.g., gulls and kittiwakes), as well as shallow and deep diving piscivorous birds (e.g., murres and puffins) largely consume small schooling fishes such as capelin, eulachon, herring, sand lance and juvenile pollock (Hunt et al. 1981a; Sanger 1983). Both pinnipeds (Steller sea lions, northern fur seals, harbor seals, and ice seals) and cetaceans (such as harbor porpoise, and fin, sei, humpback, beluga whales) feed on smelts, which may provide an important seasonal food source near the ice-edge in winter, and as they assemble nearshore in spring to spawn (Frost and Lowry 1987; Wespestad 1987). Smelts are also found in the diets of some commercially exploited fish species, such as Pacific cod, walleye pollock, arrowtooth flounder, Pacific halibut, sablefish, Greenland turbot and salmon, throughout the North Pacific Ocean and the Bering Sea (Allen 1987; Yang 1993; Livingston, in prep.).

D.23.4 Habitat and Biological Associations

Egg/Spawning: Spawn adhesive eggs (about 1 mm in diameter) on fine gravel or coarse sand (0.5-1 mm grain size) beaches intertidally to depths of up to 10 m in May-July in Alaska (later to the north in Norton Sound). Hatching occurs in 2-3 weeks. Most intense spawning when coastal water temperatures are 5-9°C.

Larvae: After hatching, 4-5 mm larvae remain on the middle-inner shelf in summer; distributed pelagically; centers of distribution are unknown, but have been found in high concentrations north of Unimak Island, in the western GOA, and around Kodiak Island.

Juveniles: In fall, juveniles are distributed pelagically in mid-shelf waters (50-100 m depth; -2-3°C), and have been found in highest concentrations east of the Pribilof Islands, west of St. Matthew and St. Lawrence Islands and north into the Gulf of Anadyr.

Adults: Found in pelagic schools in inner-mid shelf in spring-fall, feed along semi-permanent fronts separating inner, mid, and outer shelf regions (~50 and 100 m). In winter, found in concentrations under ice-edge and along mid-outer shelf.

Habitat and Biological Associations: Capelin

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano- graphic Features	Other
Eggs	2-3 weeks to hatch	na	May-August	BCH (to 10 m)	D	S, CB		5-9°C peak spawning
Larvae	4-8 months?	Copepods phytoplankton	summer/fall/ winter	ICS, MCS	N, P	U NA?	U	
Juveniles	1.5+ yrs up to age 2	Copepods Euphausiids	all year	ICS, MCS	P	U NA?	U F? Ice edge in winter	
Adults	2 yrs ages 2-4+	Copepods Euphausiids polychaetes small fish	Spawning (May-August) non-spawning (Sep-Apr)	BCH (to 10 m) ICS, MCS, OCS	D, SD P	S, CB, G NA?	F Ice edge in winter	-2 - 3°C Peak distributions in EBS?

D.23.5 Additional Sources of information

Paul Anderson, NMFS/RACE, Kodiak AK 907-487-4961

Jim Blackburn, ADFG, Kodiak AK 907-486-1861

Mark W. Nelson, NMFS/REFM, Seattle WA 206-526-4699

D.23.6 Literature

Allen, M.J. 1987. Demersal fish predators of pelagic forage fishes in the southeastern Bering Sea. Pp. 29-32 In Forage fishes of the southeastern Bering Sea. Proceedings of a Conference, November 1986, Anchorage, AK. U.S. Dept Interior, Minerals Management Service, OCS Study MMS 87-0017.

Allen, M.J., and G.B. Smith. 1988. Atlas and zoogeography of common fishes in the Bering Sea and Northeastern Pacific. U.S. Dep. Commerce, NOAA Tech. Rept. NMFS 66, 151 p.

Crawford, T.W. 1981. Vertebrate prey of Phocoenoides dalli (Dall's porpoise), associated with the Japanese high seas salmon fishery in the North Pacific Ocean. M.S. Thesis, Univ. Washington, Seattle, 72 p.

Doyle, M.J., W.C. Rugen, and R.D. Brodeur. 1995. Neustonic ichthyoplankton in the western Gulf of Alaska during spring. Fishery Bulletin 93: 231-253.

Eschmyer, W.N., and E.S. Herald. 1983. A field guide to Pacific coast fishes, North America. Houghton Mifflin Co., Boston. 336 p.

Fritz, L.W. 1996. Other species In Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions as Projected for 1997. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Fritz, L.W., V.G. Wespestad, and J.S. Collie. 1993. Distribution and abundance trends of forage fishes in the Bering Sea and Gulf of Alaska. Pp. 30-44 In Is It Food: Addressing marine mammal and seabird declines. Workshop Summary. Alaska Sea Grant College Program Rept. No. AK-SG-93-01, Univ. Alaska, Fairbanks, AK 99775-5040.

Frost, K.J. and L. Lowry. 1987. Marine mammals and forage fishes in the southeastern Bering Sea. Pp. 11-18 In Forage fishes of the southeastern Bering Sea. Proceedings of a Conference, November 1986, Anchorage, AK. U.S. Dept Interior, Minerals Management Service, OCS Study MMS 87-0017.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Res. Bd. Canada Bull. 180. Ottawa. 740 p.

Hunt, G.L., Jr., B. Burgeson, and G.A. Sanger. 1981a. Feeding ecology of seabirds of the eastern Bering Sea. Pp 629-647 In D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf: Oceanography and Resources, Vol. II. U.S. Dept. Commerce, NOAA, OCSEAP, Office of Marine Pollution Assessment, Univ. WA Press, Seattle, WA.

Hunt, G.L., Jr., Z. Eppley, B. Burgeson, and R. Squibb. 1981b. Reproductive ecology, foods and foraging areas of seabirds nesting on the Pribilof Islands, 1975-79. Environmental Assessment of the Alaskan Continental Shelf, Final Reports of Principal Investigators, RU-83, U.S. Dept. Commerce, NOAA, OCSEAP, Boulder, CO.

Kawakami, T. 1980. A review of sperm whale food. Sci. Rep. Whales Res. Inst. Tokyo 32: 199-218.

Kendall, A.W., Jr., and J.R. Dunn. 1985. Ichthyoplankton of the continental shelf near Kodiak Island, Alaska. U.S. Dep. Commerce, NOAA Tech. Rept NMFS 20, 89 p.

Kendall, A.W., Jr., J.R. Dunn, and R.J. Wolotira, Jr. 1980. Zooplankton, including ichthyoplankton and decapod larvae, of the Kodiak shelf. NWAFC Processed Rept. 80-8, AFSC-NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 393 p.

Livingston, P.A. Groundfish utilization of walleye pollock (Theragra chalcogramma), Pacific herring (Clupea pallasi) and capelin (Mallotus villosus) resources in the Gulf of Alaska. In preparation.

Morris, B.F., M.S. Alton, and H.W. Braham. 1983. Living marine resources of the Gulf of Alaska: a resource assessment for the Gulf of Alaska/Cook Inlet Proposed Oil and Gas Lease Sale 88. U.S. Dept. Commerce, NOAA, NMFS.

Murphy, E.C., R.H. Day, K.L. Oakley, A.A. Hoover. 1984. Dietary changes and poor reproductive performances in glaucous-winged gulls. Auk 101: 532-541.

Naumenko, E.A. 1996. Distribution, biological condition, and abundance of capelin (Mallotus villosus socialsis) in the Bering Sea. Pp. 237-256 In O.A. Mathisen and K.O. Coyle (eds.), Ecology of the Bering Sea: a review of Russian literature. Alaska Sea Grant Report No. 96-01, Alaska Sea Grant College Program, U. Alaska, Fairbanks, AK 99775-5040. 306 p.

Pahlke, K.A. 1985. Preliminary studies of capelin Mallotus villosus in Alaska waters. Alaska Dept. Fish Game, Info. Leaf. 250, 64 p.

Perez, M.A. and M.A. Bigg. 1986. Diet of northern fur seals, Callorhinus ursinus, off western North America. Fish. Bull., U.S. 84: 957-971.

Pitcher, K.W. 1980. Food of the harbor seal, Phoca vitulina richardsi, in the Gulf of Alaska. Fish. Bull., U.S. 78: 544-549.

Rugen, W.C. 1990. Spatial and temporal distribution of larval fish in the western Gulf of Alaska, with emphasis on the period of peak abundance of walleye pollock (Theragra chalcogramma) larvae. NWAFC Processed Rept 90-01, AFSC-NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 162 p.

Waldron, K.D. 1978. Ichthyoplankton of the eastern Bering Sea, 11 February-16 March 1978. REFM Report, AFSC, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 33 p.

Waldron, K.D., and B.M. Vinter. 1978. Ichthyoplankton of the eastern Bering Sea. Final Report (RU 380), Environmental Assessment of the Alaskan continental shelf, REFM, AFSC, NMFS, 7600 Sand Point Way, NE, Seattle, WA 98115. 88 p.

Wespestad, V.G. 1987. Population dynamics of Pacific herring (Clupea palasii), capelin (Mallotus villosus), and other coastal pelagic fishes in the eastern Bering Sea. Pp. 55-60 In Forage fishes of the southeastern Bering Sea. Proceedings of a Conference, November 1986, Anchorage, AK. U.S. Dept Interior, Minerals Management Service, OCS Study MMS 87-0017.

Yang, M.S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-AFSC-22. 150 pp.

D.24 Eulachon (*osmeridae*)

The species representative for eulachon is the candlefish *(Thaleichthys pacificus*).

D.24.1 Life History and General Distribution

Eulachon is a short-lived anadromous, pelagic schooling fish distributed from the Pribilof Islands in the eastern Bering Sea, throughout the Gulf of Alaska, and south to California. Consistently found pelagically in Shelikof Strait (hydroacoustic surveys in late winter-spring) and between Unimak Island and the Pribilof Islands (bycatch in groundfish trawl fisheries) from the middle shelf to over the slope. In the North Pacific, eulachon grow to a maximum of 23 cm and 5 years of age. Spawn at ages 3-5 in spring and early summer (April-June) when about 14-20 cm in rivers on coarse sandy bottom. Age at 50% maturity=3 years. Fecundity: ~25,000 eggs per female. Eggs adhere to sand grains and other substrates on river bottom. Eggs hatch in 30-40 days in BC at 4-7°C. Most eulachon die after first spawning. Larvae drift out of rivers and develop at sea. Smelts are captured during trawl surveys, but their patchy distribution both in space and time reduces the validity of biomass estimates.

The approximate upper size limit of juvenile fish is 14cm.

D.24.2 Fishery

Not a target species in groundfish fisheries of BSAI or GOA, but caught as bycatch (up to several hundred tons per year in the 1990s) principally by midwater pollock fisheries in Shelikof Strait (GOA), on the east side of Kodiak (GOA), and between the Pribilof Islands and Unimak Island on the outer continental shelf and slope (EBS); almost all discarded. Small local coastal fisheries occur in spring and summer.

D.24.3 Relevant Trophic Information

Eulachon may be important prey for marine birds and mammals as well as other fish. Surface feeding (e.g., gulls and kittiwakes), as well as shallow and deep diving piscivorous birds (e.g., murres and puffins) largely consume small schooling fishes such as capelin, eulachon, herring, sand lance and juvenile pollock (Hunt et al. 1981a; Sanger 1983). Both pinnipeds (Steller sea lions, northern fur seals, harbor seals, and ice seals) and cetaceans (such as harbor porpoise, and fin, sei, humpback, beluga whales) feed on smelts, which may provide an important seasonal food source near the ice-edge in winter, and as they assemble nearshore in spring to spawn (Frost and Lowry 1987; Wespestad 1987). Smelts also comprise significant portions of the diets of some commercially exploited fish species, such as Pacific cod, walleye pollock, arrowtooth flounder, Pacific halibut, sablefish, Greenland turbot and salmon, throughout the North Pacific Ocean and the Bering Sea (Allen 1987; Yang 1993; Livingston, in prep.).

D.24.4 Habitat and Biological Associations

Egg/Spawning: Anadromous; return to spawn in spring (May-June) in rivers; demersal eggs adhere to bottom substrate (sand, cobble, etc.). Hatching occurs in 30-40 days.

Larvae: After hatching, 5-7 mm larvae drift out of river and develop pelagically in coastal marine waters; centers of distribution are unknown.

Juveniles and Adults: Distributed pelagically in mid-shelf to upper slope waters (50-1000 m water depth), and have been found in highest concentrations between the Pribilof Islands and Unimak Island on the outer shelf, and in Shelikof east of the Pribilof Islands, west of St. Matthew and St. Lawrence Islands and north into the Gulf of Anadyr.

Habitat and Biological Associations: Eulachon (Candlefish)

Stage - EFH Level	Duration or Age	Diet/Prey	Season/ Time	Location	Water Column	Bottom Type	Oceano-graphic Features	Other
Eggs	30-40 days	na	April-June	Rivers, FW	D	S (CB?)		4 - 8°C for egg development
Larvae	1-2 months?	Copepods phytoplankton mysids, larvae	summer/fall	ICS ?	P?	U, NA?	U	
Juveniles	2.5+ yrs up to age 3	Copepods Euphausiids	all year	MCS, OCS, USP	P	U, NA?	U F?	
Adults	3 yrs ages 3-5+	 Copepods Euphausiids	Spawning (May-June) non-spawning (July-Apr)	Rivers-FW MCS, OCS, USP	D P	S (CB?) NA?	 F?	

D.24.5 Literature

Allen, M.J. 1987. Demersal fish predators of pelagic forage fishes in the southeastern Bering Sea. Pp. 29-32 In Forage fishes of the southeastern Bering Sea. Proceedings of a Conference, November 1986, Anchorage, AK. U.S. Dept Interior, Minerals Management Service, OCS Study MMS 87-0017.

Crawford, T.W. 1981. Vertebrate prey of Phocoenoides dalli (Dall's porpoise), associated with the Japanese hign seas salmon fishery in the North Pacific Ocean. M.S. Thesis, Univ. Washington, Seattle, 72 p.

Fritz, L.W., V.G. Wespestad, and J.S. Collie. 1993. Distribution and abundance trends of forage fishes in the Bering Sea and Gulf of Alaska. Pp. 30-44 In Is It Food: Addressing marine mammal and seabird declines. Workshop Summary. Alaska Sea Grant College Program Rept. No. AK-SG-93-01, Univ. Alaska, Fairbanks, AK 99775-5040.

Frost, K.J. and L. Lowry. 1987. Marine mammals and forage fishes in the southeastern Bering Sea. Pp. 11-18 In Forage fishes of the southeastern Bering Sea. Proceedings of a Conference, November 1986, Anchorage, AK. U.S. Dept Interior, Minerals Management Service, OCS Study MMS 87-0017.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Res. Bd. Canada Bull. 180. Ottawa. 740 p.

Hunt, G.L., Jr., B. Burgeson, and G.A. Sanger. 1981a. Feeding ecology of seabirds of the eastern Bering Sea. Pp 629-647 In D.W. Hood and J.A. Calder (eds.), The Eastern Bering Sea Shelf:

Oceanography and Resources, Vol. II. U.S. Dept. Commerce, NOAA, OCSEAP, Office of Marine Pollution Assessment, Univ. WA Press, Seattle, WA.

Hunt, G.L., Jr., Z. Eppley, B. Burgeson, and R. Squibb. 1981b. Reproductive ecology, foods and foraging areas of seabirds nesting on the Pribilof Islands, 1975-79. Environmental Assessment of the Alaskan Continental Shelf, Final Reports of Principal Investigators, RU-83, U.S. Dept. Commerce, NOAA, OCSEAP, Boulder, CO.

Kawakami, T. 1980. A review of sperm whale food. Sci. Rep. Whales Res. Inst. Tokyo 32: 199-218.

Livingston, P.A. Groundfish utilization of walleye pollock (Theragra chalcogramma), Pacific herring (Clupea pallasi) and capelin (Mallotus villosus) resources in the Gulf of Alaska. In preparation.

Morris, B.F., M.S. Alton, and H.W. Braham. 1983. Living marine resources of the Gulf of Alaska: a resource assessment for the Gulf of Alaska/Cook Inlet Proposed Oil and Gas Lease Sale 88. U.S. Dept. Commerce, NOAA, NMFS.

Perez, M.A. and M.A. Bigg. 1986. Diet of northern fur seals, Callorhinus ursinus, off western North America. Fish. Bull., U.S. 84: 957-971.

Pitcher, K.W. 1980. Food of the harbor seal, Phoca vitulina richardsi, in the Gulf of Alaska. Fish. Bull., U.S. 78: 544-549.

Sanger, G.A. 1983. Diets and food web relationships of seabirds in the Gulf of Alaska and adjacent marine regions. Outer Continental Shelf Environmental Assessment Program, Final Reports of Principal Investigators 45: 631-771.

Wespestad, V.G. 1987. Population dynamics of Pacific herring (Clupea palasii), capelin (Mallotus villosus), and other coastal pelagic fishes in the eastern Bering Sea. Pp. 55-60 In Forage fishes of the southeastern Bering Sea. Proceedings of a Conference, November 1986, Anchorage, AK. U.S. Dept Interior, Minerals Management Service, OCS Study MMS 87-0017.

Yang, M.S. 1993. Food habits of the commercially important groundfishes in the Gulf of Alaska in 1990. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-AFSC-22. 150 pp.December 11, 2006

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Appendix E Maps of Essential Fish Habitat

Maps of essential fish habitat are included in this section for the following species (life stage is indicated in parentheses):

Figures E-1 to E-3	Walleye pollock (eggs, larvae, late juveniles/adults)
Figures E-4 to E-5	Pacific cod (larvae, late juveniles/adults)
Figure E-6	Yellowfin sole (late juveniles/adults)
Figures E-7 to E-9	Greenland turbot (eggs, larvae, late juveniles/adults)
Figure E-10	Arrowtooth flounder (late juveniles/adults)
Figures E-11 to E-12	Rock sole (larvae, late juveniles/adults)
Figures E-13 to E-14	Alaska Plaice (eggs, late juveniles/adults)
Figure E-15	Rex sole (late juveniles/adults)
Figure E-16	Dover sole (late juveniles/adults)
Figures E-17 to E-19	Flathead sole (eggs, larvae, late juveniles/adults)
Figures E-20 to E-21	Sablefish (larvae, late juveniles/adults)
Figure E-22	Rockfish (larvae)
Figure E-23	Pacific ocean perch (late juveniles/adults)
Figure E-24	Shortraker and rougheye rockfish (adults)
Figure E-25	Northern rockfish (adults)
Figure E-26	Thornyhead rockfish (late juveniles/adults)
Figure E-27	Yelloweye rockfish (late juveniles/adults)
Figure E-28	Dusky rockfish (adults)
Figures E-29 to E-30	Atka mackerel (larvae, adults)
Figure E-31	Skates species (adults)
Figure E-32	Sculpin species (adults)
Figure E-33	Squid (late juveniles/adults)

Figure E-1 EFH Distribution - BSAI Walleye Pollock (Eggs)

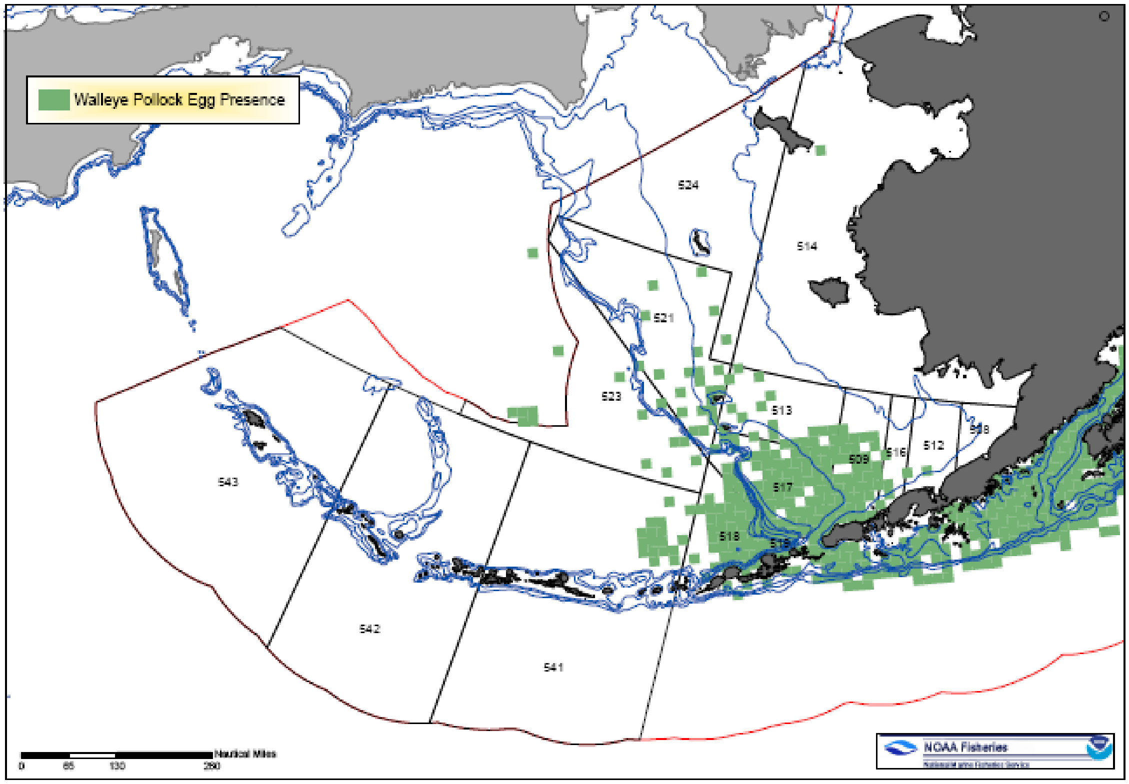


Figure E-2 EFH Distribution - BSAI Walleye Pollock (Larvae)

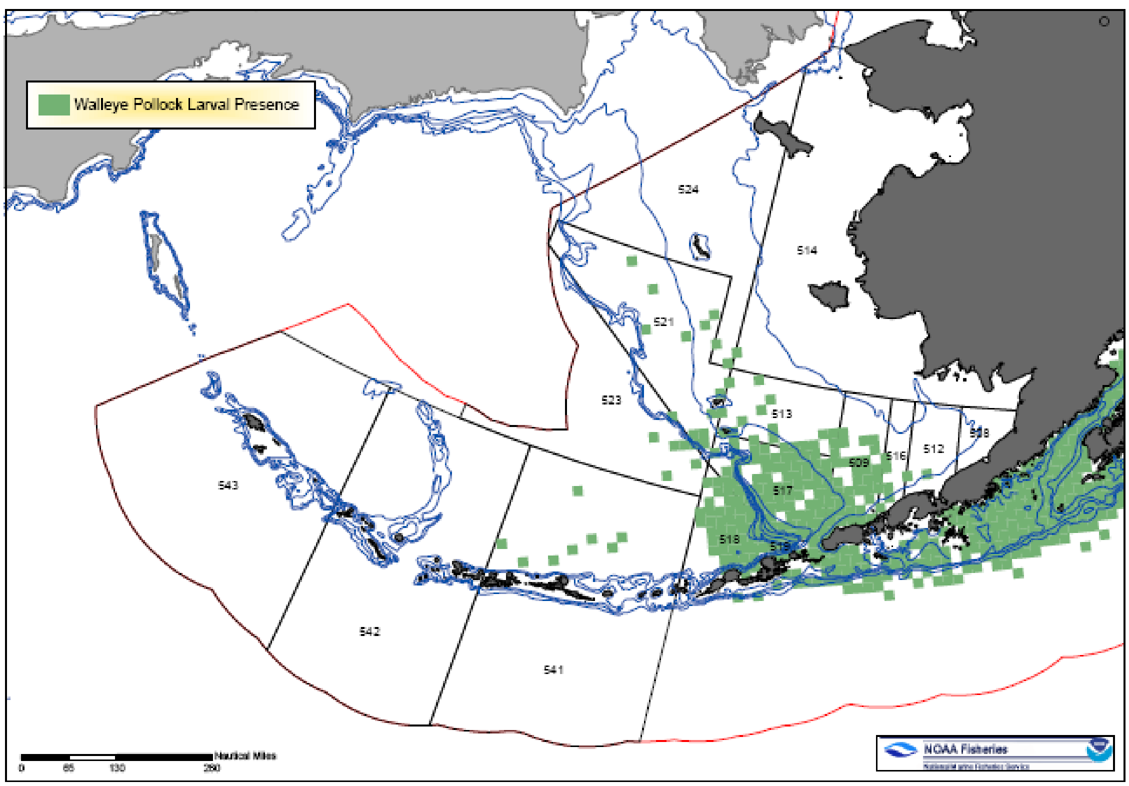


Figure E-3 EFH Distribution - BSAI Walleye Pollock (Late Juveniles/Adults)

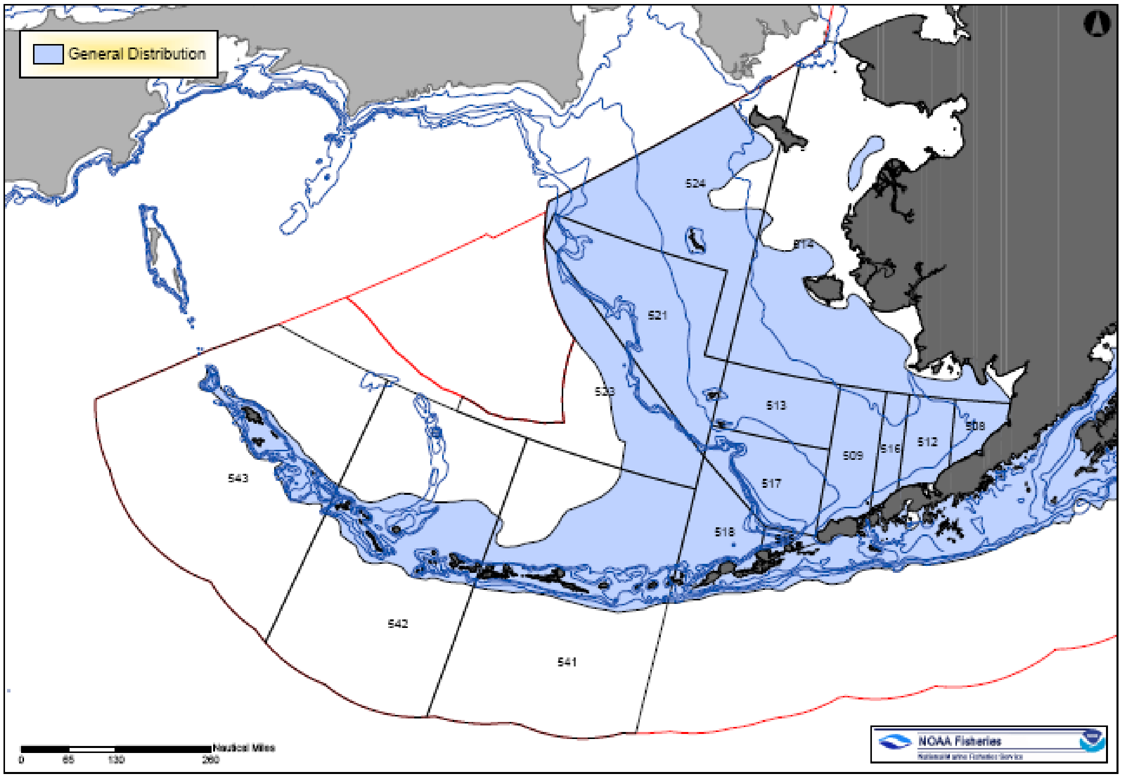


Figure E-4 EFH Distribution - BSAI Pacific Cod (Larvae)

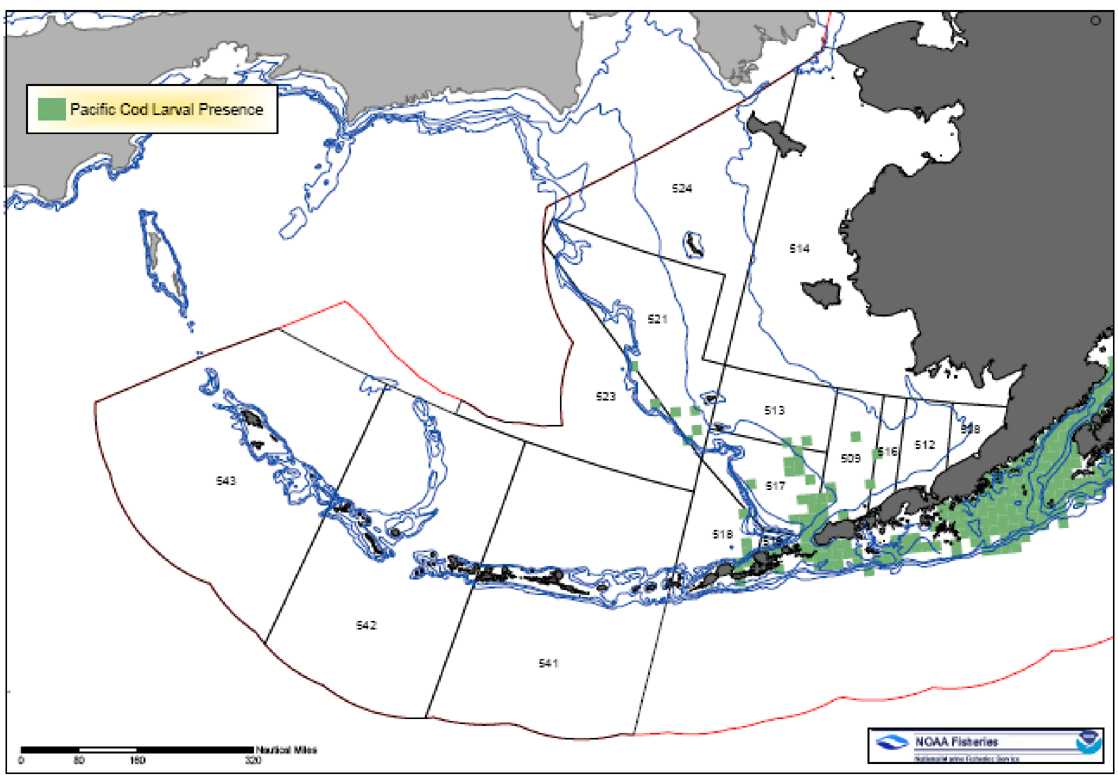


Figure E-5 EFH Distribution - BSAI Pacific Cod (Late Juveniles/Adults)

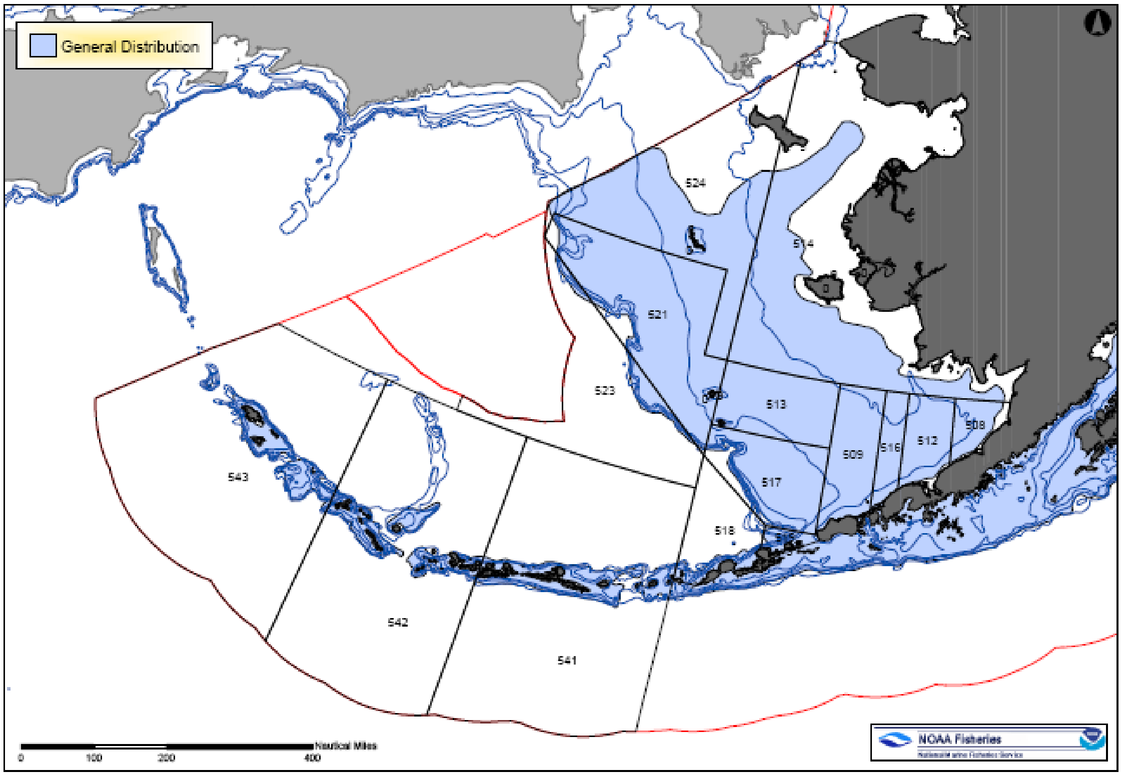


Figure E-6 EFH Distribution - BSAI Yellowfin Sole (Late Juveniles/Adults)

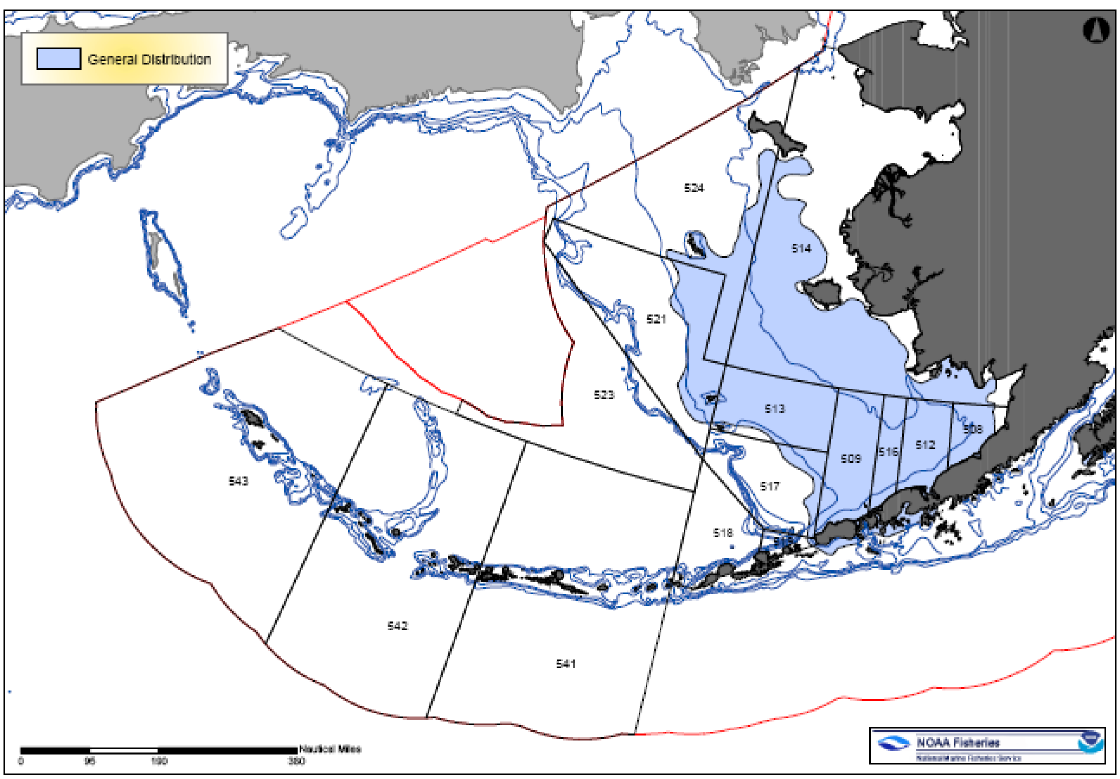


Figure E-7 EFH Distribution - BSAI Greenland Turbot (Eggs)

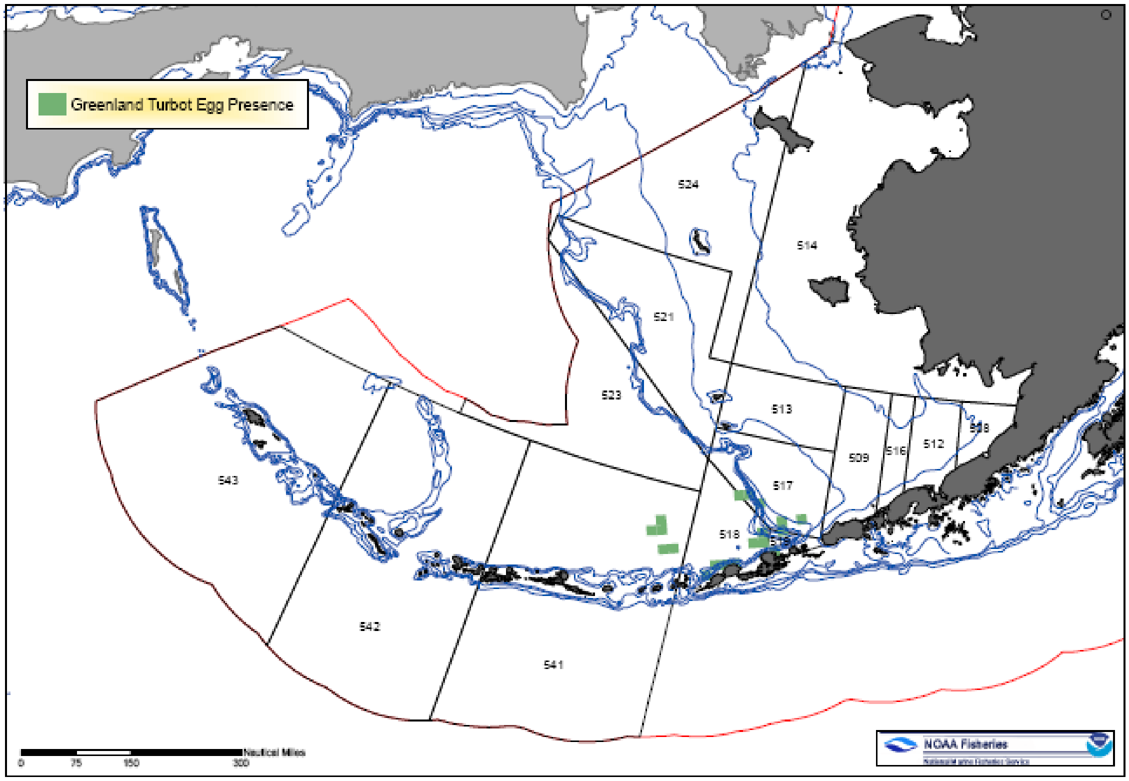


Figure E-8 EFH Distribution -BSAI Greenland Turbot (Larvae)

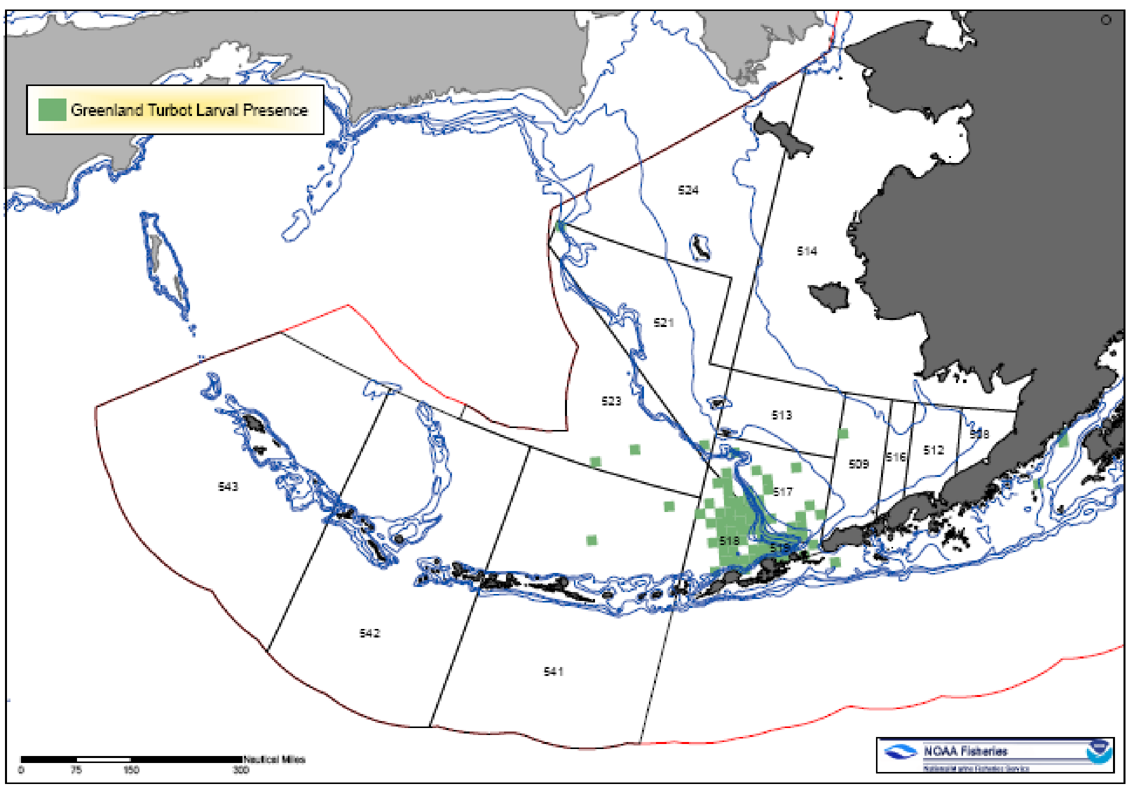


Figure E-9 EFH Distribution - BSAI Greenland Turbot (Late Juveniles/Adults)

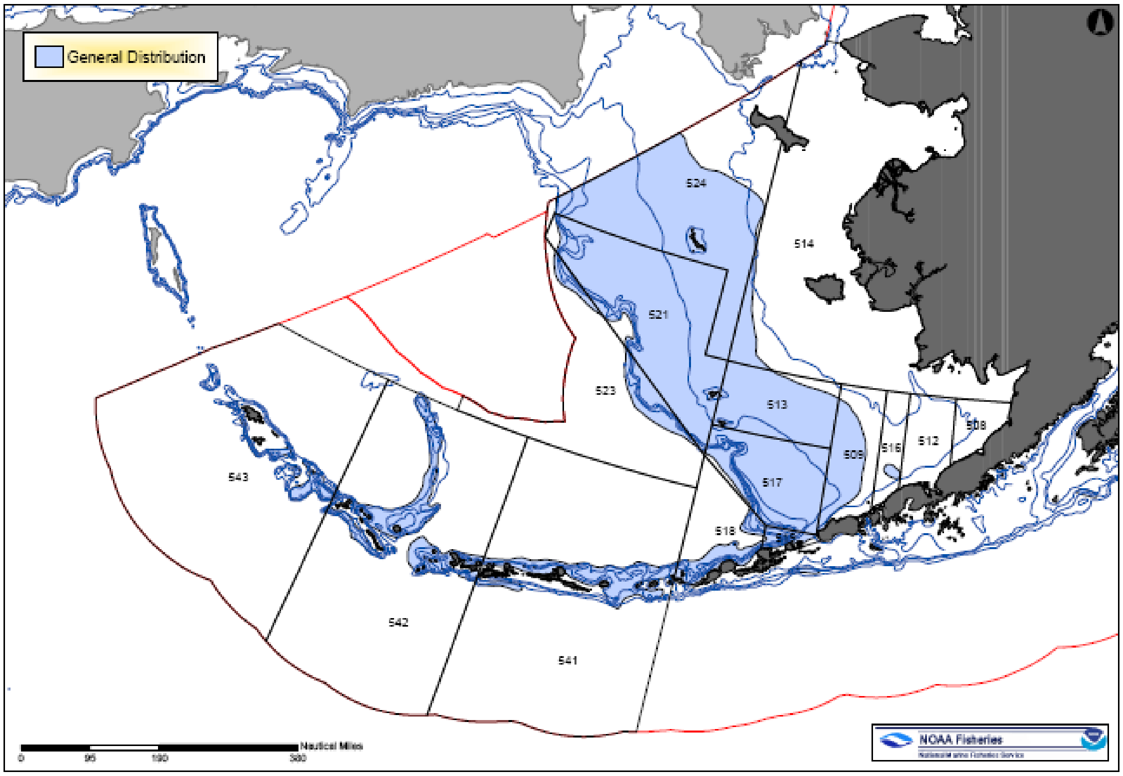


Figure E-10 EFH Distribution - BSAI Arrowtooth Flounder (Late Juveniles/Adults)

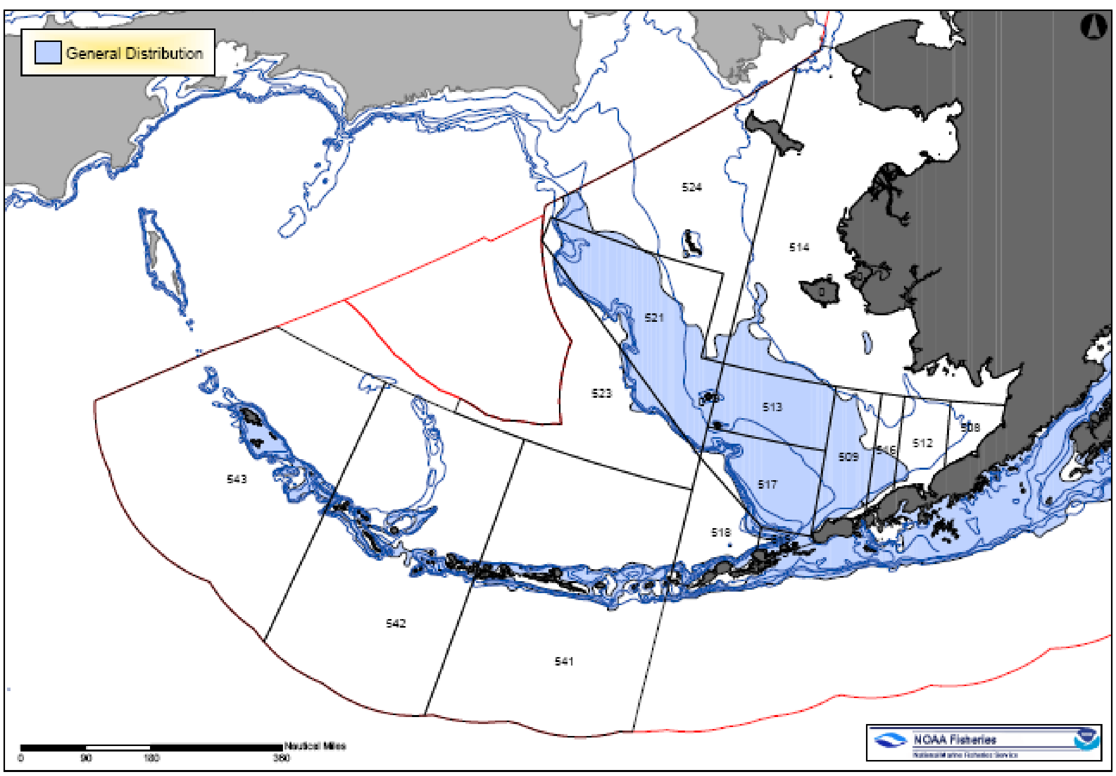


Figure E-11 EFH Distribution - BSAI Rock Sole (Larvae)

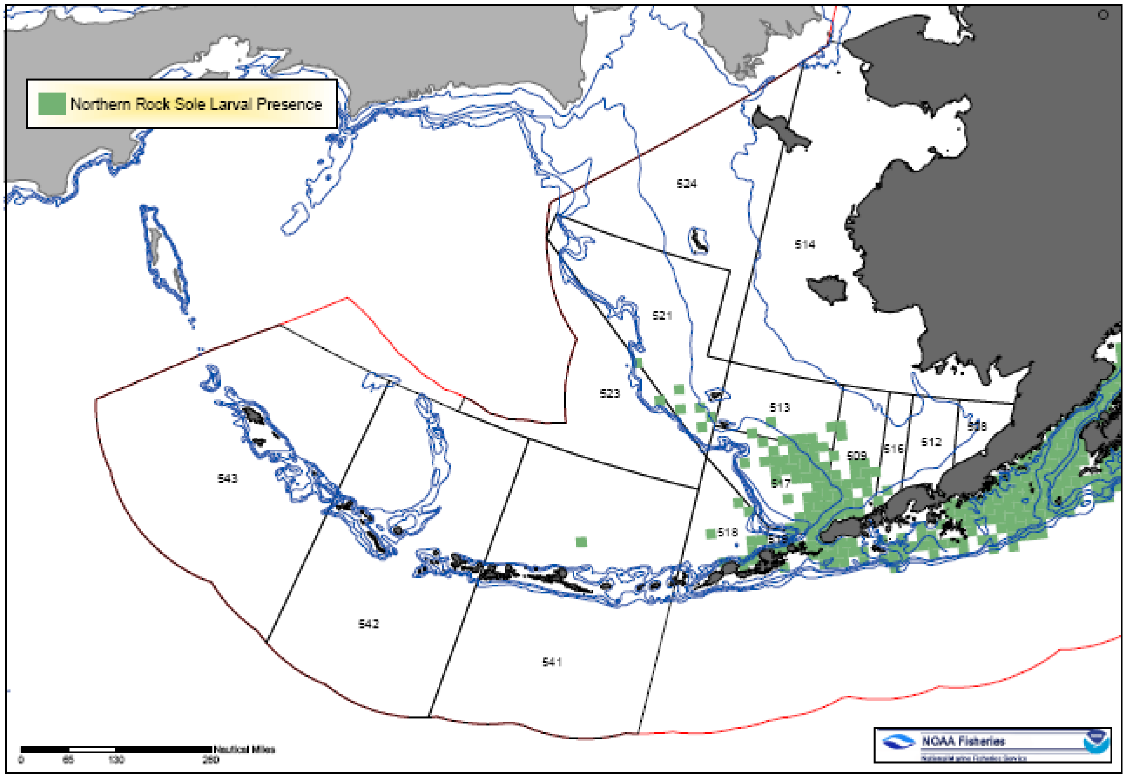


Figure E-12 EFH Distribution - BSAI Rock Sole (Late Juveniles/Adults)

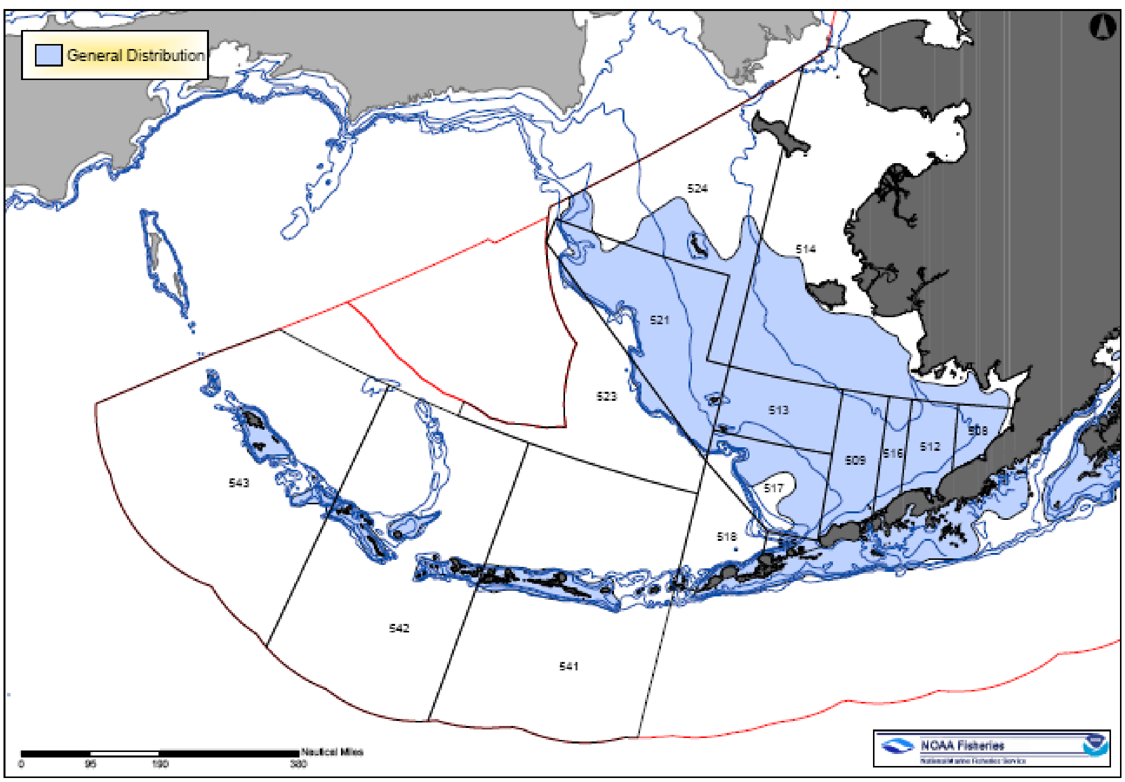


Figure E-13 EFH Distribution - BSAI Alaska Plaice (Eggs)

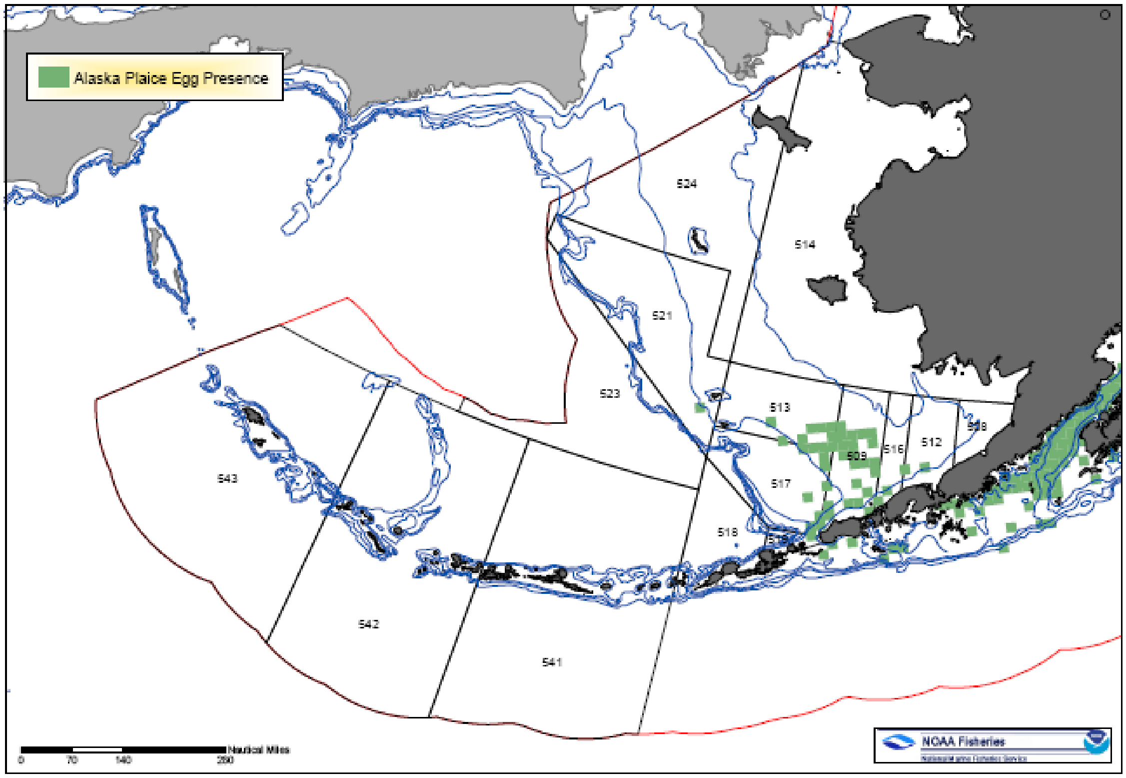


Figure E-14 EFH Distribution - BSAI Alaska Plaice (Late Juveniles/Adults)

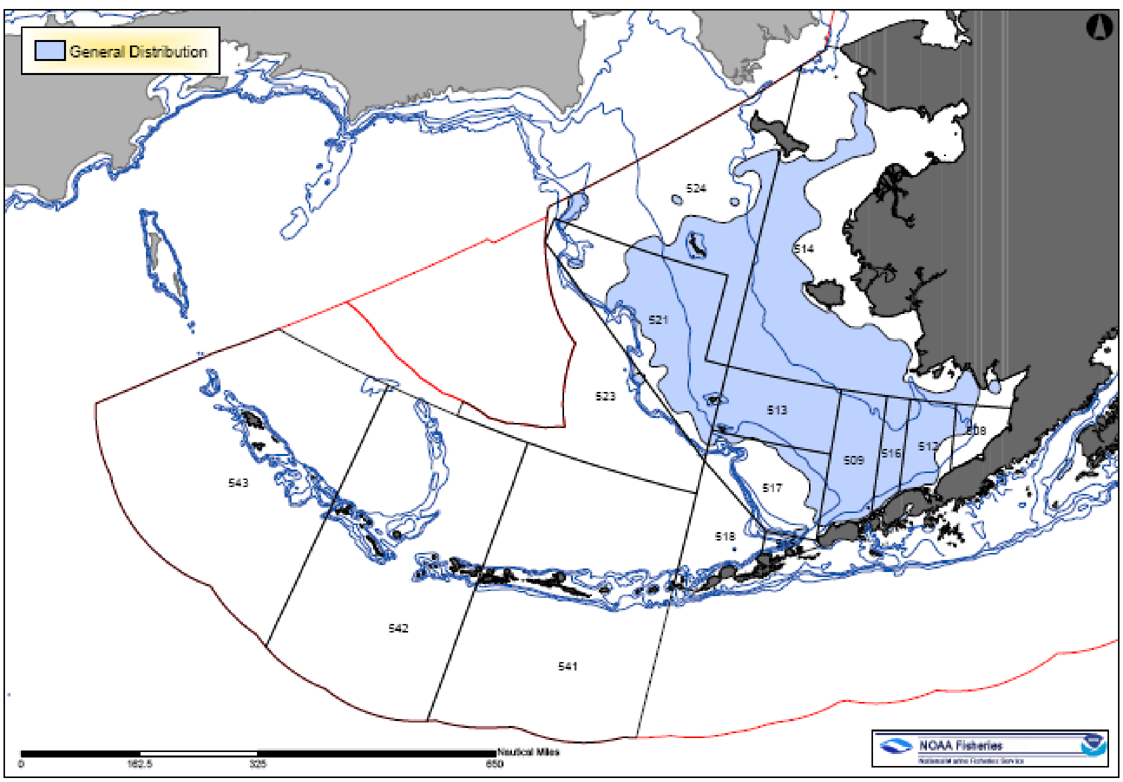


Figure E-15 EFH Distribution - BSAI Rex Sole (Late Juveniles/Adults)

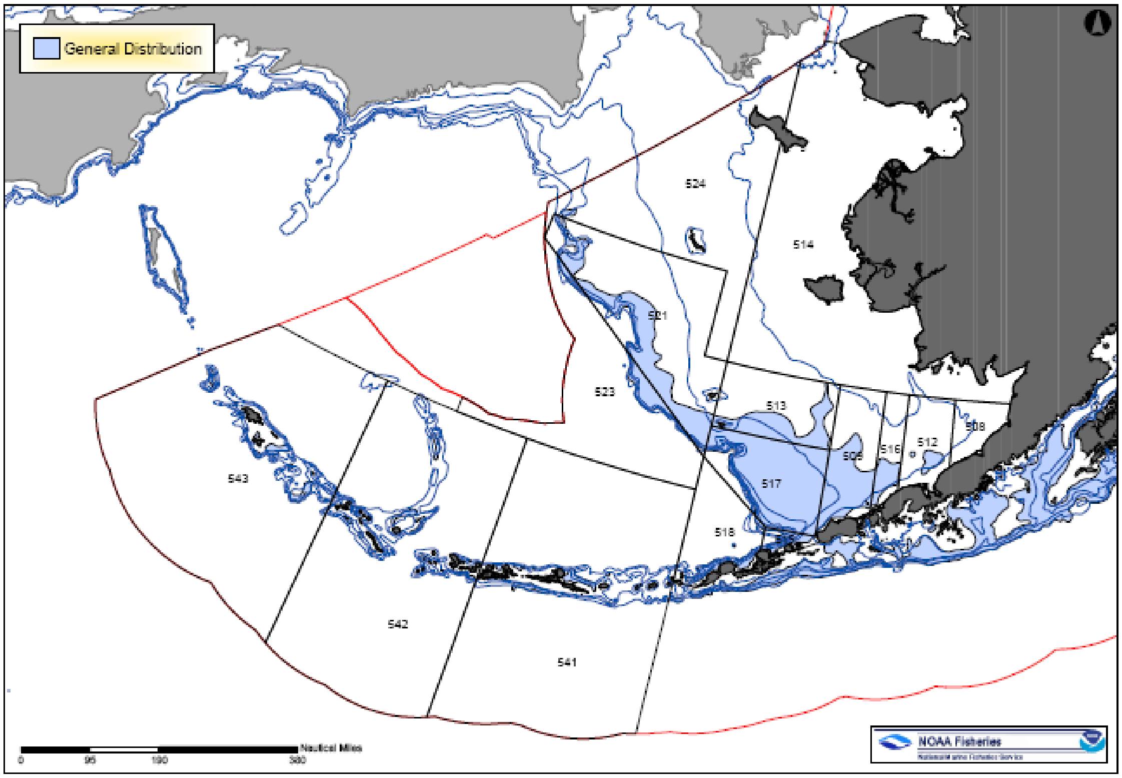


Figure E-16 EFH Distribution - BSAI Dover Sole (Late Juveniles/Adults)

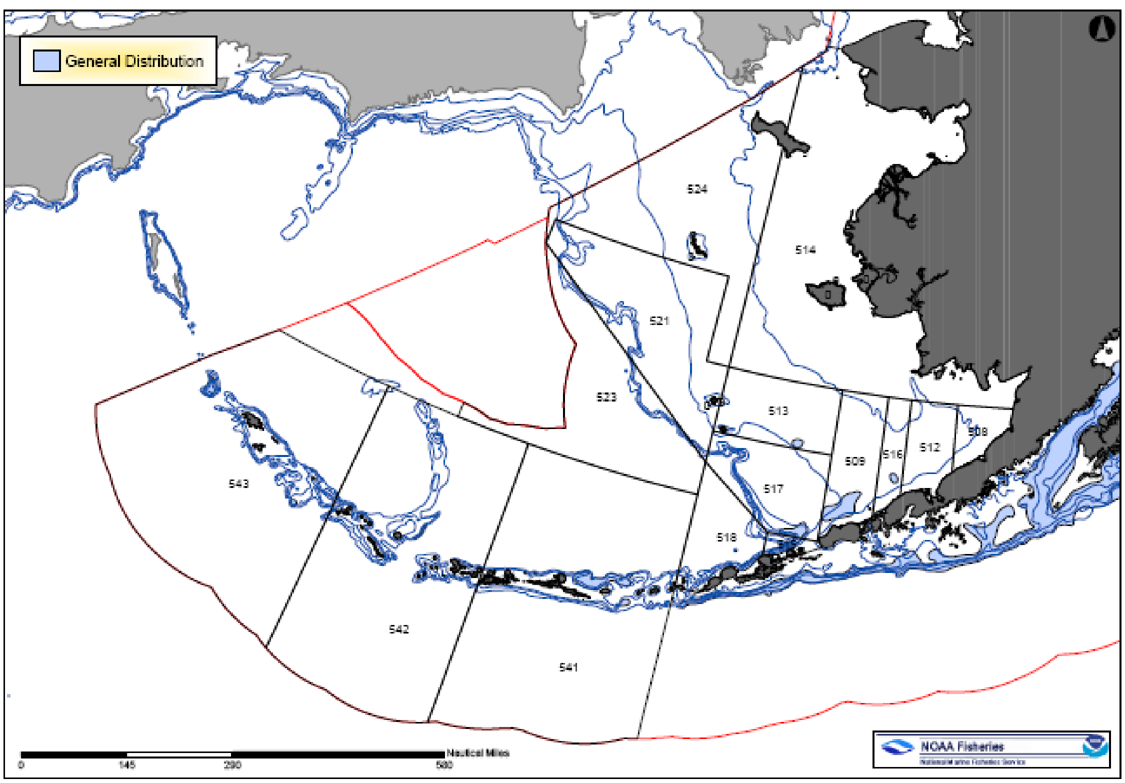


Figure E-17 EFH Distribution - BSAI Flathead Sole (Eggs)

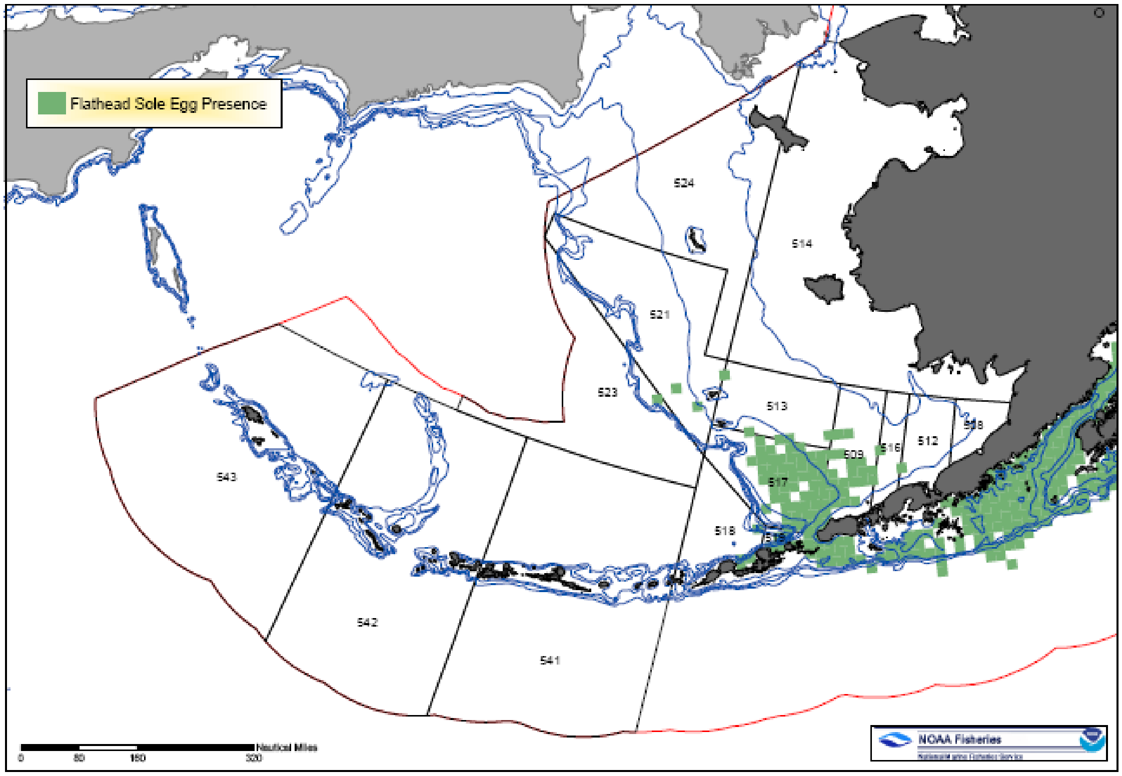


Figure E-18 EFH Distribution - BSAI Flathead Sole (Larvae)

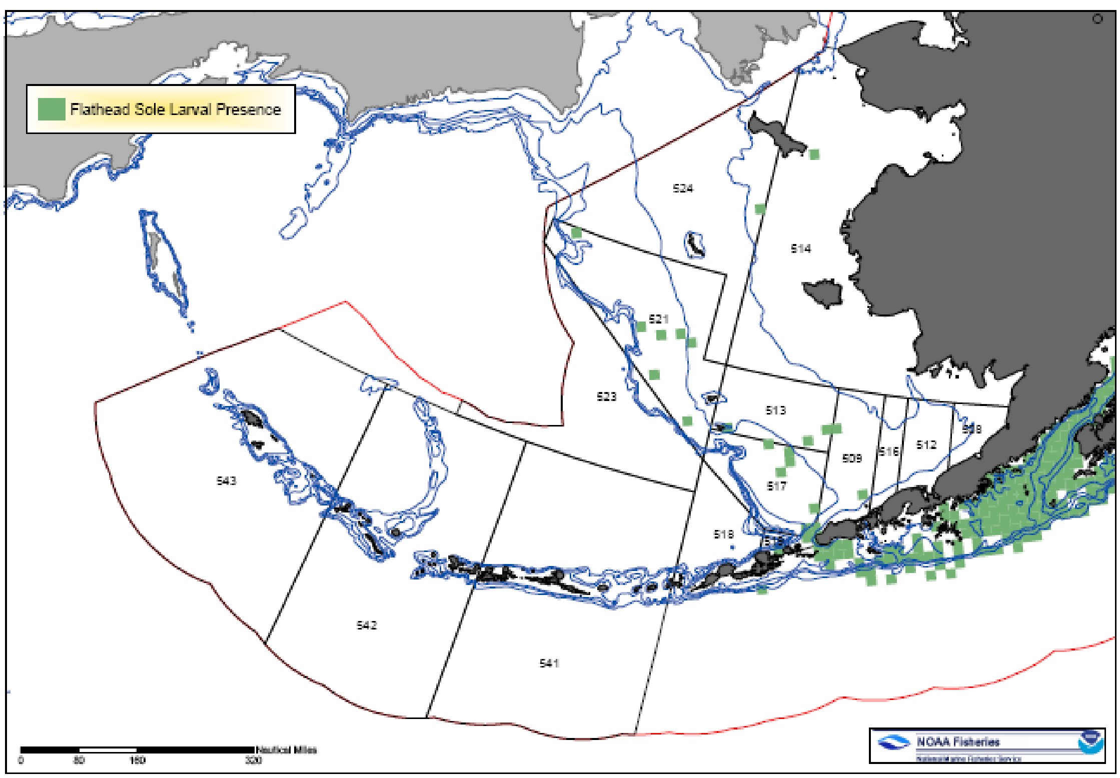


Figure E-19 EFH Distribution - BSAI Flathead Sole (Late Juveniles/Adults)

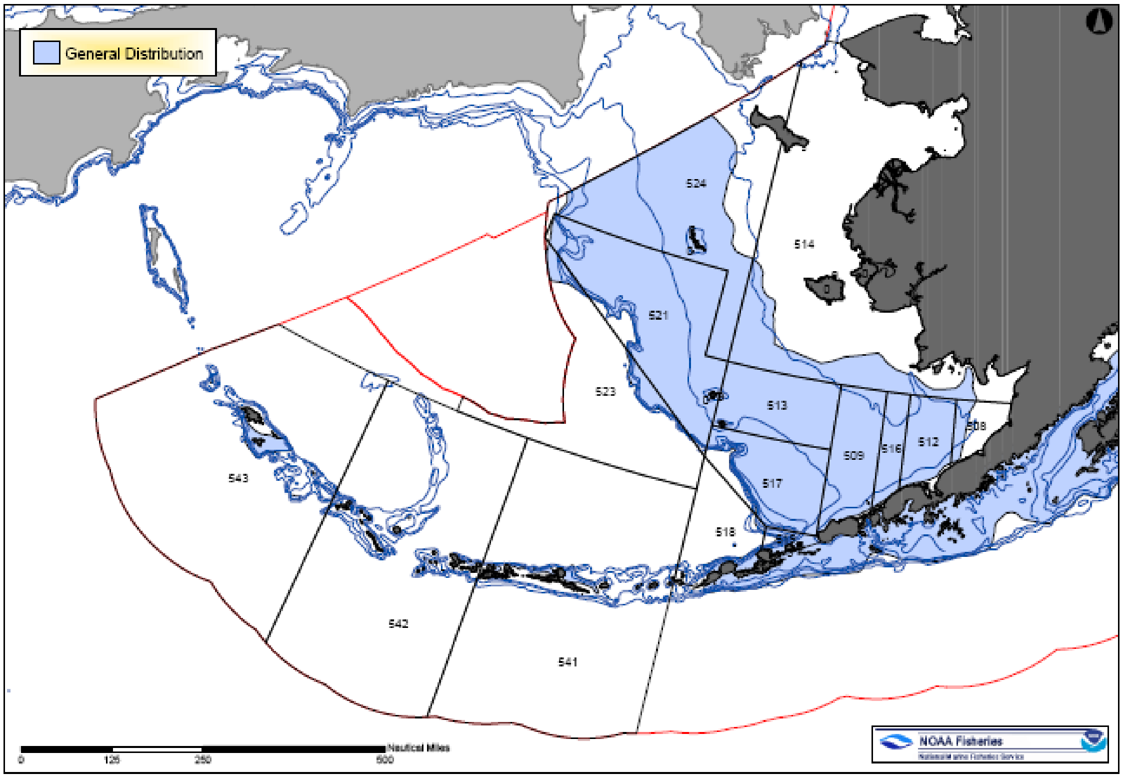


Figure E-20 EFH Distribution - BSAI Sablefish (Larvae)

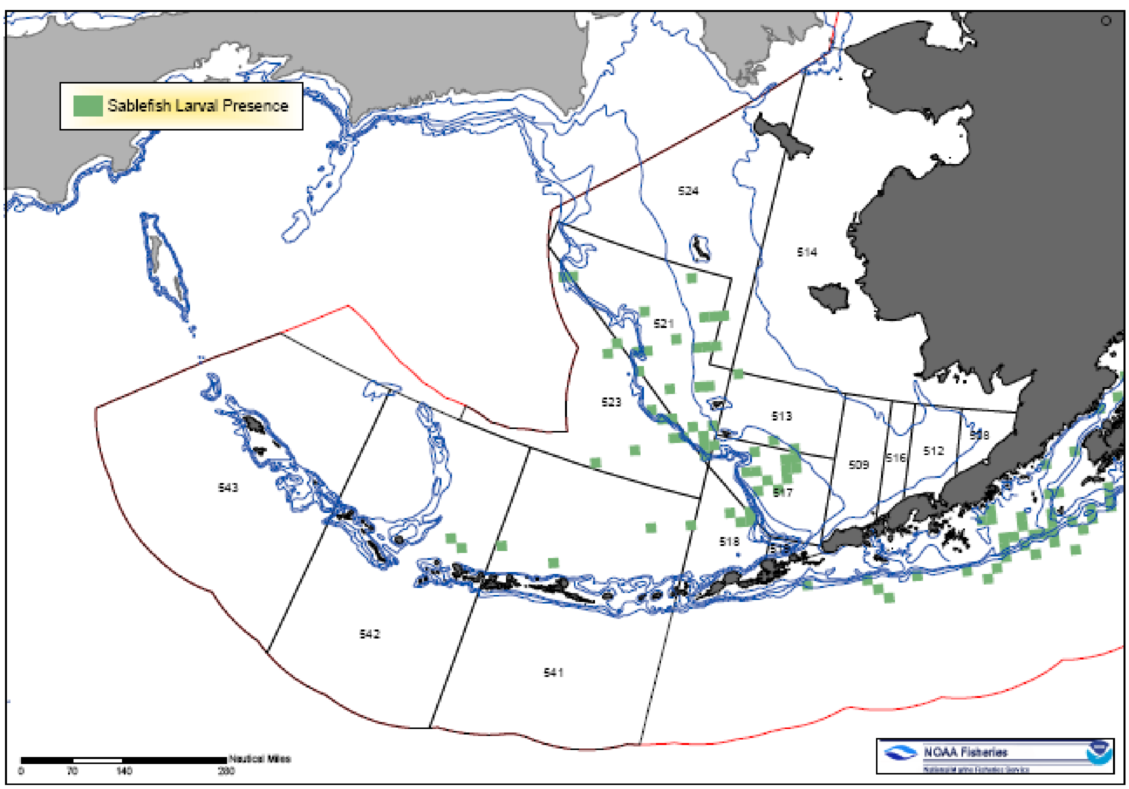


Figure E-21 EFH Distribution - BSAI Sablefish (Late Juvenile/Adults)

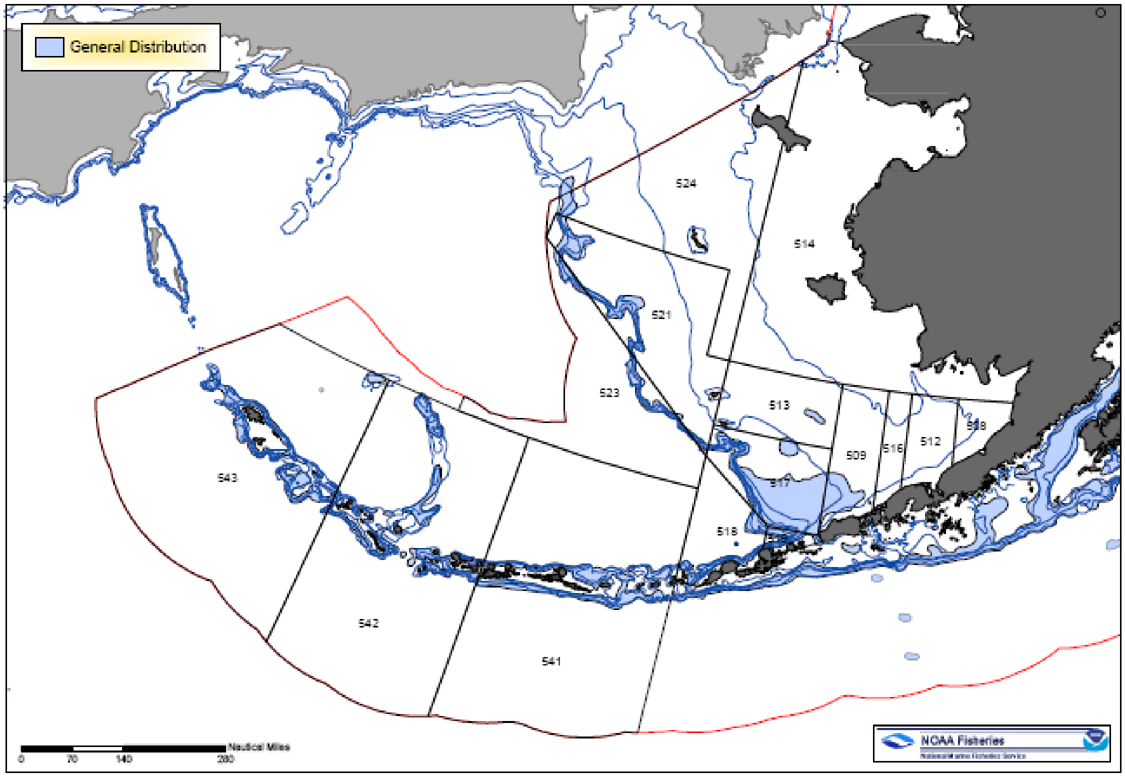


Figure E-22 EFH Distribution - BSAI Rockfish (Larvae)

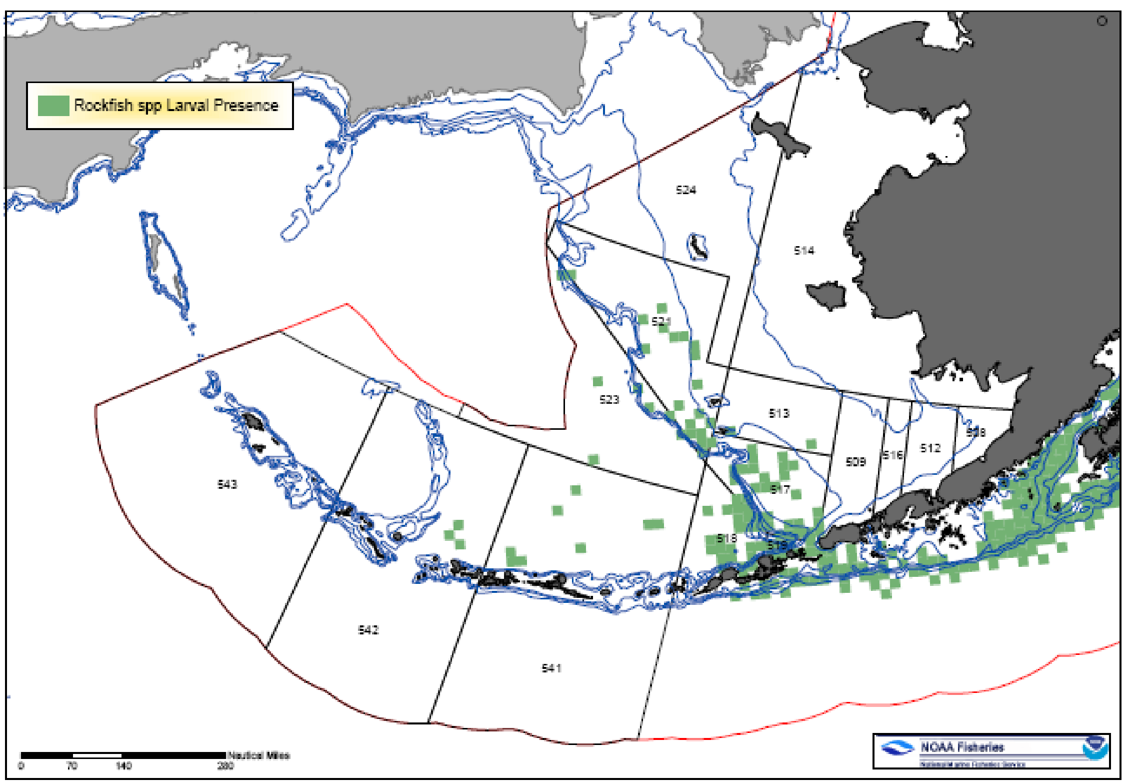


Figure E-23 EFH Distribution - BSAI Pacific Ocean Perch (Late Juveniles/Adults)

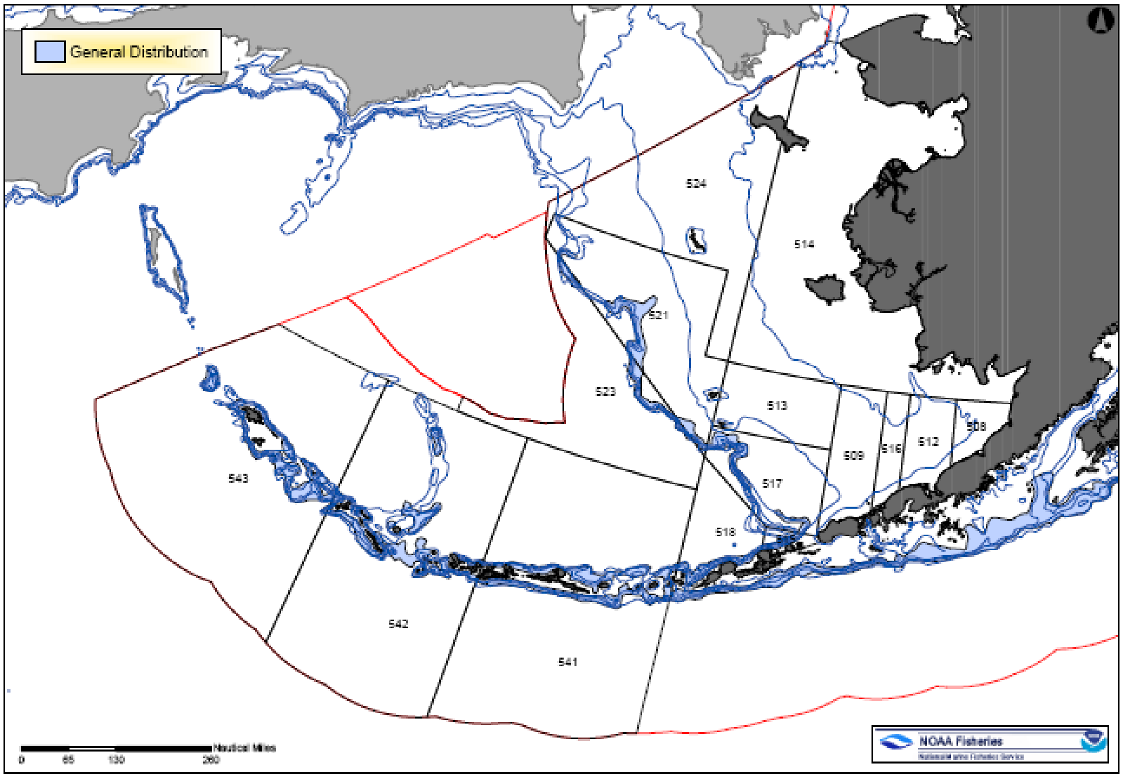


Figure E-24 EFH Distribution - BSAI Shortraker/Rougheye Rockfish (Adults)

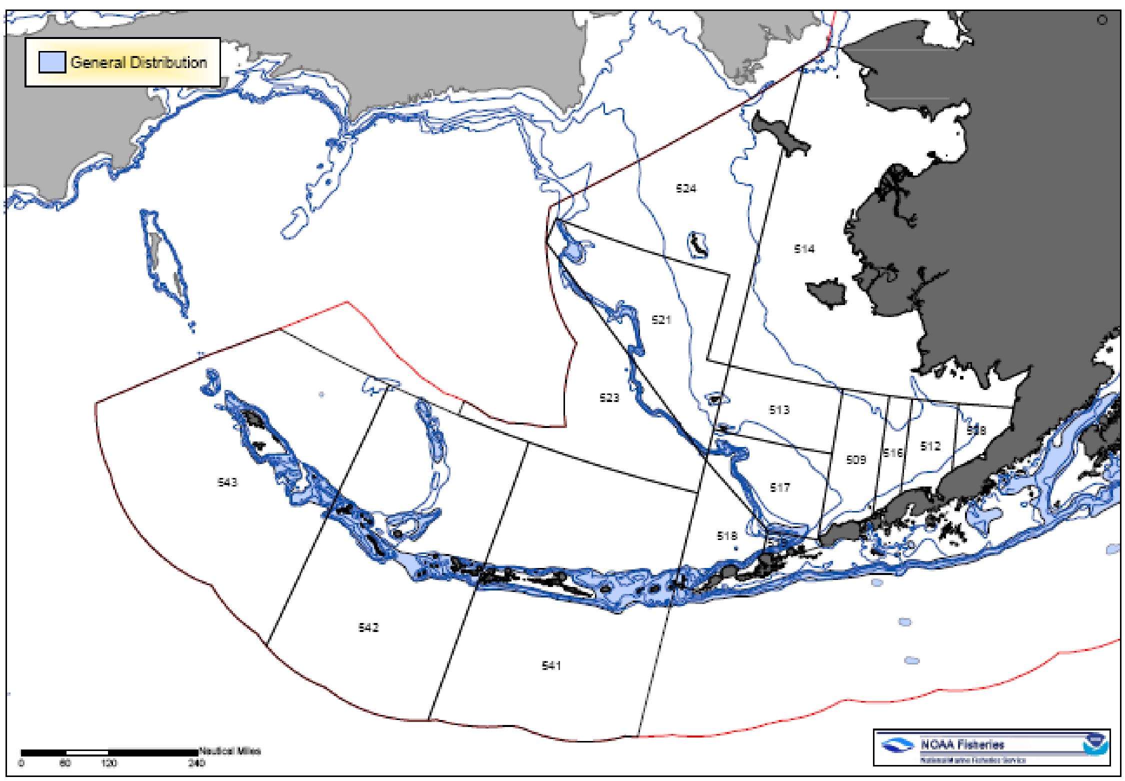


Figure E-25 EFH Distribution - BSAI Northern Rockfish (Adults)

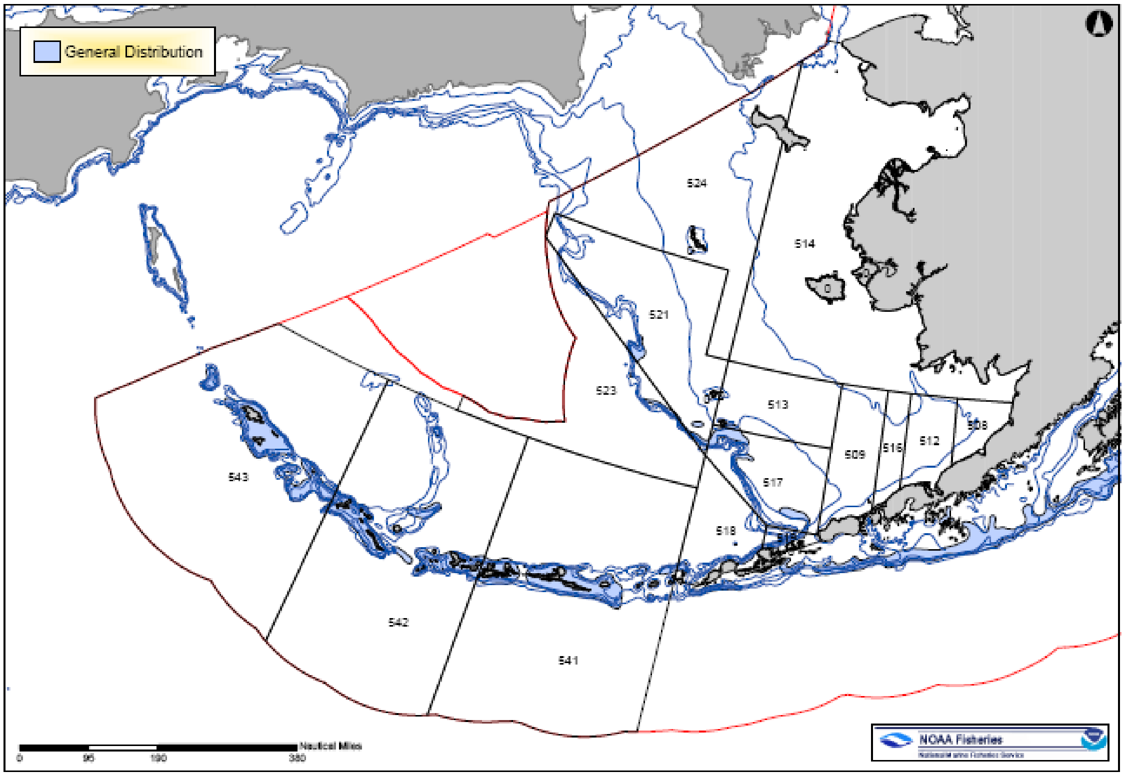


Figure E-26 EFH Distribution - BSAI Thornyhead Rockfish Late Juveniles/Adults)

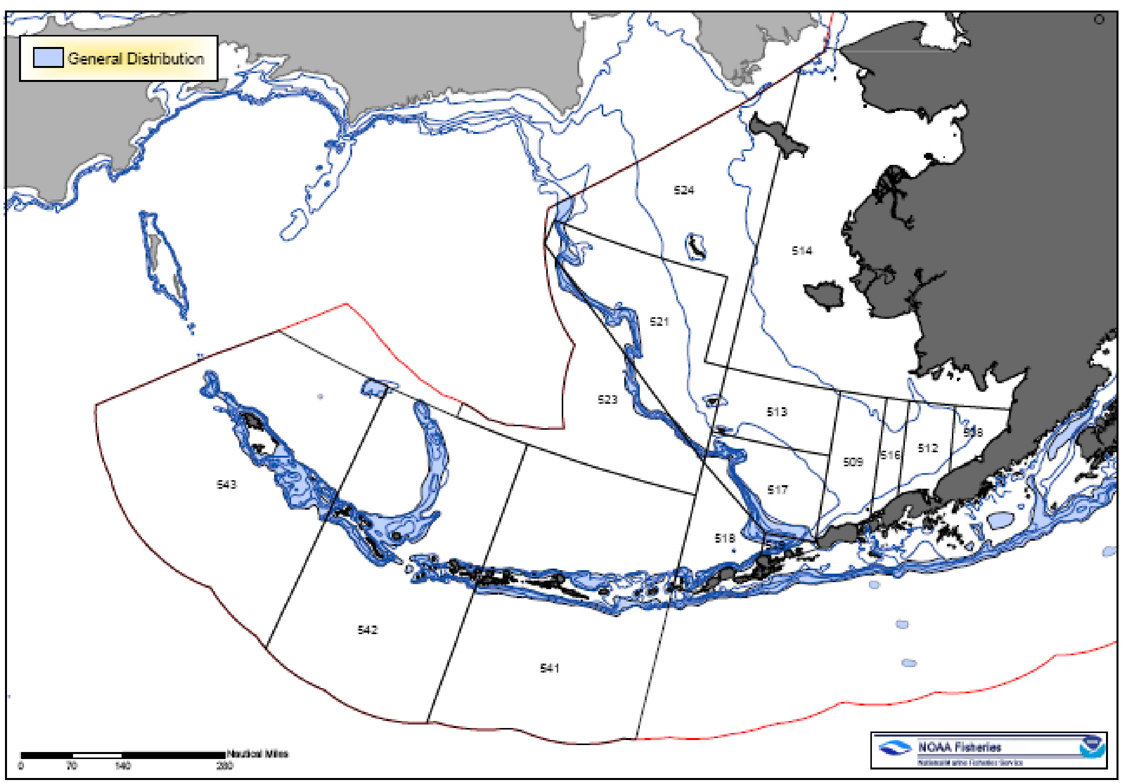


Figure E-27 EFH Distribution - BSAI Yelloweye Rockfish (Late Juveniles/Adults)

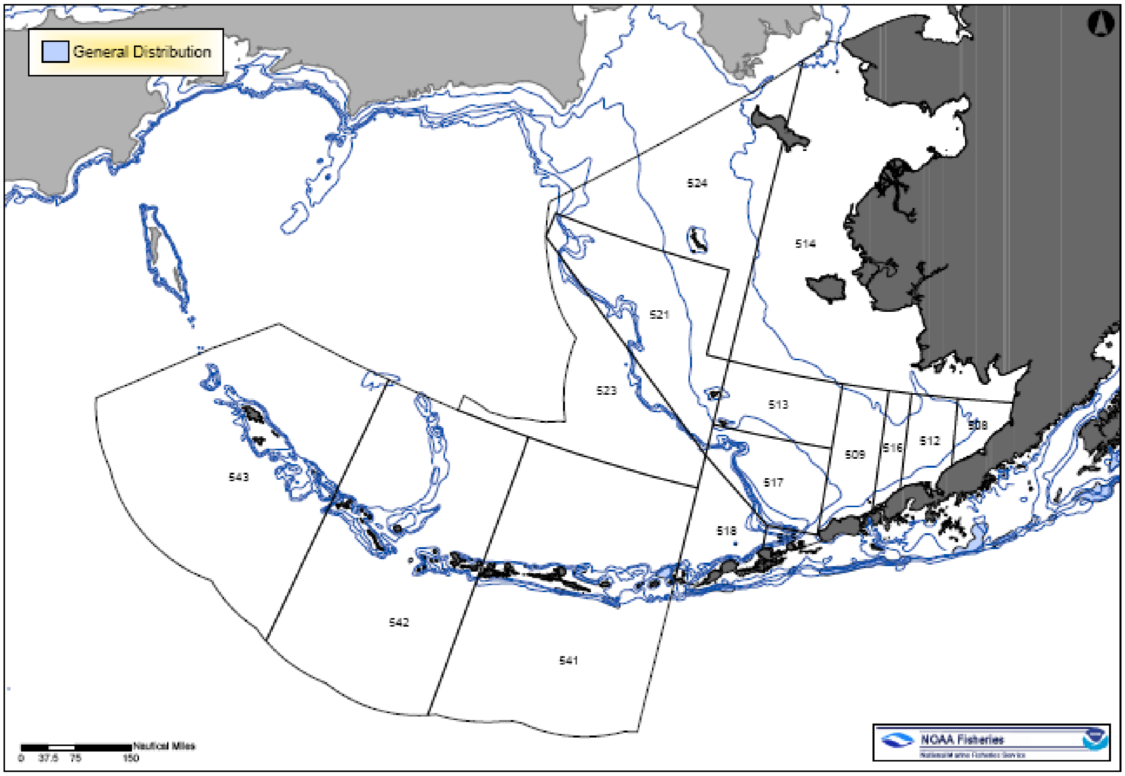


Figure E-28 EFH Distribution - BSAI Dusky Rockfish (Adults)

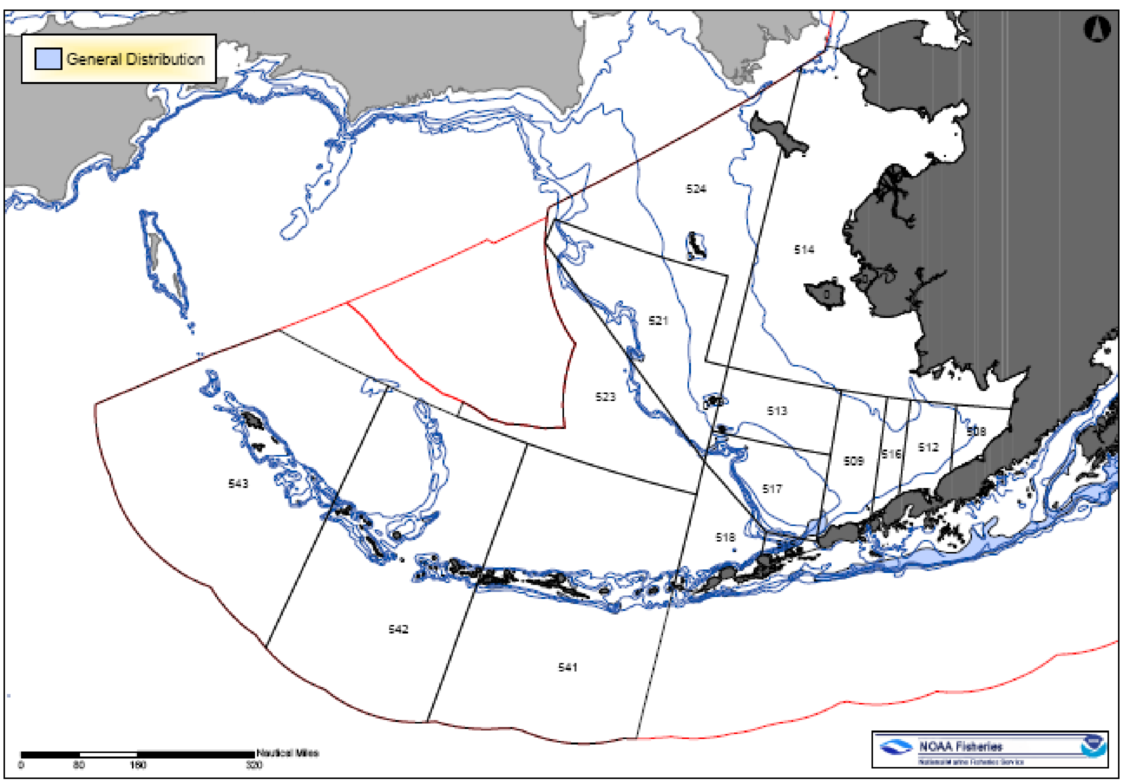


Figure E-29 EFH Distribution - BSAI Atka Mackerel (Larvae)

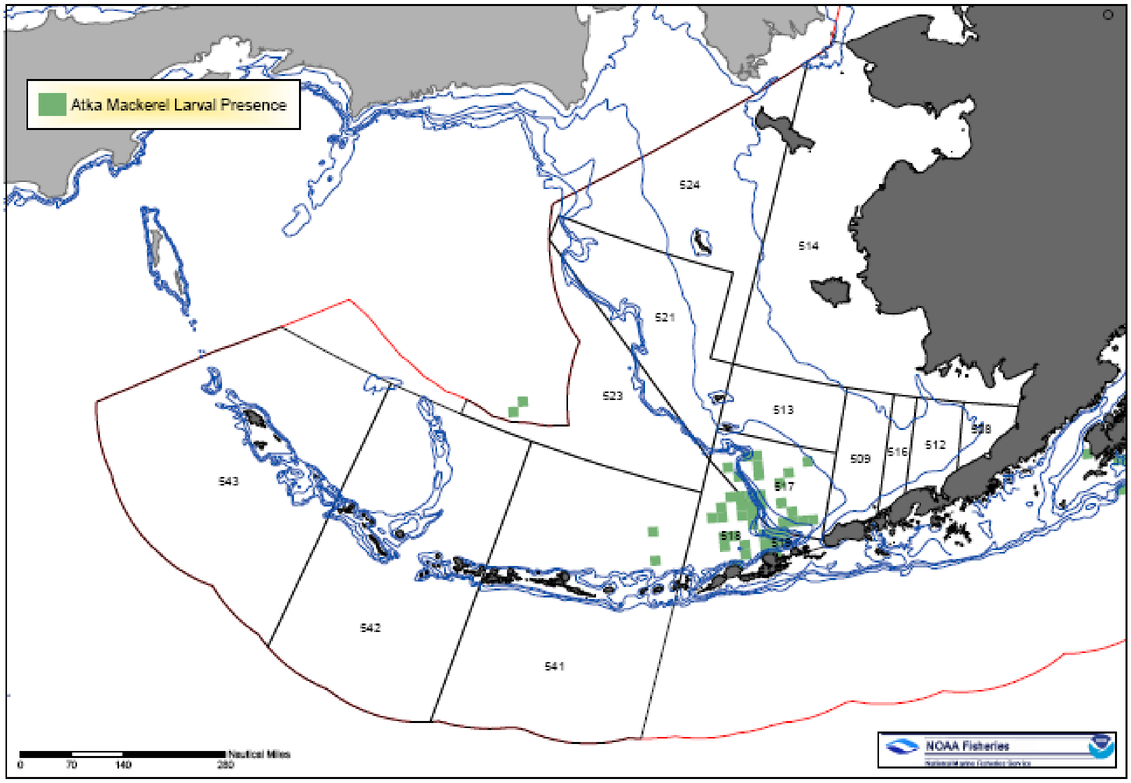


Figure E-30 EFH Distribution - BSAI Atka Mackerel (Adults)

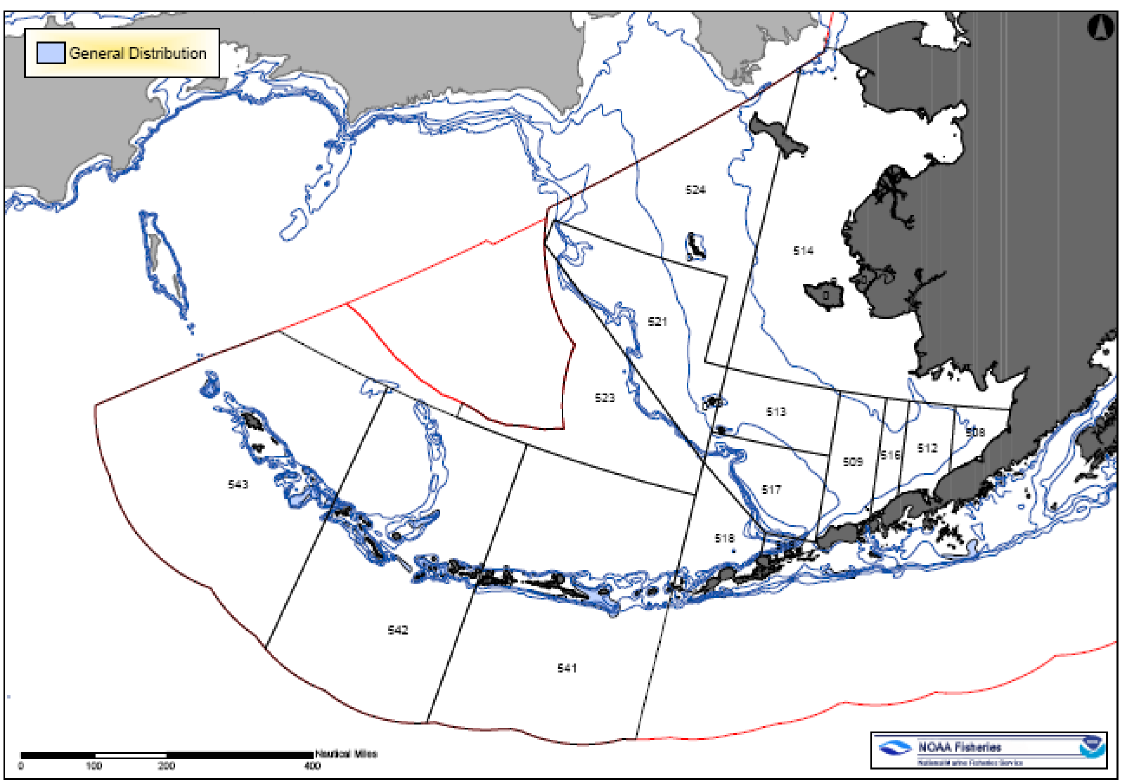


Figure E-31 EFH Distribution - BSAI Skate (Adults)

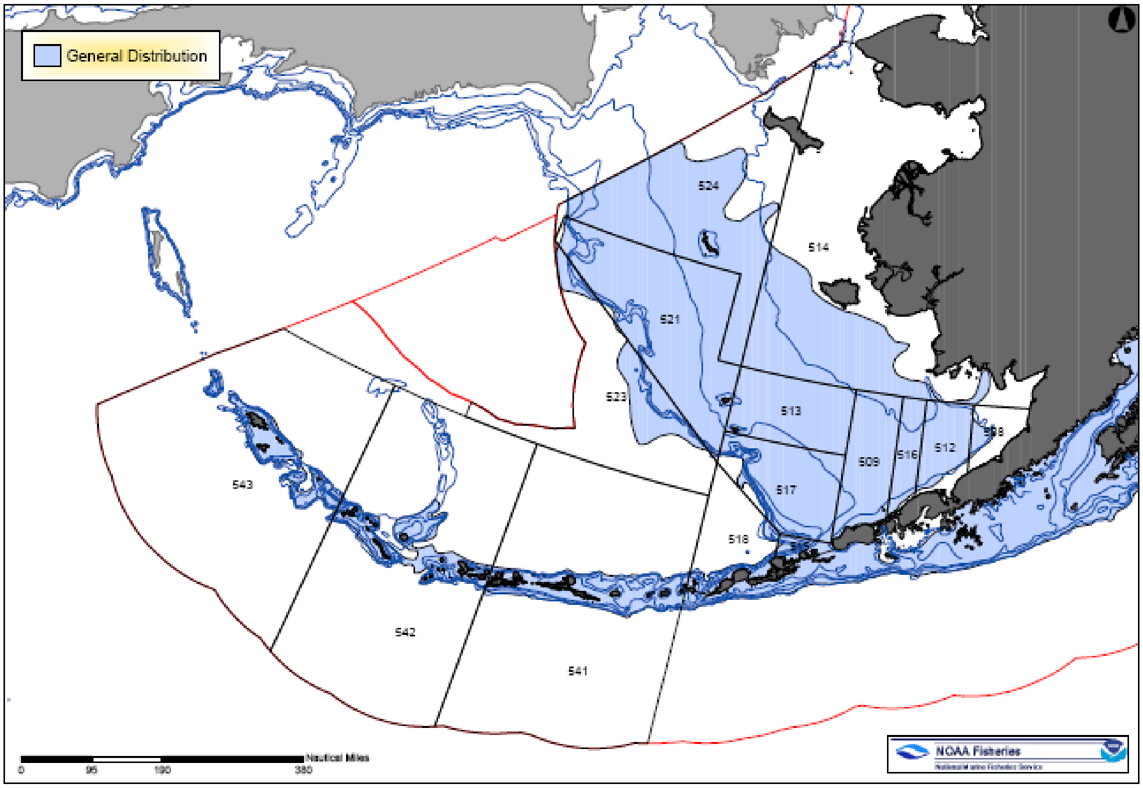


Figure E-32 EFH Distribution - BSAI Sculpin (Adults)

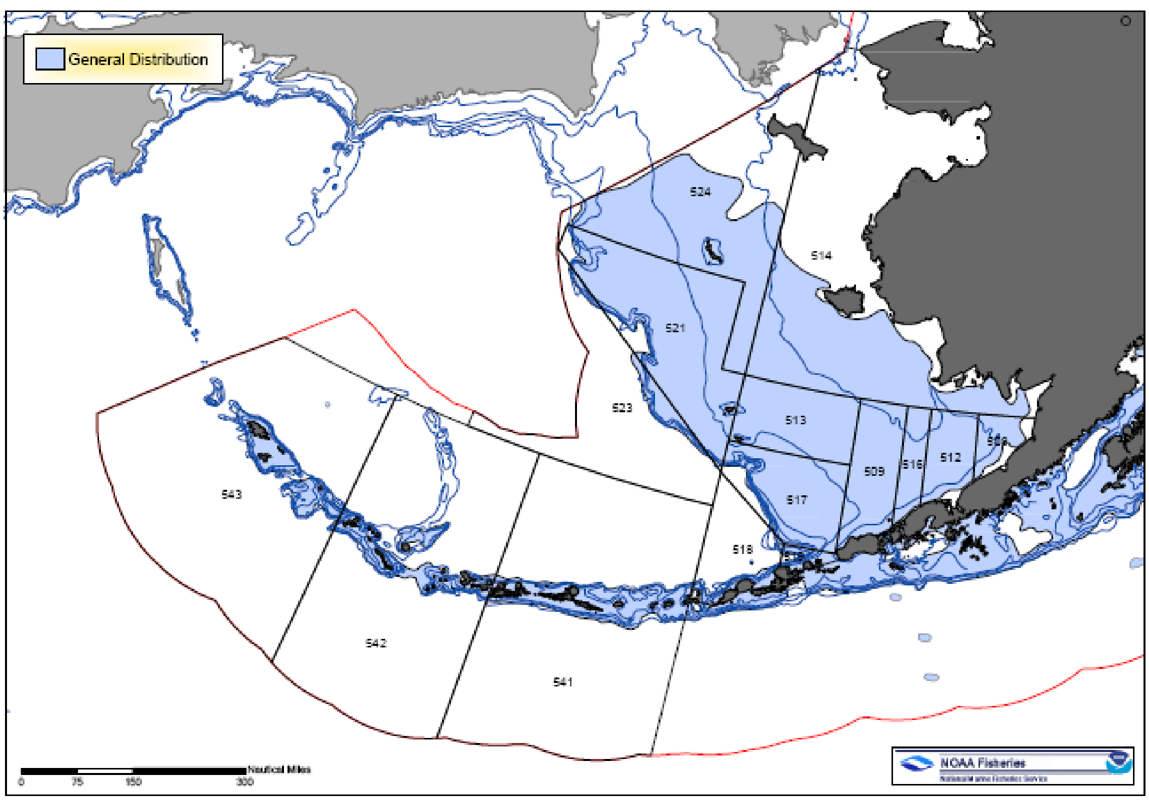
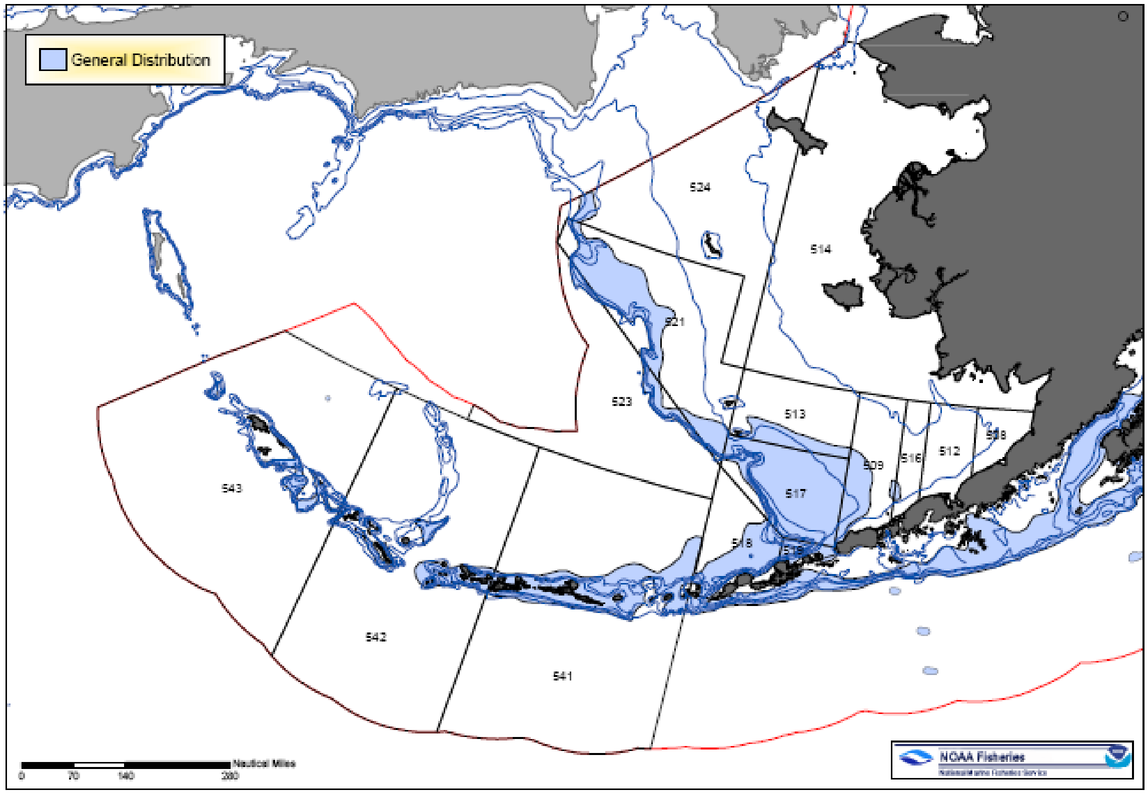


Figure E-33 EFH Distribution – BSAI Squid (Late Juveniles/Adults)



Appendix F Adverse Effects on Essential Fish Habitat

This appendix includes a discussion of fishing (Section F.1) and non-fishing (Section F.2) activities that may adversely affect essential fish habitat (EFH) for Bering Sea and Aleutian Islands (BSAI) groundfish, as well as a discussion of the potential impact of cumulative effects on EFH (Section F.3).

F.1 Fishing Activities that may Adversely Affect Essential Fish Habitat

F.1.1 Overview

This appendix addresses the requirement in Essential Fish Habitat (EFH) regulations (50 Code of Federal Regulations [CFR] 600.815(a)(2)(i)) that each FMP must contain an evaluation of the potential adverse effects of all regulated fishing activities on EFH. This evaluation must 1) describe each fishing activity, 2) review and discuss all available relevant information, and 3) provide conclusions regarding whether and how each fishing activity adversely affects EFH. Relevant information includes the intensity, extent, and frequency of any adverse effect on EFH; the type of habitat within EFH that may be affected adversely; and the habitat functions that may be disturbed.

In addition, the evaluation should 1) consider the cumulative effects of multiple fishing activities on EFH, 2) list and describe the benefits of any past management actions that minimize potential adverse effects on EFH, 3) give special attention to adverse effects on habitat areas of particular concern (HAPCs) and identify any EFH that is particularly vulnerable to fishing activities for possible designation as HAPCs, 4) consider the establishment of research closure areas or other measures to evaluate the impacts of fishing activities on EFH, 5) and use the best scientific information available, as well as other appropriate information sources.

This evaluation assesses whether fishing adversely affects EFH in a manner that is more than minimal and not temporary in nature (50 CFR 600.815(a)(2)(ii)). This standard determines whether Councils are required to act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable.

Much of the material supporting this evaluation is located in the following sections of the environmental impact statement (EIS) for EFH (NMFS 2005). These areas include:

- Descriptions of fishing activities (including gear, intensity, extent and frequency of effort) - Sections 3.4.1 and 3.4.2.
- Effects of fishing activities on fish habitat - Section 3.4.3.
- Past management actions that minimize potential adverse effects on EFH - Sections 2.2 and 4.3.
- Habitat requirements of managed species - Sections 3.2.1, 3.2.2, and Appendices D and F.
- Features of the habitat - Sections 3.1, 3.2.4 and 3.3.
- HAPCs - 2.2.2.7, 2.2.2.8, 2.3.2, and 4.2

Appendix B of the EFH EIS also contains a comprehensive, peer-reviewed analysis of fishing effects on EFH and detailed results for each managed species. This FMP incorporates by reference the complete analysis in Appendix B of the EFH EIS and summarizes the results for each managed species.

Section B.1 of Appendix B of the EFH EIS has a detailed discussion regarding the relevant rules and definitions that must be considered in developing the fishing effects on EFH analysis. The analysis is based on determining whether an effect on EFH is more than minimal and not temporary (50 CFR 600.815(a)(2)(ii)).

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

A mathematical model was developed as a tool to structure the relationships among available sources of information that may influence the effects of fishing on habitat. This model was designed to estimate proportional effects on habitat features that would persist if current fishing levels were continued until affected habitat features reached an equilibrium with the fishing effects. Details on the limitations and uncertainties of the model and the process used by the analyst are in Section B.1 of Appendix B of the EFH EIS (NMFS 2005).

F.1.2 Effects of Fishing Analysis

Section B.2 of Appendix B of the EFH EIS (NMFS 2005) contains details on the fishing effects on EFH analysis. Fishing operations can adversely affect the availability of various habitat features for use by fish species. Habitat features are those parts of the habitat used by a fish species for the processes of spawning, breeding, feeding, or growth to maturity. A complex combination of factors influences the effects of fishing on habitat features, including the following:

(1) Intensity of fishing effort

(2) Sensitivity of habitat features to contact with fishing gear

(3) Recovery rates of habitat features

(4) Distribution of fishing effort relative to different types of habitat

The goal of this analysis was to combine available information on each of these factors into an index of the effects of fishing on features of fish habitat that is applicable to issues raised in the EFH regulations.

The effects of fishing on recovery for EFH is described by the long term effect index (LEI). Features that recover very quickly could achieve a small LEI under any fishing intensity. Features that recover very slowly may have a high LEI even with small rates of fishing effects. The LEI is used in the summaries to describe the fishing effects on EFH for managed species. The LEI scores represent the ability of fishing to reduce however much of each feature was present in an area as a proportional reduction. LEIs were calculated for all areas where fishing occurred, including some areas where the subject feature may never have existed.

Section B.2.4.3 of Appendix B of the EFH EIS contains information regarding recovery rates for various habitat types. Long and short recovery times were 3 to 4 months for sand, 6 to 12 months for sand/mud, and 6 to 18 months for mud habitats. In general, very little data are available on the recovery periods for living structure. Recovery rates of structure-forming invertebrates associated with the soft bottom, based on their life history characteristics, is estimated at 10 to 30 percent per year with a mean of 20 percent per year. Hard-bottom recovery rates are estimated to be slower, 1 to 9 percent per year, with a mean of 5 percent per year based on hard-bottom invertebrate life history characteristics. Recovery rates of gorgonian corals are potentially much longer, with rates of 50, 100, and 200 years estimated.

The habitat and regional boundaries were overlaid using geographic information systems (GIS) (ArcMap), resulting in the classification of each of the 5-by-5-km blocks by habitat type. Where a boundary passed through a block, the area within each habitat was calculated, and those areas were analyzed separately. For the GOA and AI habitats, the estimates of proportions of hard and soft substrate habitat types were entered into the classification matrix for each block. The total area of each benthic habitat was calculated through GIS based on coastlines, regional boundaries, habitat boundaries, and depth contours (Table B.2-7 of the EFH EIS).

Additional details on the quantity and quality of data and studies used to develop the analysis, how the analysis model was derived and applied, and considerations for the LEIs are contained in Section B.2 of Appendix B of the EFH EIS.

F.1.3 Fishing Gear Impacts

The following sections summarize pertinent research on the effects of fishing on seafloor habitats.

F.1.3.1 Bottom Trawls

The EFH EIS effects of fishing analysis evaluates the effects of bottom trawls on several categories of habitats: infaunal prey, epifaunal prey, living structure, hard corals, and nonliving structure.

Infaunal Prey

Infaunal organisms, such as polychaetes, other worms, and bivalves, are significant sources of prey for Alaska groundfish species. Because researchers were not able to determine which crustaceans cited in trawl effects studies were actually infauna, all crustaceans were categorized as epifaunal prey. Studies of the effects of representative trawl gear on infauna included Kenchington et al. (2001), Bergman and Santbrink (2000), Brown (2003), Brylinsky et al. (1994), and Gilkinson et al. (1998).

Kenchington et al. (2001) examined the effects on over 200 species of infauna from trawl gear that closely resembled the gear used off of Alaska. Three separate trawling events were conducted at intervals approximating 1 year. Each event included 12 tows through an experimental corridor, resulting in an average estimate of three to six contacts with the seafloor per event. Of the approximately 600 tests for species effects conducted, only 12 had statistically significant results. The statistical methods were biased toward a Type 1 error of incorrectly concluding an impact. Ten of the significant results are from a year when experimental trawling was more concentrated in the center of the corridors where the samples of infauna were taken. It is likely that more trawl contacts occurred at these sampled sites than the 4.5 estimate (average of three to six contacts) used to adjust the multiple contact results. As such, the results that were available from the study (non-significant values were not provided) represent a sample biased toward larger reductions when used to assess median reductions of infauna. The resulting median effect was 14 percent reduction in biomass.

Bergman and Santbrink (2000) studied effects on infauna (mostly bivalves) from an otter trawl equipped with 20-centimeter (cm) rollers in the North Sea. Because the study was conducted on fishing grounds with a long history of trawling, the infaunal community may already have been affected by fishing. Experimental trawling was conducted to achieve average coverage of 1.5 contacts within the experimental area over the course of the study. Results were provided for two substrate types: coarse sand with 1 to 5 percent of the area contacted, and silt and fine sand with 3 to 10 percent of the area contacted. The five infauna biomass reductions in the first area had a median of 8 percent. The ten infauna biomass reductions from the second area had a median of 5 percent.

In a recent master's thesis, Brown (2003) studied the effects of experimental trawling in an area of the nearshore EBS with sandy sediments. Trawling covered 57 percent of the experimental area. Several bivalves had lower abundance after trawling, while polychaetes were less affected. The median of the reduction in percentages for each species, after adjusting for coverage, was a 17 percent reduction in biomass per gear contact.

Brylinsky et al. (1994) investigated effects of trawling on infauna, mainly in trawl door tracks, at an intertidal estuary. Only three results were provided for infauna in roller gear tracks, but the results were so variable (-50 percent, +12 percent, +57 percent) that they were useless for the purpose of this analysis. Eight results on the effects of trawl doors on species biomass were available for polychaetes and nemerteans. These results had a median of 31 percent reduction in biomass and a 75th percentile of 42 percent reduction in biomass. Gilkinson et al. (1998) used a model trawl door on a prepared substrate to estimate that 64 percent of clams in the door's path were exposed after one pass, but only 5 percent were injured. Doors make up less than 4 percent of the area of the seafloor contacted by Alaska trawls.

The results of Kenchington et al. (2001), Bergman and Santbrink (2000), and Brown (2003) were combined for inclusion in the model, resulting in a median of 10 percent reduction in biomass per gear contact for infaunal species due to trawling, and 25th and 75th percentiles of 5 and 21 percent, respectively (Table B.2-5 of the EFH EIS).

Epifaunal Prey

Epifaunal organisms, such as crustaceans, echinoderms, and gastropods, are significant prey of Alaska groundfish species. However, one of the most common classes of echinoderms, asteroids, are rarely found in fish stomachs. While some crustaceans may be infauna, an inability to consistently identify these species resulted in all crustaceans being categorized as epifaunal prey. Studies of the effects of representative trawl gear on epifauna included Prena et al. (1999), Brown (2003), Freese et al. (1999), McConnaughey et al. (2000), and Bergman and Santbrink (2000).

Prena et al. (1999), as a component of the Kenchington et al. (2001) study, measured the effects of trawling on seven species of epifauna. The median of these results was a 4 percent biomass reduction per gear contact. There appeared to be in-migration of scavenging crabs and snails in this and other studies. Removing crab and snails left only two measurements, 6 and 7 percent reductions in biomass. Bergman and Santbrink (2000) measured effects on four epifaunal species in the experimental coarse sand area (median reduction in biomass was 12 percent) and five epifaunal species in the experimental fine sand area (median reduction in biomass was 16 percent). When crabs and snails were removed, the coarse sand area was unchanged, and the median value for the fine sand area was 15 percent biomass reduction. Brown (2003) studied six epifaunal species, resulting in a median reduction in biomass per gear contact of 5 percent. Combining results from Prena et al. (1999), Brown (2003), and Bergman and Santbrink (2000), and removing crabs and snails, gives a median reduction in biomass of epifaunal species of 10 percent, and 25th and 75th percentiles of 4 and 17 percent, respectively. These are the q values (proportion of the contacted elements that are made unavailable, due to damage, removal, or mortality) used for the analysis of the effects of full trawls on epifaunal prey, except for those fisheries using tire gear (see below).

The study of McConnaughey et al. (2000) compared the effects of fishing on an area that received heavy fishing pressure between 4 and 8 years previously, using an adjacent unfished area as a control. Therefore, results included a combination of species reductions and recovery, were not adjusted for multiple contacts, and were not directly comparable to the results of the studies above. However, for comparison with previously discussed studies, the resulting median and 75th percentile reductions in biomass for six species of epifauna (excluding snails and crabs) were 12 and 28 percent, respectively. The median result was within the same range as those from the more direct studies, and the 75th percentile result was not sufficiently higher as to indicate substantial error in the direct estimates.

Freese et al. (1999) studied the effects of tire gear on the epifauna of a pebble and boulder substrate. Eight epifaunal species gave a median response of 17 percent reduction in biomass and a 75th percentile of 43 percent reduction in biomass. Before snails were removed, the 25th percentile indicated an increase in biomass of 82 percent due to colonization by snails. The resulting values when two snail taxa were removed were 38 and 43 percent medians and a 5 percent reduction in epifaunal biomass for the 75th and 25th percentiles. The authors noted a strong transition to apparently smaller effects outside of the direct path of the tire gear. For fisheries in hard-bottom areas, where tire gear is most common, epifaunal effects were adjusted for this increased effect within the path of the tire gear. Typical tire gear covers about 25 percent of the full trawl path (i.e., 14 m out of 55 m total), so the resulting q values are 17 percent reduction in epifaunal biomass for the median (0.25 times 38 plus 0.75 times 10), 23 percent reduction for epifaunal biomass for the 75th percentile (0.25 times 43 plus 0.75 times17), and 5 percent reduction for the 25th percentile.

Living Structure

Organisms that create habitat structure in Alaska waters include sponges, bryozoans, sea pens, soft and stony corals, anemones, and stalked tunicates. Studies of the effects of representative trawls on these groups include Van Dolah et al. (1987), Freese et al. (1999), Moran and Stephenson (2000), Prena et al. (1999), and McConnaughey et al. (2000). The first three studies examined the effects on epifauna on substrates such as pebble, cobble, and rock that support attached erect organisms, while the last two studies were located on sandy substrates. Effect estimates were available for only one type of structure-providing organism, the soft coral *Gersemia*, from Prena et al. (1999). After adjustment for multiple contacts, *Gersemia* had a q of 10 percent reduction in biomass per gear contact.

Both the Van Dolah et al. (1987) and Freese et al. (1999) studies identified removal rates and rates of damage to organisms remaining after contact, raising the question of how damage incurred from contact with gear reduces the structural function of organisms. In Freese et al. (1999), sponges were indicated as damaged if they had more than 10 percent of the colony removed, or if tears were present through more than 10 percent of the colony length. Van Dolah et al. (1987) classified organisms as heavily damaged (more than 50 percent damage or loss) or lightly damaged (less than 50 percent damage or loss). Lacking better information, the damaged organisms from Freese et al. (1999) were assigned a 50 percent loss of structural function, and the heavily and lightly damaged organisms from VanDolah et al. (1987) were assigned 75 and 25 percent losses of their function respectively.

Adjustments to the Freese et al.(1999) results were based on observations of a further decrease in vase sponge densities 1 year post-study. Freese (2001) indicates that some of the damaged sponges had suffered necrotization (decay of dead tissues) to the extent that they were no longer identifiable. This percentage was added to the category of removed organisms, resulting in q estimates for epifauna structures in the path of tire gear of a 35 percent median reduction in biomass per contact and a 75th percentile of 55 percent reduction in biomass per contact. Summary results of the VanDolah data show a median of 17 percent reduction in biomass per gear contact and a 75th percentile of 22 percent reduction in biomass per gear contact. Moran and Stephenson (2000) combined all erect epifauna taller than 20 cm and studied their reductions subsequent to each of a series of trawl contacts. They estimated a per contact reduction in biomass (q) of 15 percent. Combining the non-tire gear studies gives a full gear q median per contact reduction estimate of 15 percent and a 75th percentile per contact reduction estimate of 21 percent. Using the same methods as applied to epifauna for combining non-tire gear data with the tire gear data produced effect estimates for trawls employing tire gear of a median per contact reduction of 20 percent and a 75th percentile per contact reduction of 30 percent.

Data from McConnaughey et al. (2000) combining initial effects of high-intensity trawling and recovery had a median value for structure-forming epifauna per contact reduction of 23 percent and a 75th percentile reduction of 44 percent. While these results show greater reductions than the single pass estimates from the other studies, the effects of multiple years of high-intensity trawling can reasonably account for such a difference; thus, the above values for q were not altered.

Hard Corals

While numerous studies have documented damage to hard corals from trawls (e.g., Fossa 2002, Clark and O'Driscoll 2003), only one (Krieger 2001) was found that related damage to a known number of trawl encounters. Fortunately, this study occurred in the GOA with a common species of gorgonian coral (*Primnoa rubi*) and with gear not unlike that used in Alaska commercial fisheries. Krieger used a submersible to observe a site where large amounts of *Primnoa* were caught during a survey trawl. An estimated 27 percent of the original volume of coral was removed by the single trawl effort. The site was in an area closed to commercial trawling, so other trawling effects were absent. This value was used for coral sensitivity in the analysis bracketed by low and high values of 22 and 35 percent.

Non-living Structure

A variety of forms of the physical substrates in Alaska waters can provide structure to managed species, particularly juveniles. These physical structures range from boulder piles that provide crevices for hiding to sand ripples that may provide a resting area for organisms swimming against currents. Unfortunately, few of these interactions are understood well enough to assess the effects of substrate changes on habitat functions. A number of studies describe changes to the physical substrates resulting from the passage of trawls. However, there is no consistent metric available to relate the use of such structures by managed species to their abundance or condition. This lack of relationship effectively precludes a quantitative description of the effects of trawling on non-living structure. The following discussion describes such effects qualitatively and proposes preliminary values of q for the analysis.

Sand and Silt Substrates:

Schwinghamer et al. (1998) described physical changes to the fine sand habitats caused by trawling as part of the same study that produced Prena et al. (1999) and Kenchington et al. (2001). Door tracks, approximately 1 m wide and 5 cm deep, were detected with sidescan sonar, adding to the surface relief of the relatively featureless seafloor. Finer scale observations, made with video cameras, indicated that trawling replaced small hummocky features a few cm tall with linear alignments of organisms and shell hash. A dark organic floc that was present before trawling was absent afterwards. While no changes in sediment composition were detected, measurements of the internal structure of the top 4.5 cm of sediment were interpreted to indicate loss of small biogenic sediment structures such as mounds, tubes, and burrows. Brylinsky et al. (1994) describe trawl tracks as the most apparent effect of trawls on a silty substrate and the tracks of rollers as resulting in much shallower lines of compressed sediment than tracks of trawls without rollers. A wide variety of papers describes trawl marks; these papers include Gilkinson et al. (1998), who describe the scouring process in detail as part of a model door study.

For effects on sedimentary forms, the action of roller gear trawls replaces one set of cm-scale forms, such as hummocks and sand ripples, with door and roller tracks of similar scales. In habitats with an abundance of such structures, this can represent a decrease in seabed complexity, while in relatively smooth areas, an increase in complexity will result (Smith et al. 2000). The effects on internal sediment structure are considered too small in scale to provide shelter directly to the juveniles of managed species. The extent to which they affect the availability of prey for managed species is better measured by directly considering the abundance or those prey species. This consideration was done by studies cited in the prey sections above. Since the observed effects of a single gear contact are relatively subtle, with ambiguous effects on function, the parameter selected for this analysis represents a small negative effect (-2 percent). This provides some effect size that can be scaled up or down if greater or lesser effects are hypothesized or measured.

Pebble to Boulder Substrates:

In substrates composed of larger particles (large pebbles to boulders), the interstitial structure of the substrate has a greater ability to provide shelter to juveniles and adults of managed species. The association of species aggregations with such substrates provides evidence of their function as structure (Krieger 1992, 1993). Freese et al. (1999) documented that the tire gear section of a trawl disturbed an average of 19 percent of the large boulders (more than 0.75-m longest axis) in its path. They noted that displaced boulders can still provide cover, while breaking up boulder piles can reduce the number and complexity of crevices.

In areas of smaller substrate particles (pebble to cobble), the track of the tire gear was distinguishable from the rest of the trawl path due to the removal of overlying silt from substrates with more cobble or the presence of a series of parallel furrows 1 to 8 cm deep from substrates with more pebble. Of the above effects, only breaking up boulder piles was hypothesized to decrease the amount of non-living functional structure for managed species. A key unknown is the proportional difference in functional structure between boulder piles and the same boulders, if separated. If that difference comprised 20 percent of the functional structure, and 19 percent of such piles were disturbed over one-third of the trawl paths (tire gear section), a single trawl pass would reduce non-living structure by only about 1 percent. Even if piles in the remaining trawl path were disturbed at half the rate of those in the path of the tire gear (likely an overestimate from descriptions in Freese et al. 1999), the effect would only increase to 2 percent. Lacking better information, this speculative value was applied in the analysis.

F.1.3.2 Pelagic Trawls

Studies using gear directly comparable to Alaska pelagic trawls, and thus identifying the resulting effect of such gear contact with the seafloor, are lacking. By regulation, these trawls must not use bobbins or other protective devices, so footropes are small in diameter (typically chain or sometimes cable or wrapped cable). Thus, their effects may be similar to other footropes with small diameters (i.e., shrimp or Nephrops trawls). However, these nets have a large enough mesh size in the forward sections that few, if any, benthic organisms that actively swim upward would be retained in the net. Thus, benthic animals that were found in other studies to be separated from the bottom and removed by trawls with small-diameter footropes would be returned to the seafloor immediately by the Alaska pelagic trawls. Pelagic trawls are fished with doors that do not contact the seafloor, so any door effects are eliminated. Finally, because the pelagic trawl's unprotected footrope effectively precludes the use of these nets on rough or hard substrates, they do not affect the more complex habitats that occur on those substrates.

Two studies of small footrope trawls were used to represent the effects of pelagic trawl footropes on infaunal prey. Since most infaunal prey are too small to be effectively retained by bottom trawls, the large mesh size of pelagic trawls was not considered a relevant difference for the feature. Ball et al. (2000) investigated the effects of two tows of a Nephrops trawl in the Irish Sea on a muddy sand bottom in two different years. Eighteen taxonomic groups were measured in each year, including bivalves, gastropods, crustaceans, and annelids. For the 27 abundance reductions cited, the median effect was a 19 percent reduction abundance per gear contact, and the 75th percentile was a 40 percent reduction in abundance per gear contact, with the adjustment for multiple tows. Sparks-McConkey and Wating (2001) used four passes of a whiting trawl on a clay-silt bottom in the Bay of Maine. The infauna responses measured included three bivalves and seven polychaetes and nemerteans. The median response was a 24 percent reduction in abundance per gear contact, and the 75th percentile was a 31 percent reduction in abundance per gear contact, with the adjustment for multiple tows. Combining the two studies gave a median per contract reduction of 21 percent and a 75th percentile per contact reduction of 36 percent. These values were higher than those for roller gear trawls since there is continuous contact across the footrope and a greater ability of smaller footropes to penetrate the substrate.

Sessile organisms that create structural habitat may be uprooted or pass under pelagic trawl footropes, while those that are more mobile or attached to light substrates may pass over the footrope, with less resulting damage. Non-living structures may be more affected by pelagic trawl footropes than by bottom trawl footropes because of the continuous contact and smaller, more concentrated, surfaces over which weight and towing force are applied. In contrast, bottom trawls may capture and remove more of the large organisms that provide structural habitat than pelagic trawls because of their smaller mesh sizes. The bottom trawl doors and footropes could add complexity to sedimentary bedforms as mentioned previously, while pelagic trawls have an almost entirely smoothing effect. Based on these considerations, values of 20 percent reduction per gear contact and 30 percent reduction per gear contact were selected for both living and non-living structure.

F.1.3.3 Longlines

Studies that quantitatively assess the effects of longlines on seafloor habitat features were not found. Due to the light weight of the lines used with longline gear, effects on either infaunal or epifaunal prey organisms are considered to be limited to anchors and weights. Since these components make up less than 1/500th of the length of the gear, their effects are considered very limited (0.05 percent reduction per contact was the value used). Similarly, effects on the non-living structure of soft bottoms are also likely to be very limited.

Organisms providing structure may be hooked or otherwise affected by contact with the line. Observers have recorded anemones, corals, sea pens, sea whips, and sponges being brought to the surface hooked on longline gear (Stellar sea lion protection measures SEIS, 2001), indicating that the lines move some distance across the seafloor and can affect some of the benthic organisms. The effects on non-living structure in hard-bottom areas due to hang-ups on smaller boulder piles and other emergent structures are limited to what may occur at forces below those necessary to break the line. Similar arguments to those used for bottom trawl effects on hard non-living structure would justify an even lower effect than the value generated for bottom-trawling (1 percent). Unfortunately, there are no data to indicate what proportion the retained organisms represent of those contacted on the seafloor or the level of damage to any of the affected organisms. Values for reduction of living structure equal to one-half of those for bottom trawls were used for the area contacted by longlines.

F.1.3.4 Pots

The only studies on pots (Eno et al. 2001) have examined gear much smaller and lighter than that used in Alaska waters and are, thus, not directly applicable in estimating effects of pots on habitat. Alaska pots are approximately 110 times as heavy and cover 19 times the area as those used by Eno et al. (2001) (2.6 kilograms [kg], 0.25 m^2). The Eno et al. (2001) study did show that most sea pens recovered after being pressed flat against the bottom by a pot. Most Alaska pots have their mesh bottoms suspended 2.5 to 5 cm above their weight rails (lower perimeter and cross pieces that contact the substrate first); hence, the spatial extent to which the greater weight of those pots is applied to organisms located underneath the pots is limited, but more intense.

The area of seafloor disturbed by the weight rails is of the greatest concern, particularly to the extent that the pot is dragged across the seafloor by bad weather, currents, or during hauling. Based on the estimated weight of the pots in water, and the surface area of the bottom of these rails, the average pressure applied to the seafloor along the weight rails (about 1 pound per square inch [lb/in^2] [0.7 kilogram per square centimeter (kg/cm^2)]) is sufficient to penetrate into most substrates during lateral movement. The effects of pots as they move across the bottom were speculated to be most similar to those of pelagic trawls with smaller contact diameter and more weight concentrated on the contact surface. Therefore, structure reduction values 5 percent greater than those determined for pelagic trawls were used.

F.1.3.5 Dinglebar

Dinglebar troll gear (Figure 3-9 of the HAPC EA) consists of a single line that is retrieved and set with a power or hand troll gurdy, with a terminally attached weight (cannon ball -12 lbs. or iron bar), from which one or more leaders with one or more lures or baited hooks are pulled through the water while a vessels is underway (NPFMC 2003). Dinglebar troll gear is essentially the same as power or hand troll gear, the difference lies in the species targeted and the permit required. For example, dinglebar troll gear can be used in the directed fisheries for groundfish (e.g. cod) or halibut. These species may only be taken incidentally while fishing for salmon with power or hand troll gear. There is a directed fishery for ling cod in Southeast Alaska using dinglebar troll gear. Trolling can occur over any bottom type and at almost any depths. Trollers work in shallower coastal waters, but may also fish off the coast, such as on the Fairweather Grounds. The dinglebar is usually made of a heavy metal, such as iron, is used in nearly continuous contact with the bottom, and therefore, is likely to disturb bottom habitat.

F.1.3.6 Dredge Gear

Dredging for scallops may affect groundfish habitat by causing unobserved mortality to marine life and modification of the benthic community and sediments. Similar to trawling, dredging places fine sediments into suspension, buries gravel below the surface and overturns large rocks that are embedded in the substrate (NEFMC 1982, Caddy 1973). Dredging can also result in dislodgement of buried shell material, burying of gravel under re-suspended sand, and overturning of larger rocks with an appreciable roughening of the sediment surface (Caddy 1968). A study of scallop dredging in Scotland showed that dredging caused significant physical disturbance to the sediments, as indicated by furrows and dislodgement of shell fragments and small stones (Eleftheriou and Robertson 1992). The authors note, however, that these changes in bottom topography did not change sediment disposition, sediment size, organic carbon content, or chlorophyll content. Observations of the Icelandic scallop fishery off Norway indicated that dredging changed the bottom substrate from shell-sand to clay with large stones within a 3-year period (Aschan 1991). Mayer et al. (1991), investigating the effects of a New Bedford scallop dredge on sedimentology at a site in coastal Maine, found that vertical redistribution of bottom sediments had greater implications than the horizontal translocation associated with scraping and plowing the bottom. The scallop dredge tended to bury surficial metabolizable organic matter below the surface, causing a shift in sediment metabolism away from aerobic respiration that occurred at the sediment-water interface and instead toward subsurface anaerobic respiration by bacteria (Mayer et al. 1991). Dredge marks on the sea floor tend to be short-lived in areas of strong bottom currents, but may persist in low energy environments (Messieh et al. 1991).

Two studies have indicated that intensive scallop dredging may have some direct effects on the benthic community. Eleftheriou and Robertson (1992), conducted an experimental scallop dredging in a small sandy bay in Scotland to assess the effects of scallop dredging on the benthic fauna. They concluded that while dredging on sandy bottom has a limited effect on the physical environment and the smaller infauna, large numbers of the larger infauna (molluscs) and some epifaunal organisms (echinoderms and crustaceans) were killed or damaged after only a few hauls of the dredge. Long-term and cumulative effects were not examined, however. Achan (1991) examined the effects of dredging for islandic scallops on macrobenthos off Norway. Achan found that the faunal biomass declined over a four-year period of heavy dredging. Several species, including urchins, shrimp, seastars, and polychaetes showed an increase in abundance over the time period. In summary, scallop gear, like other gear used to harvest living aquatic resources, may effect the benthic community and physical environment relative to the intensity of the fishery.

Adverse effects of scallop dredges on benthic communities in Alaska may be lower in intensity than trawl gear. Studies on effects of trawl and dredge gear have revealed that, in general, the heavier the gear in contact with the seabed, the greater the damage (Jones 1992). Scallop dredges generally weigh less than most trawl doors, and the relative width they occupy is significantly smaller. A 15 ft wide New Bedford style scallop dredge weighs about 1,900 lbs (Kodiak Fish Co. data). Because scallop vessels generally fish two dredges, the total weight of the gear is 3,800 lbs. Trawl gear can be significantly heavier. An 850 horsepower vessel pulling a trawl with a 150 ft sweep may require a pair of doors that weigh about 4,500 pounds. Total weight of all trawl gear, including net, footrope, and mud gear would weigh even more (T. Kandianis, personal communication). Hence, based on weight of gear alone, scallop fishing may have less effect than bottom trawling, however its effects may be more concentrated.

F.1.4 Results of the Analysis of Effects of Fishing on Habitat Features

No fishing occurred in blocks covering a large proportion of the seafloor area shallower than 1,000 m from 1998 to 2002 (Table B.2-8 of the EFH EIS), and even more blocks were unaffected by trawling. Most of the fished blocks experienced intensities less than 0.1, and only a small proportion of the area (2.5 percent BS, 0.8 percent AI, and 0.9 percent GOA) was in blocks with intensities above 1.0. These fishing intensities determined the spatial distribution of the indices of fishing effects estimated by the model.

The analysis estimated an LEI of the effects of fishing on infaunal prey, epifaunal prey, living structure (coral treated separately), and non-living structure across different habitats and between fisheries. The LEI estimated the percentage by which these habitat features would be reduced from a hypothetical unfished abundance if recent intensity and distribution of fishing effort were continued over a long enough term to achieve equilibrium. Equilibrium is defined as a point where the rate of loss of habitat features from fishing effects equal the gain from feature recovery. The spatial pattern of long-term effect indices largely reflects the distribution of fishing effort scaled by the sensitivity and recovery rates assigned to different features in different habitat types. Thus, patterns on the charts of LEI for each feature class were very similar, with higher overall LEIs for more sensitive or slower recovering features (Figures B.2-2 to B.2-5 of the EFH EIS). Prey LEIs were substantially lower than structure LEIs, reflecting their lower sensitivity and faster recovery rates.

All habitats included substantially unfished and lightly fished areas that have low LEIs (less than 1 percent) as well as some areas of high fishing that resulted in high LEIs (more than 50 percent or even more than 75 percent). In the AI, GOA, and EBS slope, substantial LEIs were primarily concentrated into many small, discrete pockets. On the EBS shelf, there were two larger areas where high LEIs were concentrated: (1) an area of sand/mud habitat between Bristol Bay and the Pribilof Islands and (2) an area of sand habitat north of Unimak Island and Unimak Pass, mostly inside of the 100-m contour.

Some of the patterns in fishing effects can be related to areas closed to bottom trawl fishing. In the GOA, no bottom trawling is allowed east of 140ºE longitude, and fishing effects are light there. Bottom trawling has been substantially restricted within specified radii (10 and 20 nm) of Steller sea lion rookeries and haulouts. The effects of these actions on LEI values are most clearly seen in the AI, where high LEI values are concentrated in small patches where the narrow shelf does not intersect these closures. Two large EBS areas around the Pribilof Islands and in and adjacent to Bristol Bay both mostly in sand substrates, are closed to bottom trawling to protect red king crab habitat. These closures concentrate fishing in the southern part of the EBS into the remaining sand, sand/mud, and slope habitats, which likely increases the predicted LEI in those areas.

Aggregate LEIs for each of the habitats are shown in Table B.2-9 of the EFH EIS. As discussed above, prey declined less than biostructure due to lower sensitivity and faster recovery rates. No prey feature was reduced by more than 3.5 percent (BS slope habitat). Biological structure features had LEIs between 7 and 9 percent in the hard substrate habitats where recovery rates were slow. LEIs above 10 percent were indicated for the biological structure of the sand/mud and slope habitats of the EBS where fishing effort is concentrated, and recovery rates are moderately slow.

Because of uncertainties in key input parameters, some evaluation was needed to determine how widely the resulting estimates might vary. In addition to the LEIs cited above, which were generated with median or central estimates for each input parameter (referred to below as central LEIs), LEI was estimated for both large and small values of sensitivity and recovery. High estimates of sensitivity were combined with low recovery rates to provide an upper LEI, and low estimates of sensitivity were combined with high recovery rates to produce a lower LEI. Lower LEIs for the habitat features (except for coral, which is discussed below) ranged from 8 to 50 percent of the original median estimates. Infaunal and epifaunal prey lower LEIs were all at or below 0.5 percent proportional reduction habitat, those for non-living structure were below 2 percent, and those for living structure were below 4 percent. The corresponding upper LEIs ranged from 1.5 to 3 times the original median estimate. The largest upper LEI values for infauna and epifauna prey were for the EBS sand/mud and slope habitats and ranged from 3.5 to 7 percent, with all other upper LEIs below 2 percent. Non-living structure upper LEIs were greatest on the GOA hard substrates, the AI shallow water habitat, and the EBS slope, ranging from 7 to 14 percent, with all other upper LEIs below 4 percent. In six habitats (the three GOA hard substrates, the AI shallow water habitats, and the EBS sand/mud and slope habitats), the upper LEI exceeded 10 percent, with the highest value (21 percent) on the GOA slope.

The analysis also calculated the proportion of each LEI attributable to each fishery. Fishery-specific LEI values for the habitat/feature combinations with the highest overall LEIs (all involving living structure) in each region are presented in Table B.2-10 of the EFH EIS. While the pollock pelagic trawl fishery was the largest single component (4.6 percent) of the total effects on living structure in the EBS sand/mud habitat, the combined effects of the bottom trawl fisheries made up all of the remaining 6.3 percent (total LEI of 10.9 percent). This was not true for living structure on the EBS slope, where nearly all (7.2 percent out of 10.9 percent) of the LEI was due to the pollock pelagic trawl fishery. Living structure on hard bottom substrates of the GOA slope was affected by bottom trawling for both deepwater flatfish and rockfish. While the LEIs of these two fisheries were nearly equal, it is likely that much more of the rockfish effort occurred on hard substrates as compared with trawling for deepwater flatfish. [Because the spatial distribution of hard and soft substrate was unknown, such differences are not explicitly accounted for in the fishing effects analysis.] Therefore, most of the effects on this feature were attributed to the rockfish trawl fishery. In the shallow, hard substrate habitat of the AI, most of the effects (4.2 out of 7.3 percent) on living structure were attributable to the trawl fishery for Pacific cod. The remainder was attributed to Atka mackerel trawling at 2.5 percent. Living structure was the only habitat feature in which the effect of a passive gear fishery, longlining for Pacific cod, had an LEI above 0.1 percent. This fishery accounts for the consistent light blue (less than 1 percent LEI) coverage in Figure B.2-3 (a, b, and c) of the EFH EIS of many shallow areas of the AI not open to trawling.

Results for ultra-slow recovering structures, represented by hard corals, were different from those of other living structure in several ways. Corals had the highest LEI values of the fishing effects analyses. Because the very slow recovery rate of these organisms results in very high (more than 75 percent LEI) eventual effects with more than the most minimal amount of trawl fishing (annual trawl effort less than one tenth the area of the block), the distribution of high LEI values directly reflects the distribution of blocks subject to more than minimal trawl effort (Figure B.2-6 [a, b, and c] of the EFH EIS). The LEI values by habitat range from 6 to 20 percent with the highest values in the shallow AI and GOA slopes. These results mostly reflect the proportion of blocks in each habitat type subject to more than minimal trawl effort. Even though fairly wide ranges of both sensitivity and recovery rates were used for the upper and lower LEI estimates for coral, the range between upper and lower LEI was not as wide as for the other living structure organisms, ranging from plus 40 to -33 percent of the central value.

This analysis combined available information to assess the effects of Alaska fisheries on marine fish habitat. It estimated the effects (as measured by LEIs) of fisheries on habitat features that may be used by fish for spawning, breeding, feeding, or growth to maturity. These LEIs represent the proportion of feature abundances (relative to an unfished state) that would be lost if recent fishing patterns were continued indefinitely (to equilibrium). Therefore, all LEIs represent effects that are not limited in duration and satisfy the EFH regulation's definition of "not temporary." The magnitude and distribution of feature LEIs can, thus, be compared with the distribution of the use of that feature by fish species to assess whether the effects are "more than minimal" relative to that species' EFH (Section B.3 of the EFH EIS). Effects meeting this second element would necessarily meet both elements (more than minimal and not temporary) due to the nature of the LEI estimates.

Additional information regarding the LEI analysis, including the comparison of results to groundfish surveys and literature, the quality of information used, and the limitations of the results are in Section B.2.6 of Appendix B of the EFH EIS.

F.1.5 Evaluation of Effects on EFH of Groundfish Species

The fishing effects analysis is performed to evaluate whether the fisheries, as they are currently conducted off Alaska, will affect habitat that is essential to the welfare of the managed fish populations in a way that is more than minimal and not temporary. The previous statement describes the standard set in the EFH regulations which, if met, requires Councils to act to minimize such effects. The above analysis has identified changes to habitat features that are not expected to be temporary. The habitat features were selected as those which a) can be affected by fishing and b) may be important to fish in spawning, breeding, feeding, and growth to maturity. This section evaluates the extent that these changes relate to the EFH of each managed species and whether they constitute an effect to EFH that is more than minimal.

Two conclusions are necessary for this evaluation: (1) the definition of EFH draws a distinction between the amount of habitat necessary for a species to "support a sustainable fishery and the managed species' contribution to a healthy ecosystem" (50 CFR 600.10) and all habitat features used by any individuals of a species; (2) this distinction applies to both the designation of EFH and the evaluation of fishing effects on EFH. If these conclusions are valid, the "more than minimal" standard relates to impacts that potentially affect the ability of the species to fulfill its fishery and ecosystem roles, not just impacts on a local scale. The forgoing analysis has indicated substantial effects to some habitat features in some locations, many of which are within the spatial boundaries of the EFH of a species that may use them in a life-history function. These habitat changes may or may not affect the welfare of that species (a term used to represent "the ability of a species to support a sustainable fishery and its role in a healthy ecosystem").

The evaluation method is detailed in Section B.3.1 of Appendix B of the EFH EIS.

The Effects of Fishing on EFH analysis in the EFH EIS was designed to answer the question: "Is there evidence that fishing adversely affects EFH in a manner that is more than minimal and not temporary in nature?" The following text summarizes the results of the analysis for each managed species. The details of the analysis for each species, including the habitat connections and the evaluation of effects, are contained in Section B.3.3 of Appendix B of the EFH EIS (NMFS 2005) and are incorporated by reference.

F.1.5.1 Walleye Pollock (BSAI and GOA)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—Pollock is a generalist species that occupies a broad geographic niche and can use a wide variety of different habitats (Bailey et al. 1999). The ability of pollock to invade and adapt to marginal habitats has been suggested as a possible reason for the rapid increases in abundance during the environmental changes that occurred in the North Pacific in the 1970s (Bailey 2000). Pollock's ecological plasticity may allow adaption to habitats that have been modified by fishing impacts. Fishing impacts might even be beneficial, particularly if there are significant adverse impacts on predators or competitors more dependent on seafloor habitat features.

The overall evaluation of fishing impacts on pollock EFH is based primarily on extensive life history information that shows that pollock eggs, larvae, juveniles, and adults are not associated with seafloor habitat features affected by fishing. Some pollock life history stages are more demersal (i.e., age-1 juveniles), but even here the association is more likely related to temperature tolerances and avoidance of predators higher up in the water column than any characteristic of the bottom that can be impacted by trawling. The rating for fishing impacts on spawning/breeding for BSAI/GOA pollock is MT because pollock are pelagic spawners, as are their eggs and larvae. The rating for fishing impacts on feeding for BSAI/GOA pollock is MT because adults feed mainly on pelagic euphausiids followed by calanoid copepods.

The primary concern for pollock is the reduction in living structure in areas that support high pollock densities and its potential importance to juvenile pollock in providing refuge from predation. Changes in predation (or cannibalism) on juveniles have been proposed as a mechanism for population control in both the BSAI (Hunt et al. 2002) and the GOA (Bailey 2000). An increase in juvenile mortality will reduce spawning output per individual and, if large enough, could impair the ability of the stock to produce MSY over the long term (Dorn 2004). In the GOA, there is evidence of an increase in pollock mortality due to increases in the abundance of the dominant piscivores (Bailey 2000, Hollowed et al. 2000). However, evidence is weak that living structure plays a significant role in mediating mortality risk for juvenile pollock in the BSAI and the GOA, and it appears more likely that juveniles avoid predation risk through behavioral mechanisms such as shoaling and position in the water column. In addition, the overall reduction in living substrate for pollock EFH is relatively small (7 percent). Therefore, the rating for fishing impacts on growth to maturity for BSAI/GOA pollock is MT.

F.1.5.2 Pacific Cod (BSAI and GOA)

Issue	Evaluation
Spawning/Breeding	MT (Minimal or temporary effect)
Growth to Maturity	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)

Summary of Effects—Fishing's effects on the habitat of Pacific cod in the BSAI and GOA do not appear to have impaired either stocks' ability to sustain itself at or near the MSY level. When weighted by the proportions of habitat types used by Pacific cod, the long-term effect indices are low, particularly those of the habitat features most likely to be important to Pacific cod (infaunal and epifaunal prey). The fishery appears to have had minimal effects on the distribution of adult Pacific cod. Effects of fishing on weight at length, while statistically significant in some cases, are uniformly small and sometimes positive. While the fishery may impose some habitat-mediated effects on recruitment, these fall below the standard necessary to justify a rating of anything other than minimal or temporary.

F.1.5.3 Sablefish (GOA and BSAI)

Issue	Evaluation
Spawning/Breeding	MT
Growth to Maturity	U (Unknown)
Feeding	U (Unknown)

Summary of Effects—The estimated productivity and sustainable yield of sablefish have declined steadily since the late 1970s. This is demonstrated by a decreasing trend in recruitment and subsequent estimates of biomass reference points and the inability of the stock to rebuild to target biomass levels despite of the decreasing level of the targets and fishing rates below the target fishing rate. While years of strong young-of-the-year survival have occurred in the 1980s and 1990s, the failure of strong recruitment to the mature stage suggests a decreased survival of juveniles during their residence as 2- to 4-year-olds on the continental shelf. While climate-related changes are a possible cause for reduced productivity, the observations noted above are consistent with possible effects of fishing on habitat and resulting changes in the juvenile ecology of sablefish, possibly through increased competition for food and space. Given the concern for the decline in the sustainable yield of sablefish, the possibility of the role of fishing effects on juvenile sablefish habitat, and the need for a better understanding of the possible causes, an MT rating is not merited, and sablefish growth to maturity and feeding is rated unknown.

F.1.5.4 Atka Mackerel (BSAI and GOA)

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Growth to Maturity	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of Atka mackerel are considered to be minimal and temporary or negligible. Affected habitat areas may impact Atka mackerel, but environmental conditions may be the dominant factor affecting the Atka mackerel population, given the moderate exploitation levels since 1977. Environmental conditions since 1977 may favor Atka mackerel and override impacts of fishing on habitat features important to the species. Some information, however, suggests that bottom trawling may have a negative effect on the benthic habitat, especially corals and sponges. The LEI analysis indicates that there is a potential for large reductions in hard coral habitats, which intersect with Atka mackerel habitat, and Atka mackerel have been observed in association with sponges and corals. The extent and nature of the associations between AI Atka mackerel and living and non-living substrate and hard corals are largely unknown. If these are desirable habitat features for Atka mackerel, however, and there is a significant dependence on these features, the potential large reduction (more than 50 percent) in hard corals in many areas of the AI could be of concern. Overall the Atka mackerel stock is in relatively good condition and is currently at a high abundance level. There are no indications that the affected habitat areas that overlap with the distribution of Atka mackerel would impair the ability of the stock to produce MSY over the long term.

There is some presumed overlap of the fishery with the distribution of Atka mackerel nesting sites, but the extent of the overlap with the spatial distribution of fishing impacted areas is likely to be low due a variety of factors. These factors include Steller Sea Lion protection measures, which likely afford protection to several Atka mackerel spawning grounds. Other spawning grounds that are not in closed areas, but that occur in untrawlable habitat, are also afforded protection. Summer resource assessment trawl surveys conducted biennially in the AI at the time of spawning provide a relative measure of abundance of the spawning biomass and have not detected a shift in the spatial distribution of biomass. To date, there is no evidence to suggest a link between habitat disturbance and the spawning/breeding success of AI Atka mackerel. There is also no evidence to suggest that habitat disturbance impairs the stock's ability to produce MSY over the long term through impacts on spawning/breeding success. Therefore, the impact of habitat disturbance on the spawning/breeding success of Atka mackerel is minimal and temporary.

There is no evidence to suggest a link between habitat disturbance and growth to maturity of AI Atka mackerel. There is also no evidence to suggest that habitat disturbance impairs the stock's ability to produce MSY over the long term through impacts on growth to maturity. Analyses of growth data do not indicate any detectable adverse impacts on the growth to maturity for Atka mackerel due to habitat disturbance.

Therefore, the impact of habitat disturbance on the growth to maturity of Atka mackerel is minimal and temporary.

The adults feed mainly on pelagic euphausiids followed by calanoid copepods, which are not one of the affected habitat features. As euphausiids and copepods are pelagic rather than benthic in their distribution and are too small to be retained by any fishing gear, fishing probably has a minimal and/or temporary effect on the availability of prey to Atka mackerel. There is no evidence to suggest that the diet or feeding distributions of Atka mackerel have changed. Overall, there is no evidence that habitat disturbance has affected feeding success of Atka mackerel. Therefore, the impact of habitat disturbance on the feeding success of Atka mackerel is minimal and temporary.

Stock assessment data do not show a negative trend in spawning biomass and recruitment or evidence of chronic low abundance and recruitment. There is no evidence that the cumulative effects of fishing activities on habitat have impaired the stock's ability to produce MSY since 1977. Spawning biomass is at a peak level. The stock has produced several years of above average recruitment since 1977, and recent recruitment has been strong.

F.1.5.5 Yellowfin Sole (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas, where spawning occurs and where early juveniles reside, are mostly unaffected by past and current fishery activities. Adult and late juvenile yellowfin sole concentrations primarily overlap with the EBS sand (61 percent and sand/mud 39 percent) habitats on the inner- and mid-shelf areas (Table B.3-3 of the EFH EIS). Projected equilibrium reductions in epifauna and infaunal prey in those overlaps were less than 1 percent for sand and 3 percent for sand/mud. The reduction in living structure is estimated at a range of 5 (sand) to 18 (sand/mud) percent for the summer distribution (relevant because 10 percent of the yellowfin sole diet consists of tunicates). Given this level of disturbance, it is unlikely that late-juvenile and adult feeding would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis also did not provide evidence of spatial shifts on the population level in response to areas of high fishing impacts.

The yellowfin sole stock is currently at a high level of abundance (Wilderbuer and Nichol 2004) and has been consistently above the B_{MSY} and MSST for the past 20 years. No declines in weight and/or length at age have been documented in this stock for year classes observed over the past 22 years. Such declines might be expected if the quality of the benthic feeding habitat was degraded or essential habitat were reduced. Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that the effects of the reductions in habitat features from fishing are either minimal or temporary for BS yellowfin sole.

F.1.5.6 Greenland Turbot (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)

Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by early juveniles of Greenland turbot are mostly unaffected by current fishery activities. Greenland turbot adult and late juvenile concentrations primarily overlap (65 percent with sand/mud habitats in the BSAI) (Table B.3-3 of the EFH EIS). Infaunal prey reductions would affect growth to maturity for late juvenile Greenland turbot. Infaunal prey reductions in the concentration areas in sand/mud habitats of the EBS are predicted to be 2 percent. This benthic disturbance is not thought to be relevant to adult Greenland turbot feeding success because fish species found in their diet are not directly associated with the seafloor.

The lack of overlap with shelf areas exhibiting effects from the reductions in habitat features from fishing indicate that their effect on Greenland turbot are minimal or temporary for the BSAI area.

F.1.5.7 Arrowtooth Flounder (BSAI and GOA)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by arrowtooth flounder early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile concentrations primarily overlap the EBS sand/mud habitat (34 percent) and the GOA deep shelf habitat (35 percent) (Table B.3-3 of the EFH EIS). Overall, epifaunal prey reduction in those overlaps is predicted to be 3 percent for EBS sand/mud and 1 percent for GOA deep shelf habitats. Given this level of disturbance, and the large percentage of the diet of arrowtooth flounder not including epifauna prey, it is unlikely that the adult feeding would be negatively impacted. The arrowtooth flounder stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s and 1990s (Turnock et al. 2002). No change in weight and length at age has been observed in this stock from bottom trawl surveys conducted from 1984 through 2003.

The BS arrowtooth flounder stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s (Wilderbuer and Sample 2004). The productivity of the stock is currently believed to correspond to favorable atmospheric forces in which larvae are advected to nearshore nursery areas (Wilderbuer et al. 2002). The GOA stock has increased steadily since the 1970s and is at a very high level. Therefore, the combined evidence from individual fish length-weight analysis, length at age analysis, examination of recruitment, stock biomass, and CPUE trends indicate that the effects of the reductions in habitat features from fishing are minimal or temporary for BSAI and GOA arrowtooth flounder.

F.1.5.8 Rock Sole (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by rock sole early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile rock sole in the BSAI are primarily concentrated in sand/mud (41 percent) and sand (37 percent) habitats and are affected by levels of infaunal prey (Table B.3-3 of the EFH EIS). Predicted reductions of infaunal prey in those concentration overlaps are 3 percent (sand/mud) and less than 1 percent (sand). Given this level of disturbance, it is unlikely that adult feeding would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis did not provide evidence of spatial shifts on the population level in response to areas of high fishing impacts.

The rock sole stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s (Wilderbuer and Walters 2004). The productivity of the stock is currently believed to correspond to favorable atmospheric forces in which larvae are advected to nearshore nursery areas (Wilderbuer et al. 2002). A decline in weight and length at age has been documented in this stock for year classes between 1979 and 1987 (Walters and Wilderbuer 2000), but was hypothesized to be a density dependent response to a rapid increase in an expanding population. Individual rock sole may have been displaced beyond favorable feeding habitat, rather than by a reduction in the quality of habitat. Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that the effects of the reductions in habitat features from fishing are minimal or temporary for BS rock sole.

F.1.5.9 Flathead Sole (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)
Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by flathead sole early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile flathead sole in the BSAI are primarily concentrated in sand/mud habitat (41 percent) and would be affected by reductions in infaunal and epifaunal prey (Table B.3-3 of the EFH EIS). The predicted reductions for infaunal and epifaunal prey in the concentration overlap for EBS sand/mud habitat are 3 and 2 percent, respectively. Given this level of disturbance, it is unlikely that the adult feeding would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis also did not provide evidence of spatial shifts on the population level in response to areas of high fishing effort impacts.

The flathead sole stock is currently at a high level of abundance due to sustained above-average recruitment in the 1980s (Spencer et al. 2002). The productivity of the stock is currently believed to correspond to favorable atmospheric forcing whereby larvae are advected to nearshore nursery areas (Wilderbuer et al. 2002). A decline in weight and length at age has not been documented in this stock during the 22-year time horizon of the trawl surveys (Spencer et al. 2002). Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that effects of the reductions in habitat features from fishing are either minimal or temporary for BS flathead sole.

F.1.5.10 Alaska Plaice (BSAI)

Issue	Evaluation
Spawning/breeding	MT (Minimal or temporary effect)

Feeding	MT (Minimal or temporary effect)
Growth to maturity	MT (Minimal or temporary effect)

Summary of Effects—The nearshore areas inhabited by Alaska plaice early juveniles are mostly unaffected by current fishery activities. Adult and late juvenile Alaska plaice concentrations in the BSAI primarily overlap with the EBS sand habitat (42 percent) and the EBS sand/mud habitat (52 percent) (Table B.3-3 of the EFH EIS). These fish would be affected by reductions in infaunal prey. However, the levels of reduction in those concentration overlaps are predicted to be less than 1 percent for EBS sand and 2 percent for EBS sand/mud habitat. Given this level of disturbance, it is unlikely that the adult feeding has been or would be negatively impacted. The diet and length-weight analysis presented in the preceding sections supports this assertion. The trawl survey CPUE analysis also did not provide evidence of spatial shifts on the population level in response to areas of high fishing effort impacts.

The Alaska plaice stock is currently at a high level of abundance (Spencer et al. 2004) and well above the MSST. There have been no observations of a decline in length or weight at age for this stock over the 22 years of trawl survey sampling. Therefore, the combined evidence from diet analysis, individual fish length-weight analysis, examination of recruitment, stock biomass, and CPUE trends indicate that effects of the reductions in habitat features from fishing are either minimal or temporary for BS Alaska plaice.

F.1.5.11 Pacific Ocean Perch (BSAI)

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Growth to Maturity	U (Unknown)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of BSAI Pacific ocean perch are rated as either unknown or minimal and temporary. The percent reduction in living and non-living substrates in the areas most commonly inhabited by BSAI Pacific ocean perch (the AI deep and AI shallow habitats) do not exceed 13 percent. Although larger percent reductions for hard corals are estimated, studies on habitat associations have not associated Pacific ocean perch with hard coral (Kreiger and Wing 2002). There is little information to suggest that these habitat reductions would affect spawning/breeding or feeding in a manner that is more than minimal or temporary, although much is unknown for these processes for BSAI Pacific ocean perch.

Regarding growth to maturity, the available literature does indicate that juvenile red rockfish do use living (anemones) and non-living (rocky areas) habitat features, with one specific use being the ability to find refuge from predators. Trawling would be expected to have negative impacts for these life stages, although the extent to which the BSAI Pacific ocean perch stock is dependent upon these habitat features is not well known. Although the LEI percentages do not exceed 13 percent for the living and non-living substrates, these figures should be interpreted as rough guidelines that are estimated with some error and relate to entire BSAI stock. Examination of LEI maps indicates that finer scale impacts do occur and could be important for stocks such as Pacific ocean perch, which are thought to show population structure on small spatial scales (Withler et al. 2001). Similarly, although the current population level data do not indicate declining trends in spawning biomass or recruitment, it is not clear what effects may have occurred at finer spatial scales.

F.1.5.12 Shortraker and Rougheye Rockfish (BSAI)

Rougheye (*Sebastes aleutianus*) and shortraker (*Sebastes borealis*) rockfish are distributed from southern California, north to GOA and the EBS, and west to the Aleutian and Kuril Islands and the Okhotsk Sea (Love et al. 2002). In Alaskan waters, concentrations of abundance occur in the GOA and the AI, with smaller concentrations along the EBS slope. The mean depth at which shortraker and rougheye rockfish appear in recent AI summer trawl surveys is approximately 400 and 375 m, respectively.

Issue	Evaluation
Spawning/breeding	MT (Minimal, temporary, or no effect)
Growth to maturity	U (Unknown effect)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of BSAI rougheye and shortraker rockfish are rated as either unknown or minimal and temporary. There is little information to suggest that these habitat reductions would affect spawning/breeding or feeding in a manner that is more than minimal or temporary, although much is unknown about these processes for BSAI shortraker and rougheye rockfish.

Regarding growth to maturity, the available literature indicates that juvenile red rockfish use living (corals) and non-living (rocky areas) habitat features, with one specific use being the ability to find refuge from predators. Although several of these studies did not specifically observe shortraker or rougheye rockfish, it is reasonable to assume that their juvenile habitat use would follow a similar pattern. Trawling would be expected to have negative impacts for these life stages, although the extent to which the BSAI rougheye and shortraker stocks are related to these habitat features is not well known. The expected percent reduction in living and non-living habitat features does not exceed 7 percent in the AI deep and AI shallow habitats, suggesting that fishing impacts on these features are not likely to substantially affect BSAI rougheye and shortraker rockfish. However, larger percent reductions for hard corals are estimated, and studies on habitat associations have indicated that rougheye rockfish are associated with hard corals such as *Primnoa,* possibly due to the concentration of prey items in these habitats or for providing refuge for juveniles (Kreiger and Wing 2002). The extent to which habitat impacts occur at smaller scales and the importance of these impacts to the overall BSAI population are unknown.

F.1.5.13 Northern Rockfish (BSAI)

Northern rockfish (*Sebastes polyspinus*) are distributed from northern British Columbia north to the GOA and the EBS and west to the AI and the Kamchatka Peninsula (Love et al. 2002). Northern rockfish are poorly studied species, and little is known about their life history.

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Growth to Maturity	U (Unknown)
Feeding	MT (Minimal, temporary, or no effect)

Summary of Effects—The effects of fishing on the habitat of BSAI northern rockfish are rated as either unknown or minimal and temporary. The percent reduction in living and non-living substrates in the areas most commonly inhabited by BSAI northern rockfish (the AI deep and AI shallow habitats) do not exceed 8 percent. Although larger percent reductions for hard corals are estimated, studies on habitat associations have not associated northern rockfish with hard coral (Kreiger and Wing 2002). Northern rockfish eat copepods and euphausiids which are not associated with benthic habitats and would not be expected to be impacted by fishing gear. There is little information to suggest that these habitat reductions would affect spawning/breeding or feeding in a manner that is more than minimal or temporary, although much is unknown for these processes for BSAI northern rockfish.

Regarding growth to maturity, the available literature does indicate that juvenile red rockfish do use living (anemones) and non-living (rocky areas) habitat features, with one specific use being the ability to find refuge from predators. In particular, northern rockfish are associated with rough and rocky habitats (Clausen and Heifetz 2002). Trawling would be expected to have negative impacts for these life stages, although the extent to which the BSAI northern rockfish stock is related to these habitat features is not well known. The LEI percentages of habitat reduction should be interpreted as rough guidelines that are estimated with some error and relate to the entire BSAI stock. Examination of LEI maps indicates that finer scale impacts do occur, and the extent to which these finer scale impacts may be important for northern rockfish is dependent upon the spatial scale of their population structure, which is currently unknown. Similarly, although the current population level data do not indicate declining trends in spawning biomass or recruitment, it is not clear what effects may have occurred at finer spatial scales.

F.1.5.14 Other Rockfish Species (BSAI)

The other rockfish complex includes all species of *Sebastes* and *Sebastolobus* spp. other than Pacific ocean perch (*Sebastes alutus*) and those species in the other red rockfish complex (northern rockfish, *S. polyspinis*; rougheye rockfish, *S. aleutianus*; and shortraker rockfish, *S. borealis*). This complex is one of the rockfish management groups in the BSAI regions. Eight out of 28 species of other rockfish have been confirmed or tentatively identified in catches from the EBS and AI region; thus, these are the only species managed in this complex (Reuter and Spencer 2001, NMFS 2003). The two most abundant species for this complex are dusky rockfish (*Sebastes variabilis*) and shortspine thornyheads (*Sebastolobus alascancus*).

Dusky Rockfish

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	MT (Minimal, temporary or no effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—In general the effects of fishing on the habitat of dusky rockfish are unknown or minimal. The main concern lies in the amount of habitat that has been estimated to be disturbed within the general distribution of dusky rockfish in the BSAI. If the loss of substrates, both living and non-living, is great due to the effects of fishing or as the result of a natural occurrence, then there is the potential that dusky rockfish growth to maturity may be affected. Many species of rockfish utilize rocky outcroppings and/or coral as a type of refugia during some or all of their life history stages. If this refugia is found to play an important role in the survival of this species, then loss of the substrate that makes up this refugia may decrease the survival rate of dusky rockfish.

BSAI Shortspine Thornyheads

Issue	Evaluation
Spawning/breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—In general, the relationship between habitat and SST survival rates has not been established. Given current information, however, impacts to habitat that may support various life stages of SST are minimal to no effect. The main concern is prey availability to SST. Because epifauna are the main prey items for SST, the impacts to those habitats that support their various life stages are also important. Unfortunately, there are no good data to determine which epifauna are the most important in SST diet along the large area of the BSAI.

F.1.5.15 Squid and Other Species

While there was considerable new information to evaluate habitat effects for the major target groundfish species in Alaska, there were some species where information was either too sparse to evaluate, or simply did not exist. For other species, especially nontarget species such as skates, sculpins, sharks, squids, and octopi, growth information has not been collected historically, and species-specific catch per unit effort information may be unreliable. Information on nontarget species is improving, but it is currently insufficient to evaluate habitat specific impacts. For these reasons, the original evaluations for the following species groups presented in the DEIS still represent the best available information, despite extensive inquiry to improve upon it.

F.1.5.15.1 BSAI Sharks (sleeper sharks and salmon sharks)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of sleeper sharks or salmon sharks. Sleeper sharks are thought to occur mainly in the middle and lower portions of the water column along the outer continental shelf and upper slope region; thus, any adverse effects to this habitat type may influence the health of the sleeper shark population. Salmon sharks are thought to occur in pelagic waters along the outer continental shelf and upper slope region of the EBS. Thus, any adverse effects to this habitat type, including disruption or removal of pelagic prey by fisheries, may influence the health of the salmon shark population.

F.1.5.15.2 BSAI Skates (between 8 and 15 species in the genus *Bathyraja*)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of skates. Skates are benthic dwellers. The Alaska skate dominates the skate complex biomass in the EBS and is distributed mainly on the upper continental shelf. The diversity of the group increases with depth along the outer continental shelf and slope, with several new species likely to be described in the near future. Therefore, any adverse affects to the shallow shelf habitat may influence the health of the Alaska skate populations, while any adverse affects to outer continental shelf and slope habitats may influence the health of multiple species of skates.

F.1.5.15.3 BSAI Sculpins (over 60 species identified in BSAI trawl surveys)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of sculpins. Sculpins are benthic dwellers. Some sculpin species guard their eggs, and at least one species, the bigmouth sculpin, lays its eggs in vase sponges in the AI, although it is not known whether a particular type of sponge, or sponges in general, are essential to reproductive success. There are so many diverse species in this category that almost all benthic areas in the EBS and AI are likely to be inhabited by at least one sculpin species. Therefore, any adverse affects to habitat may influence the health of species in the sculpin complex.

F.1.5.15.4 BSAI Squids (5 or more species)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of squid. Squid are thought to occur in pelagic waters along the outer continental shelf and upper slope region of the EBS and AI, and concentrate over submarine canyons; thus, any adverse effects to this habitat may influence the health of the squid populations.

F.1.5.15.5 BSAI octopi (5 or more species)

Issue	Evaluation
Spawning/breeding	U (Unknown effect)
Feeding	U (Unknown effect)
Growth to maturity	U (Unknown effect)

Summary of Effects—Essential habitat requirements for species in this category are unknown. No studies have been conducted in the EBS or AI to determine whether fishing activities have an effect on the habitat of octopi. Octopi occupy all types of benthic habitats, extending from very shallow subtidal areas to deep slope habitats; thus, any adverse effects to this habitat may influence the health of octopus populations. Knowledge of octopi distributions are insufficient to allow comparison with fishing effects.

F.1.5.16 Effects of Fishing on Essential Fish Habitat of Forage Species

The forage species category was created by Amendments 36 and 39 to the BSAI and GOA FMP. This category includes eight families of fish (Osmeridae, Myctophidae, Bathylagidae, Ammodytidae, Trichodontidae, Pholidae, Stichaeidae, and Gonostomatidae) and one order of crustaceans (Euphausiacea). The aforementioned amendments prohibit the directed fishery of any forage species. The species included in this category have diverse life histories and it is impractical to analyze the group as a whole. Therefore, for the purpose of this document, each family and order will be analyzed separately.

F.1.5.16.1 Family Osmeridae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Most of the Alaska species of smelt spawn on beaches, rivers, or in estuaries. Certain species of smelt, such as capelin, have been shown to have an affinity towards spawning grounds with specific substrate grain size (coarse sand or fine gravel). Therefore, non-living substrate is assumed to be very important for spawning/breeding. However, smelt spawning areas do not overlap with areas of intensive fishing. There is little to no fishing pressure in the nearshore environment needed by these species. Hence, the effects of fishing are anticipated to have little impact on the stock. The rating for the effects of fishing on spawning and breeding of smelt is MT.

Juvenile and adult smelt feed primarily on neritic plankton. There is little evidence that survival or prey availability of smelt is dependent on habitat that is disturbed by fishing. Therefore, the effects of fishing on the feeding and growth to maturity of smelt are rated MT.

F.1.5.16.2 Family Myctophidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Myctophids are pelagic throughout all life history stages. There is little evidence that Myctophid survival is dependent on habitat affected by fishing. Myctophids are broadcast spawners with pelagic eggs. Juvenile and adult Myctophids prey on neritic zooplankton and do not require physical structure for protection. Therefore, the effects of fishing on the spawning and breeding, feeding, and growth to maturity of Myctophids is rated MT.

F.1.5.16.3 Family Ammodytidae

Issue	Evaluation

Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—The sole member of family Ammodytidae found in Alaska is the Pacific sand lance (*Ammodytes hexapterus*). Sand lance have been shown to have an affinity towards spawning grounds with specific substrate grain size (coarse sand). Therefore, non-living substrate is assumed to be very important for spawning/breeding. However, smelt spawning areas do not overlap with known areas of intensive fishing. There is little to no fishing pressure in the nearshore habitat needed by these species. Hence, the effects of fishing on the EFH of sand lance is rated MT.

Juvenile and adult sand lance feed primarily on copepods. There is little evidence that survival or prey availability of sand lance is dependent on habitat disturbed by fishing. Therefore, the effects of fishing on the feeding and growth to maturity of smelt are rated MT.

F.1.5.16.4 Family Trichodontidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	U (Unknown)
Growth to maturity	U (Unknown)

Summary of Effects—Two members of the family Trichodontidae are found in the BSAI and GOA: the sailfin sandfish (*Arctoscopus japonicus*) and the Pacific sandfish (*Trichodon trichodon*). However, the sailfin sandfish is rarely encountered in Alaska waters. For the purposes of this document, attention will be focused on the Pacific sandfish.

Pacific sandfish lay demersal adhesive egg masses in rocky intertidal areas. The presence of the proper non-living substrate is important for the spawning/breeding of sandfish. However, there is little overlap of the spawning areas with known areas of intensive fishing. Hence, the effects of fishing on spawning/breeding of sandfish are rated MT.

Pacific sandfish are ambush predators that lay in wait for prey buried under the sand. They have been shown to consume some epifauna prey, but more than 95 percent of their diet consisted of small fish. It is unknown how the habitat for these prey species is affected by fishing.

Pacific sandfish larvae are pelagic, but juveniles and adults are demersal. Little is known about sandfish distribution in the BSAI and GOA. The effect of fishing on the survival of Pacific sandfish is unknown due to lack of data.

F.1.5.16.5 Family Pholidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—There are several species of Pholids (or gunnels) found in Alaska waters. Most species of gunnels reside, feed, and breed in the shallow, nearshore habitat, where there is little to no fishing effort. Due to the lack of fishing pressure in the environs used by Pholids, the effects of fishing on the habitat necessary for spawning/breeding, feeding, and growth to maturity are all rated MT.

F.1.5.16.6 Family Stichaeidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Due to the lack of fishing pressure in the environs used by pricklebacks, the effects of fishing on the spawning/breeding, feeding, and growth to maturity are all rated MT.

F.1.5.16.7 Family Gonostomatidae

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Bristlemouths are pelagic throughout all life history stages. There is little evidence that bristlemouths survival is dependent on habitat that is affected by fishing. Bristlemouths are broadcast spawners with pelagic eggs. Juvenile and adult bristlemouths prey on neritic zooplankton and do not require physical structure for protection. Therefore, the effects of fishing on the habitat necessary for spawning/breeding, feeding, and growth to maturity of bristlemouths are rated MT.

F.1.5.16.8 Order Euphausiacea

Issue	Evaluation
Spawning/Breeding	MT (Minimal, temporary, or no effect)
Feeding	MT (Minimal, temporary, or no effect)
Growth to maturity	MT (Minimal, temporary, or no effect)

Summary of Effects—Euphausiids (or krill) are small, shrimp-like crustaceans which, along with copepods, make up the base of the food web in the BSAI and GOA. Euphausiids are pelagic throughout their entire life cycle and do not have a strong link to habitat that is affected by fishing. Euphausiids do not require habitat that is disrupted by fishing for spawning/breeding, feeding, or growth to maturity. Therefore, the effects of fishing on habitat for euphausiids is MT.

F.1.6 Conclusions

F.1.6.1 Species Evaluations

Evaluations were completed for 26 managed species (or species groups) and 8 forage species (Table B.4-1 of the EFH EIS). See Sections B.3.2 to B.3.4 of the EFH EIS for more detailed information. Based on the available information, the analysis found no indication that continued fishing at the current rate and intensity would affect the capacity of EFH to support the life history processes of any species. In other words, the effects of fishing on EFH would not be more than minimal. Reasons for minimal ratings were predominantly either lack of a connection to affected habitat features, or findings from stock analyses that current fishing practices (including effects on habitat) do not jeopardize the ability of the stock to produce MSY over the long term. Other evaluations indicated that, even though a connection may exist between a habitat feature and a life-history process, the expected feature reductions were considered too small to make effects at the population level likely. There were also cases where the effects did not overlap significantly with the distribution of the species.

About one-third of the ratings were U (unknown effect). Most of unknown ratings were for species that have received relatively little study; hence, their life history needs and population status are poorly known. Most species with unknown ratings support small or no fisheries. Conversely, species that support significant fisheries have been studied more. In some cases, associations between the habitat features and life history processes were indicated, but the evaluator did not have enough information to assess whether the linkage and the amount of feature reduction would affect species welfare.

Even for well studied species, the knowledge to trace use of habitat features confidently for spawning, breeding, feeding, and growth to maturity to population level effects is not yet available. Several evaluators specifically cited uncertainty regarding the effect of particular noted linkages, and some urged caution. Most of these situations involved potential linkages between the growth-to-maturity of rockfish and Atka mackerel and habitat structure.

F.1.6.2 General Effects on Fish Habitat

While this evaluation identified no specific instances of adverse effects on EFH that were more than minimal and not temporary, the large number of unknown ratings and expressions of concern make it prudent to look for more general patterns across all of the species and habitat features (Table B.4-2 of the EFH EIS).

Specific areas with high fishing effort, and hence high LEIs, were identified in the effects-of-fishing analysis. These included two large areas of the EBS, one north of Unimak Island and Unimak Pass and the other between the Pribilof Islands and Bristol Bay. Both of these areas have continued to be highly productive fishing grounds through decades of intensive fishing. While that may initially seem at odds with the LEI results, it is consistent with the evaluation that the habitat features affected by fishing either are not those important to the species fished in those areas, or are not being affected in a way that limits species welfare.

Fishing concentrations in other areas were smaller, but made up higher proportions of the GOA and EBS slopes. The largest effect rates were on living structure, including coral. The high reliance on limited areas for fishing production and their high estimated LEIs make it prudent to obtain better knowledge of what processes occur in those locations.

Table B.3-1 of the EFH EIS shows the habitat connections identified for each life stage of managed species and species groups. Each row represents a species life stage and each column one of the habitat types from the fishing-effects analysis. At their intersections, evaluators entered letters representing each of the habitat features (prey or structure classes) used by that life stage in that habitat. Most species of groundfish have pelagic larval and egg stages. Only one species, Atka mackerel, had a connection with a benthic habitat feature for its egg or larval stages. A combined tally at the bottom of the table notes how many species/life-stages were identified for each habitat feature in each habitat. Prey features represented about twice as many connections as structure features. The habitat feature/type combinations that had LEIs above 5 percent, outlined in the table, tended to have few connections. The highest number of connections (six) were for living structures on the GOA deep shelf, which had the lowest LEI of the outlined habitat feature/type combinations (6.2 percent). Connections with the highlighted blocks mostly involved rockfish species, with a few connections from Atka mackerel and blue king crab.

Cropping and summing effects on habitat features by distributions of the adults of each species (Table B.3-3 of the EFH EIS) depicted how the fishing effects overlapped in the locations where each species is present. The general distribution values related to the broader areas occupied, while the concentration values related to areas of higher abundance. Concentration LEIs were generally higher than the estimates based on general distribution because adult species concentrations determine where fisheries operate. It is unfortunate that distributions were not available for juveniles because connections to the habitat feature with the highest LEIs (living structure) mostly involved the growth to maturity process. Characterizing juvenile distributions should be a high priority for future research.

Reductions across adult species distributions for the living structure were mostly between 10 and 17 percent. Higher values occurred for red king crab (29 percent for both coverages) and Atka mackerel (18 and 26 percent). The king crab evaluator noted that the distribution of juveniles was mostly outside of the affected areas. The evaluator for Atka mackerel emphasized use of non-living substrates by that species. Prey class effects by species distributions were all at or below 5 percent. In combination with negligible effects on habitat of forage species (Section B.3.5 of the EFH EIS), this indicates that effects on availability of prey were minimal.

While LEIs for hard corals are subject to the limitations mentioned in Section B.2.6 of the EFH EIS, they had the highest LEIs when considered by species distributions. Intersections where meaningful effects are most likely to occur are those between areas where hard corals are prevalent and species for which a significant portion of their distribution occurs in the same areas, including populations of golden king crab, Atka mackerel, sablefish, and the rockfish species. Coral LEIs at these points ranged from 23 to 59 percent. While few evaluators cited coral as specifically linked to life history functions, in some areas it may be an important component of the living structure that is potentially linked to growth to maturity for some of these species. Because of their very slow recovery, corals warrant particular consideration for protection and for the development of improved knowledge of their habitat functions and distribution.

References

Bailey, K.M. 2000. Shifting control of recruitment of walleye pollock *Theragra chalcogramma* after a major climatic and ecosystem change. Mar. Ecol. Prog. Ser 198:215-224.

Bailey, K.M., T.J. Quinn II, P. Bentzen, and W.S. Grant. 1999. Population structure and dynamics of walleye pollock, *Theragra chalcogramma*. Advances in Mar. Biol. 37: 179-255.

Ball, B.J., G. Fox, and B.W. Munday. 2000. Long- and short-term consequences of a Nephrops trawl fishery on the benthos and environment of the Irish Sea. ICES Journal of Marine Science. 57(5):1,315-1,320.

Bergman, M.J.N. and J.W. van Santbrink. 2000. Mortality in megafaunal benthic populations caused by trawl fisheries on the Dutch continental shelf in the North Sea in 1994 ICES Journal of Marine Science 57:1,321-1,331.

Brown, E. 2003. Effects of commercial otter trawling on EFH of the southeastern BS shelf. Master's Thesis, University of Washington.

Brylinsky, M., J. Gibson, and D.C. Gordon, Jr. 1994. Impacts of flounder trawls on the intertidal habitat and community of the Minas Basin, Bay of Fundy. Canadian Journal of Fisheries and Aquatic Sciences. 51(3):650-661.

Clark, M.R. and R. O'Driscoll. 2003. Deepwater fisheries and their impact on seamount habitat in New Zealand. Journal of Northwest Atlantic Fishery Science 31: 441-458.

Clausen, D.M. and J. Heifetz. 2002. The northern rockfish, *Sebastes polyspinus*, in Alaska: Commercial fishery, distribution, and biology. Mar. Fish. Rev 64(4):1-28.

Dorn, M.W. 2004. Extending separable age-structured assessment models to evaluate trends in juvenile mortality of walleye pollock in the GOA. ICES CM 2004/FF:31.

Eno, N., D.S. Macdonald, J.A. Kinnear, S. Amos, C.J. Chapman, R.A. Clark, F.S. Bunker, and C. Munro. 2001. Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science. 58(1):11-20.

Fossa, J.H., P.B. Mortensen, and D.M. Furevik. 2002. The deep-water coral *Lophelia pertusa* in Norwegian waters distribution and fishery impacts. Hydrobiologia 471: 1-12.

Freese, J.L. 2001. Trawl induced damage to sponges observed from a research submersible. Marine Fisheries Review 63(3) 7-13.

Freese, L., P.J.Auster, J. Heifetz, and B.L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the GOA. Marine Ecology Progress Series 182:119-126.

Gilkinson, K., M. Paulin, S. Hurley, and P. Schwinghamer. 1998. Impacts of trawl door scouring on infaunal bivalves: results of a physical trawl door model/dense sand interaction Journal of Experimental Marine Biology and Ecology 224(2):291-312.

Hollowed, A., J. N. Ianelli, and P. Livingston. 2000. Including predation mortality in stock assessments: A case study for GOA pollock. ICES J. Mar. Sci 57(2):279-293.

Hunt, Jr., G.L., P. Stabeno, G. Walters, E. Sinclair, R.D. Brodeur, J.M. Napp, and N.A. Bond. 2002. Climate change and control of the southeastern BS pelagic ecosystem. Deep-Sea Res. Pt. II, 49(26), 5821–5853.

Kenchington, E.L.R., J. Prena, K.D. Gilkinson, D.C. Gordon, K. MacIsaac, C. Bourbonnais, P.J. Schwinghamer, T.W. Rowell, D.L McKeown, and W.P. Vass. 2001. Effects of experimental otter trawling on the macrofauna of a sandy bottom ecosystem on the Grand Banks of Newfoundland. Canadian Journal of Fisheries and Aquatic Sciences. 58(6):1043-1057.

Krieger, K. 2001. Coral impacted by fishing gear in the GOA. Proceedings of the First International Symposium on Deepwater Corals. (Ecology Action Centre and Nova Scotia Museum, Halifax, Nova Scotia 106-117).

Krieger, K. 1993. Distribution and abundance of rockfish determined from a submersible and by bottom trawling. Fishery Bulletin 91(1):87-96.

Krieger, K. 1992. Shortraker rockfish, *Sebastes borealis*, observed from a manned submersible. Marine Fisheries Review. 54(4):34-37.

Love, M.S., M. Yoklavich, and L. Thorsteinson. 2002. The rockfishes of the northeast Pacific. University of California Press, Berkeley, CA. 414 p.

McConnaughey, R.A., K.L. Mier, and C.B. Dew. 2000. An examination of chronic trawling effects on soft-bottom benthos of the EBS. ICES Journal of Marine Sciences. 57(5):1377-1388.

Moran, M.J. and P.C. Stephenson. 2000. Effects of otter trawling on macrobenthos and management of demersal scalefish fisheries on the continental shelf of north-western Australia. 2000. ICES Journal of Marine Science. 57(3):510-516.

National Marine Fisheries Service (NMFS). 2005. Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. April 2005. DOC, NOAA, National Marine Fisheries Service, Alaska Region, P. O. Box 21668, Juneau, Alaska 99802-1668.

NMFS. 2003. Annual Report to Congress on the Status of U.S. Fisheries, 2002. U.S. Department of Commerce, NOAA, National Marine Fisheries Service, Silver Spring, MD. 156 p.

Prena, J., P. Schwinghamer, T.W. Rowell, D.C. Jr Gordon, K.D. Gilkinson, W.P. Vass, and D.L McKeown. 1999. Experimental otter trawling on a sandy bottom ecosystem of the Grand Banks of Newfoundland: Analysis of trawl bycatch and effects on epifauna. Marine Ecology Progress Series. 181:107-124.

Reuter, R.F., and P.D. Spencer. 2004. 2004 BSAI other rockfish *In* Appendix A stock assessment and fishery evaluation report for the groundfish resources of the BS and AI region, North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Schwinghamer, P., D.C. Gordon, Jr., T.W. Rowell, J.P. Prena, D.L McKeown, G. Sonnichsen, and J.Y. Guignes. 1998. Effects of experimental otter trawling on surficial sediment properties of a sandy-bottom ecosystem on the Grand Banks of Newfoundland. Conservation Biology 12: 1215-1222.

Smith, C.J., K.N. Papadopoulou, S. Diliberto. 2000. Impact of otter trawling on eastern Mediterranean commercial trawl fishing ground. ICES Journal of Marine Science 55:1340-1351. (B-16).

Sparks-McConkey, P.J. and L. Watling. 2001. Effects on the ecological integrity of a soft-bottom habitat from a trawling disturbance. Hydrobiologia. 456(1-3):73-85.

Spencer, P.D., G.E. Walters, and T.K. Wilderbuer. 2002. Flathead sole. *In* Appendix A Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the BSAI Region. P 361-408. North Pacific Fishery Management Council, 605 West 4th Ave., Suite 306, Anchorage, AK 99501.

Spencer, P., T.K. Wilderbuer, and T.M. Sample. 2004. Alaska plaice. *In* Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the BSAI Region as Projected for 2005. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Turnock, B.J., T.K. Wilderbuer, and E.S. Brown. 2002. Arrowtooth flounder. *In* Appendix B Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the GOA Region. P 199-228. North Pacific Fishery Management Council, 605 West 4th Ave., Suite 306, Anchorage, AK 99501.

Van Dolah, R.F., P.H. Wendt, and N. Nicholson. 1987. Effects of a research trawl on a hard-bottom assemblage of sponges and corals. Fisheries Research 5: 39-54.

Walters, G.E. and T.K. Wilderbuer. 2000. Decreasing length at age in a rapidly expanding population of northern rock sole in the EBS and its effect on management advice. J. Sea Ressearch 44(2000) 17-26.

Wilderbuer, T.K, A.B. Hollowed, W.J. Ingraham Jr., P.D. Spencer, M.E. Conners, N.A. Bond, and G.E. Walters. 2002. Flatfish recruitment response to decadal climatic variability and ocean conditions in the EBS. Prog. Oceanog. 55 (2002) 235-247.

Wilderbuer, T.K. and D. Nichol. 2004. Yellowfin sole. *In* Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the BSAI Region as Projected for 2005. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Wilderbuer, T.K. and T.M. Sample. 2004. Arrowtooth flounder. *In* Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the BSAI Region as Projected for 2005. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Wilderbuer, T.K. and G.E. Walters. 2004. Northern rock sole. *In* Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the BSAI Region as Projected for 2005. North Pacific Fishery Management Council, P.O. Box 103136, Anchorage Alaska 99510.

Withler, R.E., T.D. Beacham, A.D. Schultze, L.J. Richards, and K.M. Miller. 2001. Co-existing populations of Pacific ocean perch, Sebastes alutus, in Queen Charlotte Sound, British Columbia. Mar. Biol. 139:1-12.

F.2 Non-fishing Impacts

The diversity, widespread distribution, and ecological linkages with other aquatic and terrestrial environments make the waters and substrates that comprise EFH susceptible to a wide array of human activities unrelated to fishing.

Non-fishing activities have the potential to adversely affect the quantity or quality of EFH in riverine, estuarine, and marine systems. Broad categories of such activities include, but are not limited to, mining, dredging, fill, impoundment, discharge, water diversions, thermal additions, actions that contribute to nonpoint source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH. For each activity, known and potential adverse impacts to EFH are described in the EFH EIS, Appendix G (NMFS 2005). The descriptions explain the mechanisms or processes that may cause the adverse effects and how these may affect habitat function. This FMP incorporates by reference the complete analysis of non-fishing impacts in Appendix G of the EFH EIS and summarizes the results for each type of non-fishing activity (NMFS 2005).

Non-fishing activities discussed in this document are subject to a variety of regulations and restrictions designed to limit environmental impacts under federal, state, and local laws. Many current requirements help to avoid or minimize adverse effects to aquatic habitats, including EFH. The conservation recommendations contained in this document are rather general and may overlap with certain existing standards for specific development activities. Nevertheless, the recommendations highlight practices that can help to avoid and minimize adverse effects to EFH. During EFH consultations between NMFS and other agencies, NMFS strives to provide reasonable and scientifically based recommendations that account for restrictions imposed under various state and federal laws by agencies with appropriate regulatory jurisdiction. Moreover, the coordination and consultation required by Section 305(b) of the Magnuson-Stevens Act do not supersede the regulations, rights, interests, or jurisdictions of other federal or state agencies. NMFS will not recommend that state or federal agencies take actions beyond their statutory authority, and NMFS' EFH conservation recommendations are not binding.

The conservation measures discussed in this document should be viewed as options to avoid, minimize, or compensate for adverse impacts and promote the conservation and enhancement of EFH. Ideally, non-water-dependent actions should not be located in EFH if such actions may have adverse impacts on EFH. Activities that may result in significant adverse effects on EFH should be avoided where less environmentally harmful alternatives are available. If there are no alternatives, the impacts of these actions should be minimized. Environmentally sound engineering and management practices should be employed for all actions that may adversely affect EFH. If avoidance or minimization is not practicable, or will not adequately protect EFH, compensatory mitigation (as defined for Section 404 of the Clean Water Act – the restoration, creation, enhancement, or in exceptional circumstances, preservation of wetlands and/or other aquatic resources for the purpose of compensating for unavoidable adverse impacts which remain after all appropriate and practicable avoidance and minimization has been achieved) should be considered to conserve and enhance EFH.

Section 303(a)(7) of the Magnuson-Stevens Act requires FMPs to identify activities other than fishing that may adversely affect EFH and define actions to encourage the conservation and enhancement of EFH, including recommended options to avoid, minimize, or compensate for the adverse effects identified. During consultation, agencies strive to consider all potential non-fishing impacts to EFH so that the appropriate recommendations can be made. Because impacts that may adversely affect EFH can be direct, indirect, and cumulative, the biologist must consider and analyze these interrelated impacts.

The conservation recommendations included with each activity present a series of site-specific measures the action agency can undertake to avoid, offset, or mitigate impacts to EFH. Not all of these suggested measures are necessarily applicable to any one project or activity that may adversely affect EFH. More specific or different measures based on the best and most current scientific information may be developed before or during EFH consultations and communicated to the appropriate agency. The conservation recommendations provided herein represent a short menu of actions that can contribute to the conservation, enhancement, and proper functioning of EFH.

While it is necessary to distinguish between activities to identify possible adverse impacts, it is equally important to consider and analyze these activities as they interrelate within habitats. This document is organized by activities that may potentially impact EFH occurring in four discrete ecosystems. The separation of these ecosystems is artificial, and many of the impacts and their related activities are not exclusive to one system.

The format for presenting the information in this document provides an introductory description of each activity, identification of potential adverse impacts, and suggested general conservation measures that would help minimize and avoid adverse effects of non-fishing activities on EFH. Table 3.4-36 in the EFH EIS identifies the categories from Appendix G and correlates them with possible changes in physical, chemical, and biological parameters, and Table 3.4-37 in the EFH EIS takes the same categories from Appendix G and broadly interprets whether the effects from the activities in Alaska have been positive, insignificant, negative, or unknown.

F.2.1 UPLAND ACTIVITIES

F.2.1.1 Nonpoint Source Pollution

Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, seepage, or hydrologic modification. Technically, the term nonpoint source means anything that does not meet the legal definition of point source in Section 502(14) of the Clean Water Act (CWA), which refers to discernable, confined, and discrete conveyance from which pollutants are or may be discharged. The major categories of nonpoint pollution are as follows:

- Agricultural runoff
- Urban runoff, including developed and developing areas (Section G.2.2 of the EFH EIS)
- Silvicultural (forestry) runoff (Section G.2.1.1 of the EFH EIS)
- Marinas and recreational boating
- Road construction
- Channel and streambank modifications, including channelization (Section G.4.7 of the EFH EIS)
- Streambank and shoreline erosion

Nonpoint source pollution is usually lower in intensity than an acute point source event, but it may be more damaging to fish habitat in the long term. Nonpoint source pollution is often difficult to detect. It may affect sensitive life stages and processes, and the impacts may go unnoticed for a long time. When severe pollution impacts are finally noticed, they may not be tied to any one event; hence, it may be difficult to correct, clean up, or mediate.

F.2.1.2 Silviculture/Timber Harvest

Recent revisions of Alaska's federal and state timber harvest regulations and best management practices (BMPs) have resulted in increased protection of EFH on federal, state, and private timber lands. Current forest management practices, when fully implemented and effective, avoid or minimize adverse effects to EFH that can result from the harvest and cultivation of timber and other forestry products. However, timber harvest can have both short- and long-term impacts throughout many coastal watersheds and estuaries if management practices are not fully implemented or effective. Past timber harvest in Alaska was not conducted under the current protective standards, and some effects from past harvesting continue to affect EFH.

If appropriate environmental standards are not followed, forest conditions after harvest may result in altered or impaired instream habitat structure and watershed function. In general, timber harvest can have a variety of effects such as removing the dominant vegetation; converting mature and old-growth upland and riparian forests to tree stands or forests of early seral stage; reducing permeability of soils and increasing the area of impervious surfaces; increasing sedimentation from surface runoff and mass wasting processes; altering hydrologic regimes; and impairing fish passage through inadequate design, construction, and/or maintenance of stream crossings (Northcote and Hartman 2004). Timber harvest may result in inadequate or excessive surface and stream flows, increased streambank and streambed erosion, loss of complex instream habitats, sedimentation of riparian habitat, and increased surface runoff with associated contaminants (e.g., herbicides, fertilizers, and fine sediments). Hydrologic characteristics (e.g., water temperature), annual hydrograph change, and greater variation in stream discharge can be associated with timber harvest. Alterations in the supply of large woody debris (LWD) and sediment can have negative effects on the formation and persistence of instream habitat features. Excess debris in the form of small pieces of wood and silt can cover benthic habitat and reduce dissolved oxygen levels.

Potential Adverse Impacts

There are many complex and important interactions, in both small and large watersheds, between fish and forests (Northcote and Hartman, 2004). Five major categories of activities can adversely affect EFH: 1) construction of logging roads, 2) creation of fish migration barriers, 3) removal of streamside vegetation, 4) hydrologic changes and sedimentation and 5) disturbance associated with log transfer facilities (LTFs) (Section G.4.9 of the EFH EIS). Potential impacts to EFH have been greatly reduced by the adoption of best management practices (BMPs) designed to protect fish habitat.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. For timber operations near streams with EFH, adhere to modern forest management practices and BMPs, including the maintenance of vegetated buffers to reduce sedimentation and supply LWD.
2. Avoid timber operations to the extent practicable in wetlands contiguous with anadromous fish streams.
3. For timber operations near estuaries or beaches, maintain vegetated buffers as needed to protect EFH.
4. Maintain riparian buffers along all streams to the extent practicable. In Alaska, buffer width is site-specific and dependent on use by anadromous and resident fish and stream process type.
5. Incorporate watershed analysis into timber and silviculture projects whenever possible or practicable. Particular attention should be given to the cumulative effects of past, present, and future timber sales within the watershed.
6. For forest roads, see Section G.2.3 in the EFH EIS, Road Building and Maintenance.

F.2.1.3 Pesticide Application (includes insecticides, herbicides, fungicides)

Pesticides are frequently detected in freshwater and estuarine systems that provide EFH. Pesticides are substances intended to prevent, destroy, control, repel, or mitigate any pest. They include the following: insecticides, herbicides, fungicides, rodenticides, repellents, bactericides, sanitizers, disinfectants, and growth regulators. More than 800 different pesticides are currently registered for use in the U.S. Legal mandates covering pesticides are the CWA and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). Water quality criteria for the protection of aquatic life have only been developed for a few of the currently used chemicals (EPA, Office of Pesticide Programs). The most common pesticides are insecticides, herbicides, and fungicides. These are used for pest control on forested lands, agricultural crops, tree farms and nurseries, highways and utility rights of way, parks and golf courses, and residences. Pesticides can enter the aquatic environment as single chemicals or as complex mixtures. Direct applications, surface runoff, spray drift, agricultural return flows, and groundwater intrusions are all examples of transport processes that deliver pesticides to aquatic ecosystems.

Habitat alteration from pesticides is different from more conventional water quality parameters, such as temperature, suspended solids, or dissolved oxygen, because, unlike temperature or dissolved oxygen, the presence of pesticides can be difficult to detect due to limitations in proven methodologies. This monitoring may also be expensive. As analytical methodologies have improved in recent years, however, the number of pesticides documented in fish and their habitats has increased.

Potential Adverse Impacts

There are three basic ways that pesticides can adversely affect EFH. These are (1) a direct toxicological impact on the health or performance of exposed fish, (2) an indirect impairment of the productivity of aquatic ecosystems, and (3) a loss of aquatic vegetation that provides physical shelter for fish.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Incorporate integrated pest management and BMPs as part of the authorization or permitting process to ensure the reduction of pesticide contamination in EFH (Scott et al. 1999).
2. Carefully review labels and ensure that application is consistent. Follow local, supplemental instructions such as state-use bulletins where they are available.
3. Avoid the use of pesticides in and near EFH.
4. Refrain from aerial spraying of pesticides on windy days.

F.2.1.4 Urban/Suburban Development

Urban development is most likely the greatest non-fishing threat to EFH. Urban growth and development in the U.S. continue to expand in coastal areas at a rate approximately four times greater than in other areas. Urban and suburban development and the corresponding infrastructure result in four broad categories of impacts to aquatic ecosystems: hydrological, physical, water quality, and biological indicators (Center for Watershed Protection [CWP] 2003). Runoff from impervious surfaces is the most widespread source of pollution into the nation's waterways (EPA 1995). When a watershed's impervious cover exceeds 10 percent, impacts to stream quality can be expected (CWP 2003).

Potential Adverse Impacts

Development activities within watersheds and in coastal marine areas often impact the EFH of managed species on both long- and short-term scales. The CWP made a comprehensive review of the impacts associated with impervious cover and urban development and found a negative relationship between watershed development and about 26 stream quality indicators (CWP 2003). Many of the impacts listed here are discussed in greater detail in other sections of this document. The primary impacts include (1) the loss of riparian and shoreline habitat and vegetation and (2) runoff. Upland and shoreline vegetation removal can increase stream water temperatures, reduce supplies of LWD, and reduce sources of prey and nutrients to the water system. An increase in impervious surfaces, such as the addition of new roads (see Section G.2.3 of the EFH EIS), roofs, bridges, and parking facilities, results in a decreased infiltration to groundwater and increased runoff volumes. This also has the potential to adversely affect water quality and water quantity/timing in downstream water bodies (i.e., estuaries and coastal waters).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Implement BMPs (EPA 1993) for sediment control during construction and maintenance operations.
2. Avoid using hard engineering structures for shoreline stabilization and channelization when possible.
3. Encourage comprehensive planning for watershed protection to avoid filling and building in floodplain areas affecting EFH.
4. Where feasible, remove impervious surfaces such as abandoned parking lots and buildings from riparian and shoreline areas, and reestablish wetlands and native vegetation.
5. Protect and restore vegetated buffer zones of appropriate width along all streams, lakes, and wetlands that include or influence EFH.
6. Manage stormwater to duplicate the natural hydrologic cycle, maintaining natural infiltration and runoff rates to the maximum extent practicable.
7. Where in-stream flows are insufficient to maintain water quality and quantity needed for EFH, establish conservation guidelines for water use permits and encourage the purchase or lease of water rights and the use of water to conserve or augment instream flows in accordance with state and federal water laws.
8. Encourage municipalities to use the best available technologies in upgrading their wastewater systems to avoid combined sewer overflow problems and chlorinated sewage discharges into rivers, estuaries, and the ocean.
9. Design and install proper on-site disposal systems.

F.2.1.5 Road Building and Maintenance

The building and maintenance of roads can affect aquatic habitats by increasing rates of natural processes such as debris slides or landslides and sedimentation, introducing exotic species, degrading water quality, and introducing chemical contamination (e.g., petroleum-based contaminants; Section G.2.2 of the EFH EIS). Paved and dirt roads introduce an impervious or semipervious surface into the landscape. This surface intercepts rain and creates runoff, carrying soil, sand and other sediments, and oil-based materials quickly downslope. If roads are built near streams, wetlands, or other sensitive areas, they may experience increased sedimentation that occurs from maintenance and use, as well as during storm and snowmelt events. Even carefully designed and constructed roads can become sources of sediment and pollutants if they are not properly maintained.

Potential Adverse Impacts

The effects of roads on aquatic habitat can be profound. They include (1) increased deposition of fine sediments, (2) changes in water temperature, (3) elimination or introduction of migration barriers such as culverts, (4) changes in streamflow, (5) introduction of non-native plant species, and (6) changes in channel configuration (see Section G.2.1.1 and the standards referenced in the EFH EIS).

Recommended Conservation Measures

The following conservation measures for road building and maintenance should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the extent practicable, avoid locating roads near fish-bearing streams.
2. Incorporate appropriate erosion control and stabilization measures into road construction plans to reduce erosion potential.
3. Build bridges when possible.
4. Locate stream crossings in stable stream reaches.
5. Design bridge abutments to minimize disturbances to streambanks and place abutments outside of the floodplain whenever possible.
6. To the extent practicable, avoid road construction across alluvial floodplains, mass wastage areas, or braided stream bottom lands unless site-specific protection can be implemented to ensure protection of soils, water, and associated resources.
7. Avoid side-casting of road construction and maintenance materials on native surfaces and into streams.
8. To the extent practicable, use native vegetation in stabilization plantings.
9. Ensure that maintenance operations avoid adverse affects to EFH.

F.2.2 RIVERINE ACTIVITIES

F.2.2.1 Mining

Mining and mineral extraction activities take many forms, such as commercial dredging and recreational suction dredging, placer, area surface removal, and contour operations (Section G.5.6 of EIS EFH). Activities include gravel mining (NMFS 2004), exploration, site preparation, mining, milling, waste management, decommissioning or reclamation, and mine abandonment (American Fisheries Society [AFS] 2000). Mining and its associated activities have the potential to cause environmental impacts from exploration through post-closure. These impacts may include adverse effects to EFH. The operation of metal, coal, rock quarries, and gravel pit mining has caused varying degrees of environmental damage in urban, suburban, and rural areas. Some of the most severe damage, however, occurs in remote areas, where some of the most productive fish habitat is often located (Sengupta 1993). In Alaska, existing regulations, promulgated and enforced by other federal and state agencies, have been designed to control and manage these changes to the landscape to avoid and minimize impacts. These regulations are regularly updated as new technologies are developed to improve mineral extraction, reclaim mined lands, and limit environmental impacts. However, while environmental regulations may avoid, limit, control, or offset many of these potential impacts, mining will, to some degree, always alter landscapes and environmental resources (National Research Council [NRC] 1999).

Mineral Mining

Potential Adverse Impacts

The effects of mineral mining on EFH depend on the type, extent, and location of the activities. Potential impacts from mining include (1) adverse modification of hydrologic conditions so as to cause erosion of desirable habitats, (2) removal of substrates that serve as habitat for fish and invertebrates, (3) conversion of habitats,(4) release of harmful or toxic materials, and (5) creation of harmful turbidity levels.

Recommended Conservation Measures

The following conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the extent practicable, avoid mineral mining in waters, riparian areas, and floodplains containing EFH.
2. Schedule necessary in-water activities when the fewest species/least vulnerable life stages of federally managed species will be present.
3. Use an integrated environmental assessment, management, and monitoring package in accordance with state and federal law and regulations.
4. Minimize spillage of dirt, fuel, oil, toxic materials, and other contaminants into EFH.
5. Treat and test wastewater (acid neutralization, sulfide precipitation, reverse osmosis, electrochemical, or biological treatments) and recycle on site to minimize discharge to streams.
6. Minimize opportunities for sediments to enter or affect EFH.
7. If possible, reclaim, rather than bury, mine waste that contains heavy metals, acid materials, or other toxic compounds if leachate can enter EFH through groundwater.
8. Restore natural contours and plant native vegetation on site after use to restore habitat function to the extent practicable.
9. Minimize the aerial extent of ground disturbance (e.g., through phasing of operations), and stabilize disturbed lands to reduce erosion.

Sand and Gravel Mining

Potential Adverse Impacts

Sand and gravel mining is extensive and occurs by several methods. These include wet-pit mining (i.e., removal of material from below the water table), dry-pit mining on beaches, exposed bars, and ephemeral streambeds, and subtidal mining. Sand and gravel mining in riverine, estuarine, and coastal environments can create EFH impacts, including (1) turbidity plumes and resuspension effects, (2) removal of spawning habitat, and (3) alteration of channel morphology.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

To the extent practicable, avoid sand/gravel mining in waters containing EFH.

1. Identify upland or off-channel (where the channel will not be captured) gravel extraction sites as alternatives to gravel mining in or adjacent to EFH, if possible.
2. Design, manage, and monitor sand and gravel mining operations to minimize potential direct and indirect impacts to EFH, if operations in EFH cannot be avoided.

3. Minimize the areal extent and depth of extraction.
4. Include restoration, mitigation, and monitoring plans, as appropriate in sand/gravel extraction plans.

F.2.2.2 Organic and Inorganic Debris

Natural occurring flotsam, such as LWD and macrophyte wrack (i.e., kelp), plays an important role in aquatic ecosystems, including EFH. LWD and wrack promote habitat complexity and provide structure to various aquatic and shoreline habitats. The natural deposition of LWD creates habitat complexity by altering local hydrologic conditions, nutrient availability, sediment deposition, turbidity, and other structural habitat conditions. Conversely, inorganic flotsam and jetsam debris can negatively impact EFH. Inorganic marine debris is a problem along much of the coastal U.S., where it litters shorelines, fouls estuaries, entangles fish and wildlife, and creates hazards in the open ocean. Marine debris consists of a wide variety of man-made materials, including general litter, plastics, hazardous wastes, and discarded or lost fishing gear. The debris enters waterbodies indirectly through rivers and storm drains, as well as directly via ocean dumping and accidental release. Although laws and regulatory programs exist to prevent or control the problem, marine debris continues to affect aquatic resources.

Organic Debris Removal

Natural occurring flotsam, such as LWD and macrophyte wrack (i.e., kelp), is sometimes intentionally removed from streams, estuaries, and coastal shores. This debris is removed for a variety of reasons, including dam operations, aesthetic concerns, and commercial and recreational uses. However, the presence of organic debris is important for maintaining aquatic habitat structure and function. Removal can alter the ecological conditions of riverine, estuarine, and coastal ecosystems and habitats.

Potential Adverse Impacts

The removal of organic debris from natural systems can reduce habitat function, adversely impacting habitat quality. Reductions in woody debris inputs to estuaries may also affect the ecological balance of estuarine systems by altering rates and patterns of nutrient transport, sediment deposition, and availability of in-water cover for larval and juvenile fish. Beach grooming and wrack removal can substantially alter the macrofaunal community structure of exposed sand beaches by reducing species richness, abundance, and biomass of macrofauna associated with beach wrack (e.g., sand crabs, isopods, amphipods, and polychaetes).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Leave LWD whenever possible, removing it only when it presents a threat to life or property.
2. Encourage appropriate federal, state, and local agencies to prohibit or minimize commercial removal of LWD from rivers, estuaries, and beaches.
3. Encourage appropriate federal, state, and local agencies to aid in the downstream movement of LWD around dams, culverts, and bridges wherever possible, rather than removing it from the system.
4. Educate landowners and recreationalists about the benefits of maintaining LWD.
5. Localize beach grooming practices, and minimize them whenever possible.

Inorganic Debris

Numerous national and international laws are intended to prevent the disposal of marine debris in ocean waters, including ocean dumping and land-based sources. Nationally, land-based sources of marine debris account for about 80 percent of the marine debris on beaches and in U.S. waters. Debris can originate from combined sewer overflows and storm drains, stormwater runoff, landfills, solid waste disposal, poorly maintained garbage bins, floating structures, and general littering of beaches, rivers, and open waters. Typical debris from these land-based sources includes raw or partially treated sewage, litter, hazardous materials, and discarded trash.

Potential Adverse Impacts

Land and ocean based marine debris is a very diverse problem, and adverse effects to EFH are likewise varied. Floating or suspended trash can directly affect fish that consume or are entangled in it. Toxic substances in plastics can kill or impair fish and invertebrates that use habitat polluted by these materials. The chemicals leach from plastics, persist in the environment, and can bioaccumulate through the food web.

Once floatable debris settles to the bottom of estuaries, coastal, and open ocean areas it may cover and suffocate immobile animals and plants, creating large spaces devoid of life. Currents can carry suspended debris to underwater reef habitats where the debris can become snagged, damaging these sensitive habitats. The typical floatable debris from combined sewer overflows includes street litter, sewage containing viral and bacterial pathogens, pharmaceutical by-products from human excretion, and pet wastes. Pathogens can also contaminate shellfish beds and reefs.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Encourage proper trash disposal in coastal and ocean settings.
2. Advocate and participate in coastal cleanup activities.
3. Encourage enforcement of regulations addressing marine debris pollution and proper disposal.
4. Provide resources and technical guidance for development of studies and solutions addressing the problem of marine debris.
5. Provide resources to the public explaining the impact of marine debris and giving guidance on how to reduce or eliminate the problem.

F.2.2.3 Dam Operation

Dams are constructed and operated to provide sources for hydropower, water storage, and flood control. Their operation, however, can affect water quality and quantity in riverine systems.

Potential Adverse Impacts

The effects of dam construction and operation on EFH can include (1) migratory impediments, (2) water flow and current pattern shifts, (3) thermal impacts, and (4) limits on sediment and woody debris transport.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Operate facilities to create flow conditions that provide for passage, water quality, proper timing of life history stages, and properly functioning channel conditions to avoid strandings and redd dewatering.

2. Develop water and energy conservation guidelines for integration into dam operation plans and into regional and watershed-based water resource plans.
3. Provide mitigation (including monitoring and evaluation) for nonavoidable adverse effects on EFH.

F.2.2.4 Commercial and Domestic Water Use

Commercial and domestic water use demands to support the needs of homes, farms, and industries require a constant supply of water. Freshwater is diverted directly from lakes, streams, and rivers by means of pumping facilities, or is stored in impoundments. Because human populations are expected to continue increasing in Alaska, it is reasonable to assume that water uses, including water impoundments and diversion, will similarly increase (Gregory and Bisson 1997).

Potential Adverse Impacts

Water diversions can involve either withdrawals (reducing flow) or discharges (increasing flow). The withdrawal of water can affect EFH by (1) altering natural flows and the process associated with flow rates, (2) affecting shoreline riparian habitats, (3) affecting prey bases, (4) affecting water quality, and (5) entrapping fishes. Problems associated with return flows include increased water temperature, increased salinity, introduction of pathogens, decreased dissolved oxygen, increased toxic contaminants from pesticides and fertilizers, and increased sedimentation (Northwest Power Planning Council [NPPC] 1986). Diversions can also physically divert or entrap EFH-managed species (Section G.5.3 of the EFH EIS).

Recommended Conservation Measures

The recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Design projects to create flow conditions that provide for adequate passage, water quality, proper timing of life history stages, and properly functioning channels to avoid juvenile stranding and redd dewatering, as well as to maintain and restore proper channel, floodplain, riparian, and estuarine conditions.
2. Establish adequate instream flow conditions for anadromous fish.
3. Screen water diversions on fish-bearing streams, as needed.
4. Incorporate juvenile and adult fish passage facilities on all water diversion projects (e.g., fish bypass systems).
5. Where practicable, ensure that mitigation is provided for nonavoidable impacts.

F.2.3 ESTUARINE ACTIVITIES

F.2.3.1 Dredging

Dredging navigable waters creates a continuous impact primarily affecting benthic and water-column habitats in the course of constructing and operating marinas, harbors, and ports. Routine dredging (i.e., the excavation of soft-bottom substrates) is used to create deepwater navigable channels or to maintain existing channels that periodically fill with sediments. In addition, port expansion has become an almost continuous process due to economic growth, competition between ports, and significant increases in vessel size (Section G.4.3 of the EFH EIS). Elimination or degradation of aquatic and upland habitats is commonplace because port expansion almost always affects open water, submerged bottoms, and, possibly, riparian zones.

Potential Adverse Impacts

The environmental effects of dredging on EFH can include (1) direct removal/burial of organisms; (2) turbidity/siltation effects, including light attenuation from turbidity; (3) contaminant release and uptake, including nutrients, metals, and organics; (4) release of oxygen consuming substances; (5) entrainment; (6) noise disturbances; and (6) alteration to hydrodynamic regimes and physical habitat.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Avoid new dredging to the maximum extent practicable.
2. Where possible, minimize dredging by using natural and existing channels.
3. Site activities that would likely require dredging (such as placement of piers, docks, marinas, etc.) in deep-water areas or design such structures to alleviate the need for maintenance dredging.
4. Incorporate adequate control measures by using BMPs to minimize turbidity and dispersal of dredged material in areas where the dredging equipment would cause such effects.
5. For new dredging projects, undertake multi-season, pre-, and post-dredging biological surveys to assess the cumulative impacts to EFH and allow for implementation of adaptive management techniques.
6. Provide appropriate compensation for significant impacts (short-term, long-term, and cumulative) to benthic environments resulting from dredging.
7. Perform dredging at times when impacts to federally managed species or their prey are least likely. Avoid dredging in areas with submerged aquatic vegetation.
8. Reference all dredging latitude-longitude coordinates at the site so that information can be incorporated into a geographical information system format.
9. Test sediments for contaminants as per EPA and USACE requirements.
10. Identify excess sedimentation in the watershed that prompts excessive maintenance dredging activities, and implement appropriate management actions, if possible, to ensure that actions are taken to curtail those causes.
11. Ensure that bankward slopes of the dredged area are slanted to acceptable side slopes (e.g., 3:1) to prevent sloughing.
12. Avoid placing pipelines and accessory equipment used in conjunction with dredging operations to the maximum extent possible close to kelp beds, eelgrass beds, estuarine/salt marshes, and other high value habitat areas.

F.2.3.2 Material Disposal/Fill

The discharge of dredged materials subsequent to dredging operations or the use of fill material in aquatic habitats can result in sediments (e.g., dirt, sand, mud) covering or smothering existing submerged substrates, loss of habitat function, and adverse effects on benthic communities.

Disposal of Dredged Material

Potential Adverse Impacts

The disposal of dredged material can adversely affect EFH by (1) altering or destroying benthic communities, (2) altering adjacent habitats, and (3) creating turbidity plumes and introducing contaminants and/or nutrients.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Study all options for disposal of dredged materials, including upland disposal sites, and select disposal sites that minimize adverse effects to EFH.
2. Where long-term maintenance dredging is anticipated, acquire and maintain disposal sites for the entire project life.
3. Encourage beneficial uses of dredged materials.
4. State and federal agencies should identify the direct and indirect impacts open-water disposal permits for dredged material may have on EFH during proposed project reviews.
5. Minimize the areal extent of any disposal site in EFH, or avoid the site entirely. Mitigate all non-avoidable adverse impacts as appropriate.

Fill Material

Potential Adverse Impacts

Adverse impacts to EFH from the introduction of fill material include (1) loss of habitat function and (2) changes in hydrologic patterns.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH:

1. Federal, state, and local resource management and permitting agencies should address the cumulative impacts of past and current fill operations on EFH and consider them in the permitting process for individual projects.
2. Minimize the areal extent of any fill in EFH, or avoid it entirely. Mitigate all non-avoidable adverse impacts as appropriate.
3. Consider alternatives to the placement of fill into areas that support EFH.

F.2.3.3 Vessel Operations/Transportation/Navigation

The growth in Alaska coastal communities is putting demands on port districts to increase infrastructure capacity to accommodate additional vessel operations for cargo handling activities and marine transportation. Port expansion has become an almost continuous process due to economic growth, competition between ports, and significant increases in vessel size (Council 1999). In addition, increasing boat sales have put more pressure on improving and building new commercial fishing and small boat harbors.

Potential Adverse Impacts

Port facilities, vessel/ferry operations, and recreational marinas can impact to EFH, especially by filling productive shallow water habitats. Potential adverse impacts to EFH can occur during both the construction and operation phases. These include direct, indirect, and cumulative impacts on shallow subtidal, deep subtidal, eelgrass beds, mudflats, sand shoals, rock reefs, and salt marsh habitats. There is considerable evidence that docks and piers block sunlight penetration, alter water flow, introduce chemicals, and restrict access and navigation (Section G.4.6 of the EFH EIS). The increase in hard surfaces close to the marine environment increases nonpoint surface discharges (Section G.2.2 of the EFH EIS), adds debris sources, and reduces buffers between land use and the aquatic ecosystem. Additional impacts include vessel groundings, modification of water circulation (breakwaters, channels, and fill), vessel wake generation, pier lighting, anchor and prop scour, discharge of contaminants and debris, and changing natural patterns of fish movement.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Locate marinas in areas of low biological abundance and diversity; if possible, for example, avoid the disturbance of eelgrass or other submerged aquatic vegetation including macroalgae, mudflats, and wetlands as part of the project design.
2. If practicable, excavate uplands to create marina basins rather than converting intertidal or shallow subtidal areas to deeper subtidal areas for basin creation.
3. Leave riparian buffers in place to help maintain water quality and nutrient input.
4. Should mitigation be required, include a monitoring plan to gauge the success of mitigation efforts.
5. Include low-wake vessel technology, appropriate routes, and BMPs for wave attenuation structures as part of the design and permit process.
6. Incorporate BMPs to prevent or minimize contamination from ship bilge waters, antifouling paints, shipboard accidents, shipyard work, maintenance dredging and disposal, and nonpoint source contaminants from upland facilities related to vessel operations and navigation.
7. Locate mooring buoys in water deep enough to avoid grounding and to minimize the effects of prop wash.
8. Use catchment basins for collecting and storing surface runoff from upland repair facilities.
9. Locate facilities in areas with enough water velocity to maintain water quality levels within acceptable ranges.
10. Locate marinas where they do not interfere with drift sectors determining the structure and function of adjacent habitats.
11. To facilitate the movement of fish around breakwaters, provide a shallow shelf or “fish bench” on the outside of the breakwater.
12. Harbor facilities should be designed to include practical measures for reducing, containing, and cleaning up petroleum spills.
13. Use appropriate timing windows for construction and dredging activities to avoid potential impacts on EFH.

F.2.3.4 Introduction of Exotic Species

Introductions of exotic species into estuarine, riverine, and marine habitats have been well documented and can be intentional (e.g., for the purpose of stock or pest control) or unintentional (e.g., fouling organisms).

Exotic fish, shellfish, pathogens, and plants can enter the environment from industrial shipping (e.g., as ballast), recreational boating, aquaculture (Section G.4.10 of the EFH EIS), biotechnology, and aquariums. The transportation of nonindigenous organisms to new environments can have many severe impacts on habitat (Omori et al. 1994).

Potential Adverse Impacts

Long-term impacts from the introduction of nonindigenous and reared species can change the natural community structure and dynamics, lower the overall fitness and genetic diversity of natural stocks, and pass and/or introduce exotic lethal disease. Overall, exotic species introductions create five types of negative effects: (1) habitat alteration, (2) trophic alteration, (3) gene pool alteration, (4) spatial alteration, and (5) introduction of diseases.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Uphold fish and game regulations of the Alaska Board of Fisheries (AS 16.05.251) and Board of Game (AS 16.05.255), which prohibit and regulate the live capture, possession, transport, or release of native or exotic fish or their eggs.
2. Adhere to regulations and use best management practices outlined in the State of Alaska Aquatic Nuisance Species Management Plan (Fay 2002).
3. Encourage vessels to perform a ballast water exchange in marine waters (in accordance with the U.S. Coast Guard's voluntary regulations) to minimize the possibility of introducing exotic estuarine species into similar habitats.
4. Discourage vessels that have not performed a ballast water exchange from discharging their ballast water into estuarine receiving waters.
5. Require vessels brought from other areas over land via trailer to clean any surfaces that may harbor non-native plant or animal species (propellers, hulls, anchors, fenders, etc.).
6. Treat effluent from public aquaria displays and laboratories and educational institutes using exotic species before discharge to prevent the introduction of viable animals, plants, reproductive material, pathogens, or parasites into the environment.
7. Prevent introduction of non-native plant species into aquatic and riparian ecosystems by avoiding use of non-native seed mixes or invasive, non-native landscaping materials near waterways and shorelines.
8. Encourage proper disposal of seaweeds and other plant materials used for packing purposes when shipping fish or other animals.

F.2.3.5 Pile Installation and Removal

Pilings are an integral component of many overwater and in-water structures. They provide support for the decking of piers and docks, function as fenders and dolphins to protect structures, support navigation markers, and help in the construction of breakwaters and bulkheads. Materials used in pilings include steel, concrete, wood (both treated and untreated), plastic, or a combination thereof. Piles are usually driven into the substrate by using either impact hammers or vibratory hammers. Impact hammers consist of a heavy weight that is repeatedly dropped onto the top of the pile, driving it into the substrate. Vibratory hammers use a combination of a stationary, heavy weight and vibration, in the plane perpendicular to the long axis of the pile, to force the pile into the substrate. Impact hammers are able to drive piles into most substrates (including hardpan, glacial till, etc.), vibratory hammers are limited to softer, unconsolidated substrates (e.g., sand, mud, and gravel).

Piles can be removed using a variety of methods, including vibratory hammer, direct pull, clam shell grab, or cutting/breaking the pile below the mudline, leaving the buried section in place.

Pile Driving

Potential Adverse Impacts

Pile driving can generate intense underwater sound pressure waves that may adversely affect EFH. These pressure waves have been shown to injure and kill fish (CalTrans 2001, Longmuir and Lively 2001, Stotz and Colby 2001, Stadler, pers. obs. 2002). Injuries associated directly with pile driving are poorly studied, but include rupture of the swimbladder and internal hemorrhaging (CalTrans 2001; Abbott and Bing-Sawyer 2002; Stadler, pers. obs. 2002). The type and intensity of the sounds produced during pile driving depend on a variety of factors, including, but not limited to, the type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer. Driving large hollow-steel piles with impact hammers produces intense, sharp spikes of sound that can easily reach levels injurious to fish. Vibratory hammers, on the other hand, produce sounds of lower intensity, with a rapid repetition rate.

Systems successfully designed to reduce the adverse effects of underwater sounds on fish have included the use of air bubbles. Both confined (i.e., metal or fabric sleeve) and unconfined air bubble systems have been shown to attenuate underwater sound pressures (Longmuir and Lively 2001, Christopherson and Wilson 2002, Reyff and Donovan 2003).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Install hollow-steel piles with an impact hammer at a time of year when larval and juvenile stages of fish species with designated EFH are not present.
2. Drive piles during low tide when they are located in intertidal and shallow subtidal areas.
3. Use a vibratory hammer when driving hollow-steel piles.
4. Implement measures to attenuate the sound should it exceed threshold levels. If sound pressure levels are anticipated to exceed acceptable limits, implement appropriate mitigation measures when practicable. Methods to reduce the sound pressure levels include, but are not limited to, the following:
    a) Surround the pile with an air bubble curtain system or air-filled coffer dam.
    b) Because the sound produced has a direct relationship to the force used to drive the pile, use a smaller hammer to reduce the sound pressures.
    c) Use a hydraulic hammer if impact driving cannot be avoided. The force of the hammer blow can be controlled with hydraulic hammers; reducing the impact force will reduce the intensity of the resulting sound.
5. Drive piles when the current is reduced (i.e., centered around slack current) in areas of strong current to minimize the number of fish exposed to adverse levels of underwater sound.

Pile Removal

Potential Adverse Impacts

The primary adverse effect of removing piles is the suspension of sediments, which may result in harmful levels of turbidity and release of contaminants contained in those sediments. Vibratory pile removal tends to cause the sediments to slough off at the mudline, resulting in relatively low levels of suspended sediments and contaminants. Breaking or cutting the pile below the mudline may suspend only small amounts of sediment, providing that the stub is left in place, and little digging is required to access the pile. Direct pull or use of a clamshell to remove broken piles may, however, suspend large amounts of sediment and contaminants. When the piling is pulled from the substrate using these two methods, sediments clinging to the piling will slough off as it is raised through the water column, producing a potentially harmful plume of turbidity and/or contaminants. The use of a clamshell may suspend additional sediment if it penetrates the substrate while grabbing the piling.

While there is a potential to adversely affect EFH during the removal of piles, many of the piles removed are old creosote-treated timber piles. In some cases, the long-term benefits to EFH obtained by removing a chronic source of contamination may outweigh the temporary adverse effects of turbidity.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Remove piles completely rather than cutting or breaking them off, if they are structurally sound.
2. Minimize the suspension of sediments and disturbance of the substrate when removing piles. Measures to help accomplish this include, but are not limited to, the following:
   a) When practicable, remove piles with a vibratory hammer, rather than using the direct pull or clamshell method.
   b) Remove the pile slowly to allow sediment to slough off at, or near, the mudline.
   c) The operator should first hit or vibrate the pile to break the bond between the sediment and the pile to minimize the potential for the pile to break, as well as to reduce the amount of sediment sloughing off the pile during removal.
   d) Encircle the pile, or piles, with a silt curtain that extends from the surface of the water to the substrate.
3. Complete each pass of the clamshell to minimize suspension of sediment if pile stubs are removed with a clamshell.
4. Place piles on a barge equipped with a basin to contain all attached sediment and runoff water after removal.
5. Using a pile driver, drive broken/cut stubs far enough below the mudline to prevent release of contaminants into the water column as an alternative to their removal.

F.2.3.6 Overwater Structures

Overwater structures include commercial and residential piers and docks, floating breakwaters, barges, rafts, booms, and mooring buoys. These structures typically are located in intertidal areas out to about 49 feet (15 meters) below the area exposed by the mean lower low tide (i.e., the shallow subtidal zone). Light, wave energy, substrate type, depth, and water quality are the primary factors controlling the plant and animal assemblages found at a particular site. Overwater structures and associated activities can alter these factors and interfere with key ecological functions such as spawning, rearing, and refugia. Site-specific factors (e.g., water clarity, current, depth, etc.) and the type and use of a given overwater structure determine the occurrence and magnitude of these impacts.

Potential Adverse Impacts

Overwater structures and associated developments may adversely affect EFH in a variety of ways, primarily by (1) changes in ambient light conditions, (2) alteration of the wave and current energy regime, and (3) activities associated with the use and operation of the facilities (Nightingale and Simenstad 2001).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Use upland boat storage whenever possible to minimize need for overwater structures.
2. Locate overwater structures in deep enough waters to avoid intertidal and shade impacts, minimize or preclude dredging, minimize groundings, and avoid displacement of submerged aquatic vegetation, as determined by a preconstruction survey.
3. Design piers, docks, and floats to be multiuse facilities to reduce the overall number of such structures and to limit impacted nearshore habitat.
4. Incorporate measures that increase the ambient light transmission under piers and docks. These measures include, but are not limited to, the following:
   a) Maximize the height of the structure, and minimize the width of the structure to decrease the shade footprint and using grated decking material.
   b) Use reflective materials (e.g., concrete or steel instead of materials that absorb light such as wood) on the underside of the dock to reflect ambient light.
   c) Use the fewest number of pilings necessary to support the structures to allow light into under-pier areas and minimize impacts to the substrate.
   d) Align piers, docks, and floats in a north-south orientation to allow the arc of the sun to cross perpendicular to the structure and to reduce the duration of light limitation.
5. Use floating rather than fixed breakwaters whenever possible, and remove them during periods of low dock use. Encourage seasonal use of docks and off-season haul-out.
6. Locate floats in deep water to avoid light limitation and grounding impacts to the intertidal or shallow subtidal zone.
7. Maintain at least 1 foot (0.30 meter) of water between the substrate and the bottom of the float at extreme low tide.
8. Conduct in-water work when managed species and prey species are least likely to be impacted.
9. To the extent practicable, avoid the use of treated wood timbers or pilings and use alternative materials such as untreated wood, concrete, or steel.
10. Mitigate for unavoidable impacts to benthic habitats. Mitigation should be adequate, monitored, and adaptively managed.

F.2.3.7 Flood Control/Shoreline Protection

Protecting riverine and estuarine communities from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. The use of dikes and berms can also have long-term adverse effects on tidal marsh and estuarine habitats. Tidal marshes are highly variable, but typically have freshwater vegetation at the landward side, saltwater vegetation at the seaward side, and gradients of species in between that are in equilibrium with the prevailing climatic, hydrographic, geological, and biological features of the coast. These systems normally drain through highly dendritic tidal creeks that empty into the bay or estuary. Freshwater entering along the upper edges of the marsh drains across the surface and enters the tidal creeks. Structures placed for coastal shoreline protection include, but are not limited to, concrete or wood seawalls, rip-rap revetments (sloping piles of rock placed against the toe of the dune or bluff in danger of erosion from wave action), dynamic cobble revetments (natural cobble placed on an eroding beach to dissipate wave energy and prevent sand loss), vegetative plantings, and sandbags.

Potential Adverse Impacts

Dikes, levees, ditches, or other water controls at the upper end of a tidal marsh can cut off all tributaries feeding the marsh, preventing freshwater flushing and annual flushing, annual renewal of sediments and nutrients, and the formation of new marshes. Water controls within the marsh proper intercept and carry away freshwater drainage, block freshwater from flowing across seaward portions of the marsh, increase the speed of runoff of freshwater to the bay or estuary, lower the water table, permit saltwater intrusion into the marsh proper, and create migration barriers for aquatic species. In deeper channels where reducing conditions prevail, large quantities of hydrogen sulfide are produced. These quantities are toxic to marsh grasses and other aquatic life. Acid conditions of these channels can also result in release of heavy metals from the sediments.

Long-term effects on the tidal marsh include land subsidence (sometimes even submergence), soil compaction, conversion to terrestrial vegetation, greatly reduced invertebrate populations, and general loss of productive wetland characteristics. Loss of these low-salinity environments reduces estuarine fertility, restricts suitable habitat for aquatic species, and creates abnormally high salinity during drought years. Low-salinity environments form a barrier that prevents the entrance of many marine species, including competitors, predators, parasites, and pathogens.

Armoring of shorelines to prevent erosion and to maintain or create shoreline real estate simplifies habitats, reduces the amount of intertidal habitat, and affects nearshore processes and the ecology of numerous species (Williams and Thom 2001). Hydraulic effects on the shoreline include increased energy seaward of the armoring, reflected wave energy, dry beach narrowing, substrate coarsening, beach steepening, changes in sediment storage capacity, loss of organic debris, and downdrift sediment starvation (Williams and Thom 2001). Installation of breakwaters and jetties can result in community changes from burial or removal of resident biota, changes in cover and preferred prey species, and predator attraction (Williams and Thom 2001). As with armoring, breakwaters and jetties modify hydrology and nearshore sediment transport, as well as movement of larval forms of many species (Williams and Thom 2001).

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Minimize the loss of riparian habitats as much as possible.
2. Do not undertake diking and draining of tidal marshlands and estuaries.
3. Wherever possible, use soft approaches (such as beach nourishment, vegetative plantings, and placement of LWD) to shoreline modifications.
4. Include efforts to preserve and enhance EFH by providing new gravel for spawning areas, removing barriers to natural fish passage, and using weirs, grade control structures, and low-flow channels to provide the proper depth and velocity for fish.
5. Construct a low-flow channel to facilitate fish passage and help maintain water temperature in reaches where water velocities require armoring of the riverbed.
6. Offset unavoidable impacts to in-stream fish habitat by providing rootwads, deflector logs, boulders, and rock weirs and by planting shaded riverine aquatic cover vegetation.

7. Use an adaptive management plan with ecological indicators to oversee monitoring and to ensure that mitigation objectives are met. Take corrective action as needed.

F.2.3.8 Log Transfer Facilities/In-water Log Storage

Rivers, estuaries, and bays were historically the primary ways to transport and store logs in the Pacific Northwest. Log storage within the bays and estuaries remains an issue in several Pacific Northwest bays. Using estuaries and bays and nearby uplands for storage of logs is common in Alaska, with most LTFs found in Southeast Alaska and a few located in Prince William Sound.

Potential Adverse Impacts

Log handling and storage in the estuary and intertidal zones of rivers can result in modification of benthic habitat and water quality degradation within the area of bark deposition (Levings and Northcote 2004). EFH may also be physically impacted by activities associated with facilities, constructed in the water, that are used to transfer commercially harvested logs to or from a vessel or log raft, including log rafts. Bark and wood debris may accumulate as a result of the abrasion of log surfaces from transfer equipment and impact EFH. After the logs have entered the water, they usually are bundled into rafts and hooked to a tug for shipment. In the process, bark and other wood debris can pile up on the ocean floor. The piles can smother clams, mussels, some seaweed, kelp, and grasses, with the bark sometimes remaining for decades. Accumulation of bark debris in shallow and deep-water environments has resulted in locally decreased epifaunal macrobenthos richness and abundance (Kirkpatrick et al. 1998, Jackson 1986). Log storage may also result in a release of soluble organic compounds within the bark pile. The physical, chemical, and biological impacts of log operations can be substantially reduced by adherence to appropriate siting and operational constraints. Adherence operational and siting guidelines will reduce (1) the amount of bark and wood debris that enters the marine and coastal environment, (2) the potential for displacement or harm to aquatic species, and (3) the accumulation of bark and wood debris on the ocean floor.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Restrict or eliminate storage and handling of logs from waters where state and federal water quality standards cannot be met at all times outside of the authorized zone of deposition.
2. Minimize potential impacts of log storage by employing effective bark and wood debris control, collection, and disposal methods at log dumps, raft building areas, and mill-side handling zones; avoiding free-fall dumping of logs; using easy let-down devices for placing logs in the water; and bundling logs before water storage (bundles should not be broken except on land and at millside).
3. Do not store logs in the water if they will ground at any time or shade sensitive aquatic vegetation such as eelgrass.
4. Avoid siting log-storage areas and LTFs in sensitive habitat and areas important for specified species, as required by the ATTF guidelines.
5. Site log storage areas and LTFs in areas with good currents and tidal exchanges.
6. Use land-based storage sites where possible, with the goal of eliminating in-water storage of logs.

F.2.3.9 Utility Line/Cables/Pipeline Installation

With the continued development of coastal regions comes greater demand for the installation of cables, utility lines for power and other services, and pipelines for water, sewage, etc. The installation of pipelines, utility lines, and cables can have direct and indirect impacts on the offshore, nearshore, estuarine, wetland, beach, and rocky shore coastal zone habitats. Many of the primary and direct impacts occur during the construction phase of installation, such as ground disturbance in the clearing of the right-of-way, access roads, and equipment staging areas. Indirect impacts can include increased turbidity, saltwater intrusion, accelerated erosion, and introduction of urban and industrial pollutants.

Potential Adverse Impacts

Adverse effects on EFH from the installation of pipelines, utility lines, and cables can occur through (1) destruction of organisms and habitat, (2) turbidity impacts, (3) resuspension of contaminants, and (4) changes in hydrology.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Align crossings along the least environmentally damaging route. Avoid sensitive habitats such as hard-bottom (e.g., rocky reefs), cold-water corals, submerged aquatic vegetation, oyster reefs, emergent marsh, and mud flats.
2. Use horizontal directional drilling where cables or pipelines would cross anadromous fish streams, salt marsh, vegetated inter-tidal zones, or steep erodible bluff areas adjacent to the inter-tidal zone to avoid surface disturbances.
3. Avoid construction of permanent access channels since they disrupt natural drainage patterns and destroy wetlands through excavation, filling, and bank erosion.
4. Store and contain excavated material on uplands.
5. Backfill excavated wetlands with either the same or comparable material capable of supporting similar wetland vegetation and at original marsh elevations.
6. Use existing rights-of-way whenever possible to lessen overall encroachment and disturbance of wetlands.
7. Bury pipelines and submerged cables where possible.
8. Remove inactive pipelines and submerged cables unless they are located in sensitive areas (e.g., marsh, reefs, sea grass, etc.) or in areas that present no safety hazard.
9. Use silt curtains or other type barriers to reduce turbidity and sedimentation whenever possible near the project site.
10. Limit access for equipment to the immediate project area.
11. Limit construction equipment to the minimum size necessary to complete the work.
12. Conduct construction during the time of year when it will have the least impact on sensitive habitats and species.
13. Suspend transmission lines beneath existing bridges or conduct directional boring under streams to reduce the environmental impact.
14. For activities on the Continental Shelf, shunt drill cuttings through a conduit and either discharge the cuttings near the sea floor, or transport them ashore.
15. For activities on the Continental Shelf, and to the extent practicable, locate drilling and production structures, including pipelines, at least 1 mile (1.6 kilometers) from the base of a hard-bottom habitat.
16. For activities on the Continental Shelf, and to avoid and minimize adverse impacts to managed species, implement the following to the extent practicable:

a) Bury pipelines at least 3 feet (0.9 meter) beneath the sea floor, whenever possible. Particular considerations (i.e., currents, ice scour) may require deeper burial or weighting to maintain adequate cover. Buried pipeline and cables should be examined periodically for maintenance of adequate earthen cover.

b) Where burial is not possible, such as in hard-bottomed areas, attach pipelines and cables to substrate to minimize conflicts with fishing gear.

c) Locate alignments along routes that will minimize damage to marine and estuarine habitat.

d) Where user conflicts are likely, consult and coordinate with fishing stakeholder groups during the route-planning process to minimize conflict.

F.2.3.10 Commercial Utilization of Habitat

Productive embayments are often used for commercial culturing and harvesting operations. These locations provide protected waters which serve as sites for oyster and mussel culturing. These operations may occur in areas of productive eelgrass beds. In 1988, Alaska passed the Alaska Aquatic Farming Act which is designed to encourage establishment and growth of an aquatic farming industry in the state. The Act establishes four criteria for issuance of an aquatic farm permit, including the requirement that the farm may not significantly affect fisheries, wildlife, or other habitats in an adverse manner.

Potential Adverse Impacts

Adverse impacts to EFH by operations that directly or indirectly use habitat include (1) discharge of organic waste, (2) shading and direct impacts to the seafloor, (3) risk of introducing undesirable species, and (4) impacts on estuarine food webs.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Site mariculture operations away from existing kelp or eelgrass beds. If mariculture operations are to be located adjacent to existing kelp or eelgrass beds, monitor these beds on an annual basis and resite the mariculture facility if monitoring reveals adverse effects.
2. Do not enclose or impound tidally influenced wetlands for mariculture. Take into account the size of the facility, migratory patterns, competing uses, hydrographic conditions, and upstream uses when siting facilities.
3. Undertake a thorough scientific review and risk assessment before any non-native species are introduced.
4. Encourage development of harvesting methods to minimize impacts on plant communities and the loss of food and/or habitat to fish populations during harvesting operations.
5. Provide appropriate mitigation for the unavoidable, extensive, or permanent loss of plant communities.

F.2.4 COASTAL/MARINE ACTIVITIES

F.2.4.1 Point-source Discharges

Point-source discharges from municipal sewage treatment facilities or storm water discharges are controlled through EPA’s regulations under the CWA and by state water regulations. The primary concerns associated with municipal point-source discharges involve treatment levels needed to attain acceptable nutrient inputs and overloading of treatment systems due to rapid development of the coastal zone. Storm drains are contaminated from communities using settling and storage ponds, street runoff, harbor activities, and honey buckets. Annually, wastewater facilities introduce large volumes of untreated excrement and chlorine through sewage outfall lines, as well as releasing treated freshwater into the nation's waters. This can significantly alter pH levels of marine waters (Council 1999).

Potential Adverse Impacts

There are many potential impacts from point-source discharge, but point-source discharges and resulting altered water quality in aquatic environments do not necessarily result in adverse impacts, either to marine resources or EFH. Because most point-source discharges are regulated by the state or EPA, effects to receiving waters are generally considered on a case-by-case basis. Point-source discharges can adversely affect EFH by (1) reducing habitat functions necessary for growth to maturity, (2) modifying community structure, (3) bioaccumulation, and (4) modifying habitat.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Locate discharge points in coastal waters well away from shellfish beds, sea grass beds, coral reefs, and other similar fragile and productive habitats.
2. Reduce potentially high velocities by diffusing effluent to acceptable velocities.
3. Determine benthic productivity by sampling before any construction activity related to installation of new or modified facilities. Develop outfall design (e.g., modeling concentrations within the predicted plume or likely extent of deposition along a productive nearshore) with input from appropriate resource and Tribal agencies.
4. Provide for mitigation when degradation or loss of habitat occurs from placement and operation of the outfall structure and pipeline.
5. Institute source-control programs that effectively reduce noxious materials to avoid introducing these materials into the waste stream.
6. Ensure compliance with pollutant discharges regulated through discharge permits which set effluent discharge limitations and/or specify operation procedures, performance standards, or BMPs. These efforts rely on the implementation of BMPs to control polluted runoff (EPA 1993).
7. Treat discharges to the maximum extent practicable, including implementation of up-to-date methodologies for reducing discharges of biocides (e.g., chlorine) and other toxic substances.
8. Use land-treatment and upland disposal/storage techniques where possible. Limit the use of vegetated wetlands as natural filters and pollutant assimilators for large-scale discharges to those instances where other less damaging alternatives are not available, and the overall environmental and ecological suitability of such actions has been demonstrated.
9. Avoid siting pipelines and treatment facilities in wetlands and streams. Since pipelines and treatment facilities are not water-dependent with regard to positioning, it is not essential that they be placed in wetlands or other fragile coastal habitats. Avoiding placement of pipelines within streambeds and wetlands will also reduce inadvertent infiltration into conveyance systems and retain natural hydrology of local streams and wetlands.

F.2.4.2 Fish Processing Waste—Shoreside and Vessel Operation

Seafood processing facilities are either shore-based facilities discharging through stationary outfalls or mobile vessels engaged in the processing of fresh or frozen seafood (Science Applications International

Corporation 2001). Discharge of fish waste from shoreside and vessel processing has occurred in marine waters since the 1800s (Council 1999). With the exception of fresh market fish, some form of processing involving butchering, evisceration, precooking, or cooking is necessary to bring the catch to market. Precooking or blanching facilitates the removal of skin, bone, shell, gills, and other materials. Depending on the species, the cleaning operation may be manual, mechanical, or a combination of both (EPA 1974). Seafood processing facilities generally consist of mechanisms to offload the harvest from fishing boats; tanks to hold the seafood until the processing lines are ready to accept them; processing lines, process water, and waste collection systems; treatment and discharge facilities; processed seafood storage areas; and necessary support facilities such as electrical generators, boilers, retorts, water desalinators, offices, and living quarters. In addition, marinas that cater to patrons who fish a large amount can produce an equally large quantity of fish waste at the marina from fish cleaning.

Potential Adverse Impacts

Generally, seafood processing wastes consist of biodegradable materials that contain high concentrations of soluble organic material. Seafood processing operations have the potential to adversely affect EFH through (1) direct and/or nonpoint source discharge, (2) particle suspension, and (3) increased turbidity and surface plumes.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the maximum extent practicable, base effluent limitations on site-specific water quality concerns.
2. To the maximum extent practicable, avoid the practice of discharging untreated solid and liquid waste directly into the environment.
3. Do not allow designation of new ZODs. Explore options to eliminate or reduce ZODs at existing facilities.
4. Control stickwater by physical or chemical methods.
5. Promote sound fish waste management through a combination of fish-cleaning restrictions, public education, and proper disposal of fish waste.
6. Encourage the alternative use of fish processing wastes (e.g., fertilizer for agriculture and animal feed).
7. Explore options for additional research.
8. Locate new plants outside rearing and nursery habitat. Monitor both biological and chemical changes to the site.

F.2.4.3 Water Intake Structures/Discharge Plumes

The withdrawal of riverine, estuarine, and marine waters by water intake structures is a common aquatic activity. Water may be withdrawn and used, for example, to cool power-generating stations and create temporary ice roads and ice ponds. In the case of power plants, the subsequent discharge of heated and/or chemically treated discharge water can also occur.

Potential Adverse Impacts

Water intake structures and effluent discharges can interfere with or disrupt EFH functions in the source or receiving waters by (1) entrainment, (2) impingement, (3) discharge, (4) operation and maintenance, and (5) construction-related impacts.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Locate facilities that rely on surface waters for cooling in areas other than estuaries, inlets, heads of submarine canyons, rock reefs, or small coastal embayments where managed species or their prey concentrate.
2. Design intake structures to minimize entrainment or impingement.
3. Design power plant cooling structures to meet the best technology available requirements as developed pursuant to Section 316(b) of the CWA.
4. Regulate discharge temperatures (both heated and cooled effluent) so they do not appreciably alter the temperature to an extent that could cause a change in species assemblages and ecosystem function in the receiving waters.
5. Avoid the use of biocides (e.g., chlorine) to prevent fouling where possible. Implement the least damaging antifouling alternatives.
6. Mitigate for impacts related to power plants and other industries requiring cooling water.
7. Treat all discharge water from outfall structures to meet state water quality standards at the terminus of the pipe.

F.2.4.4 Oil/Gas Exploration/Development/Production

Offshore exploration, development, and production of natural gas and oil reserves have been, and continue to be, an important aspect of the U.S. economy. As demand for energy resources grows, the debate over trying to balance the development of oil and gas resources and the protection of the environment will also continue. Projections indicate that U.S. demand for oil will increase by 1.3 percent per year between 1995 and 2020. Gas consumption is projected to increase by an average of 1.6 percent during the same time frame (Waisley 1998). Much of the 1.9 billion acres within the offshore jurisdiction of the U.S. remains unexplored (Oil and Gas Technologies for the Arctic and Deepwater 1985). Some of the older oil and gas platforms in operation will probably reach the end of their productive life in the near future, and decommissioning them is also an issue.

Potential Adverse Impacts

Offshore oil and gas operations can be classified into exploration, development, and production activities (which includes transportation). These activities occur at different depths in a variety of habitats. Not all of the potential disturbances in this list apply to every type of activity. These areas are subject to an assortment of physical, chemical, and biological disturbances, including the following (Council 1999, Helvey 2002):

- Noise from seismic surveys, vessel traffic, and construction of drilling platforms or islands
- Physical alterations to habitat from the construction, presence, and eventual decommissioning and removal of facilities such as islands or platforms, storage and production facilities, and pipelines to onshore common carrier pipelines, storage facilities, or refineries
- Waste discharges, including well drilling fluids, produced waters, surface runoff and deck drainage, domestic waste waters generated from the offshore facility, solid waste from wells (drilling muds and cuttings), and other trash and debris from human activities associated with the facility
- Oil spills
- Platform storage and pipeline decommissioning

The potential disturbances and associated adverse impacts on the marine environment have been reduced through operating procedures required by regulatory agencies and, in many cases, self-imposed by facilities operators. Most of the activities associated with oil and gas operations are conducted under permits and regulations that require companies to minimize impacts or avoid construction in sensitive marine habitats. New technological advances in operating procedures also reduce the potential for impacts.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH:

1. As part of pre-project planning, identify all species of concern regulated under federal or state fishery management plans that inhabit, spawn, or migrate through areas slated for exploration, development, or production.
2. Avoid the discharge of produced waters into marine waters and estuaries. Reinject produced waters into the oil formation whenever possible.
3. Avoid discharge of muds and cuttings into the marine and estuarine environment.
4. To the extent practicable, avoid the placement of fill to support construction of causeways or structures in the nearshore marine environment.
5. As required by federal and state regulatory agencies, encourage the use of geographic response strategies that identify EFH and environmentally sensitive areas.
6. To the extent practicable, use methods to transport oil and gas that limit the need for handling in environmentally sensitive areas, including EFH.
7. Ensure that appropriate safeguards have been considered before drilling the first development well into the targeted hydrocarbon formations whenever critical life history stages of federally managed species are present.
8. Ensure that appropriate safeguards have been considered before drilling exploration wells into untested formations whenever critical life stages of federally managed species are present.
9. Oil and gas transportation and production facilities should be designed, constructed, and operated in accordance with applicable regulatory and engineering standards.
10. Evaluate and minimize impacts to EFH during the decommissioning phase of oil and gas facilities, including possible impacts during the demolition phase.

F.2.4.5 Habitat Restoration/Enhancement

Habitat loss and degradation are major, long-term threats to the sustainability of fishery resources (NMFS 2002). Viable coastal and estuarine habitats are important to maintaining healthy fish stocks. Good water quality and quantity, appropriate substrate, ample food sources, and substantial hiding places are needed to sustain fisheries. Restoration and/or enhancement of coastal and riverine habitat that supports managed fisheries and their prey will assist in sustaining and rebuilding fisheries stocks and recovering certain threatened or endangered species by increasing or improving ecological structure and functions. Habitat restoration/enhancement may include, but is not limited to, improvement of coastal wetland tidal exchange or reestablishment of historic hydrology, dam or berm removal, fish passage barrier removal/ modification, road-related sediment source reduction, natural or artificial reef/substrate/habitat creation, establishment or repair of riparian buffer zones, improvement of freshwater habitats that support anadromous fishes, planting of native coastal wetland and submerged aquatic vegetation, creation of oyster reefs, and improvements to feeding, shade or refuge, spawning, and rearing areas that are essential to fisheries.

Potential Adverse Impacts

The implementation of restoration/enhancement activities may have localized and temporary adverse impacts on EFH. Possible impacts can include (1) localized nonpoint source pollution such as influx of sediment or nutrients, (2) interference with spawning and migration periods, (3) temporary or permanent removal feeding opportunities, and (4) indirect effects from actual construction portions of the activity.

Recommended Conservation Measures

The following recommended conservation measures should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. Use BMPs to minimize and avoid potential impacts to EFH during restoration activities. BMPs should include, but are not limited to, the following:
   a) Use turbidity curtains, haybales, and erosion mats to protect the water column.
   b) Plan staging areas in advance, and keep them to a minimum size.
   c) Establish buffer areas around sensitive resources; flag and avoid rare plants, archeological sites, etc.
   d) Remove invasive plant and animal species from the proposed action area before starting work. Plant only native plant species. Identify and implement measures to ensure native vegetation or revegetation success (Section G.4.4 of the EFH EIS).
   e) Establish temporary access pathways before restoration activities to minimize adverse impacts from project implementation.
2. Avoid restoration work during critical life stages for fish such as spawning, nursery, and migration. Determine these periods before project implementation to reduce or avoid any potential impacts.
3. Provide adequate training and education for volunteers and project contractors to ensure minimal impact to the restoration site. Train volunteers in the use of low-impact techniques for planting, equipment handling, and any other activities associated with the restoration.
4. Conduct monitoring before, during, and after project implementation to ensure compliance with project design and restoration criteria. If immediate post-construction monitoring reveals that unavoidable impacts to EFH have occurred, ensure that appropriate coordination with NMFS occurs to determine appropriate response measures, possibly including mitigation.
5. To the extent practicable, mitigate any unavoidable damage to EFH within a reasonable time after the impacts occur.
6. Remove and, if necessary, restore any temporary access pathways and staging areas used in the restoration effort.
7. Determine benthic productivity by sampling before any construction activity in the case of subtidal enhancement (e.g., artificial reefs). Avoid areas of high productivity to the maximum extent possible. Develop a sampling design with input from state and federal resource agencies. Before construction, evaluate of the impact resulting from the change in habitat (sand bottom to rocky reef, etc.). During post-construction monitoring, examine the effectiveness of the structures for increasing habitat productivity.

F.2.4.6 Marine Mining

Mining activity, which is also described in Sections G.3.1.1 and G.3.1.2 of the EFH EIS, can lead to the direct loss of EFH for certain species. Offshore mining, such as the extraction of gravel and gold in the Bering Sea and the mining of gravel from beaches, can increase turbidity of water. Thus, the resuspension of organic materials could affect less motile organisms (i.e., eggs and recently hatched larvae) in the area.

Benthic habitats could be damaged or destroyed by these actions. Mining large quantities of beach gravel may significantly affect the removal, transport, and deposition of sand and gravel along the shore, both at the mining site and down-current (Council 1999). Neither the future extent of this activity nor the effects of such mortality on the abundance of marine species is known.

Potential Adverse Impacts

Mining practices that can affect EFH include physical impacts from intertidal dredging and chemical impacts from the use of additives such as flocculates (Council 1999). Impacts may include the removal of substrates that serve as habitat for fish and invertebrates; habitat creation or conversion in less productive or uninhabitable sites, such as anoxic holes or silt bottom; burial of productive habitats, such as in near-shore disposal sites (as in beach nourishment); release of harmful or toxic materials either in association with actual mining, or in connection with machinery and materials used for mining; creation of harmful turbidity levels; and adverse modification of hydrologic conditions so as to cause erosion of desirable habitats. Submarine disposal of mine tailings can also alter the behavior of marine organisms. Submarine mine tailings may not provide suitable habitat for some benthic organisms. In laboratory experiments, benthic dwelling flatfishes (Johnson et al. 1998a) and crabs (Johnson et al. 1998b) strongly avoided mine tailings.

During beach gravel mining, water turbidity increases and the resuspension of organic materials can affect less motile organisms (i.e., eggs and recently hatched larvae) in the area. Benthic habitats can be damaged or destroyed by these actions. Changes in bathymetry and bottom type may also alter population and migrations patterns (Hurme and Pullen 1988).

Recommended Conservation Measures

The following recommended conservation measures for marine mining should be viewed as options to avoid and minimize adverse impacts and promote the conservation, enhancement, and proper functioning of EFH.

1. To the extent practicable, avoid mining in waters containing sensitive marine benthic habitat including EFH (e.g., spawning, migrating, and feeding sites).
2. Minimize the areal extent and depth of extraction to reduce recolonization times.
3. Monitor turbidity during operations, and cease operations if turbidity exceeds predetermined threshold levels. Use sediment or turbidity curtains to limit the spread of suspended sediments and minimize the area affected.
4. Monitor individual mining operations to avoid and minimize cumulative impacts. For instance, three mining operations in an intertidal area could impact EFH, whereas one may not. Disturbance of previously contaminated mining areas may cause additional loss of EFH.
5. Use seasonal restrictions, as appropriate, to avoid and minimize impacts to EFH during critical life history stages of managed species (e.g., migration and spawning).

F.2.4.7 Persistent Organic Pollutants

The single biggest pollution threat to marine waters in Alaska is the deposition of persistent pollutants from remote sources. A large variety of contaminants can be found in Alaska’s marine environment, including persistent organic pollutants (POPs) and heavy metals. North Pacific and Alaska marine waters are perceived as pristine because most of Alaska’s 6,640 miles (10,686 kilometers) of coastline are devoid of point-source pollution, unlike much of North America. Effluents from pulp mills, marinas and boat harbors, municipal outfalls, and other industrial activities are generally considered to be the primary sources of contamination in Alaska waters, so most efforts at monitoring and mitigation have been focused on the local level. However, there is an increasing body of evidence suggesting that the greatest contaminant threat in Alaska comes from atmospheric and marine transport of contaminants from areas quite distant from Alaska.

The geography of Alaska makes it particularly vulnerable to contaminants volatilized from Asia. Pesticides applied to crops in Southeast Asia can be volatilized into the air, bound to suspended particulates, transported in the atmosphere to Alaska, and deposited in snow or rain directly into marine ecosystems or indirectly from freshwater flow to nearshore waters. Revolatilization of these compounds is inhibited by the cold temperatures associated with Alaska latitudes, resulting in a net accumulation of these compounds in northern habitats. This same distillation process also transfers volatilized contaminants from the atmosphere to the Pacific at lower latitudes, and ocean currents also deliver the contaminants to Alaska. Concentrations will be very low, but there will extensive geographical marine or land areas to act as cold deposit zones. The effect of these transport mechanisms has been the appearance of persistent organic contaminants in northern latitudes, despite the absence of local sources.

With over 100,000 chemicals on the market and an additional 1,000 to 2,000 new ones introduced annually, there are likely other toxic compounds in the environment whose concentrations are increasing. In addition, combustion and industrial processes result in the inadvertent production of unregulated chemicals (Arctic Monitoring and Assessment Programme [AMAP] 2002).

Potential Adverse Impacts

It is not clear if the levels of contaminants in Alaska waters are causing deleterious effects to populations, because research in this area is still in its infancy. Relatively small and spotty contaminant surveys have established that POPs are present in Alaska waters, forage, and predators. No comprehensive geographical and temporal studies have been done to date to examine trends or sources of variation. The potential for the problem has been exposed; the extent and significance remain to be determined.

The existence of organic contaminants in biological tissues means these contaminants are being transported within the food webs in Alaska fish habitats. The trophic structure of Alaska marine food webs, coupled with the tendency of contaminants to accumulate in Alaska habitats, causes apex predators to concentrate significant amounts of POPs in their tissues. Contamination is probably widespread among forage species at low levels, but apex predators are likely be the most affected as a result of their longevity, lipid storage, and the relatively high concentrations they bear. Contamination can cause immunological and reproductive impairment, acute toxic effects, and population declines. This issue is particularly relevant when the contaminant loads experienced by Alaska natives subsisting on foods derived from marine habitats are considered. Impacts may also occur at lower trophic levels, but there has been even less research in this area.

The impacts of persistent contaminants on populations in Alaska waters are not likely to be acute. The impacts are more likely be expressed as sublethal impacts in apparently healthy animals. These sublethal impacts ultimately lead to reduced reproductive fitness or decreased survival to maturity; therefore, they manifest themselves indirectly. Science is certain that the physical properties of these compounds couple with global climate patterns to ensure that they will be deposited in Alaska habitats, while maintaining their toxicity and perfusing through Alaska food webs, which include some of the most valuable fisheries on the planet. What is uncertain is how these compounds impact the health of organisms deriving sustenance from those food webs and how those impacts might feed back into the food web.

Recommended Conservation Measures

No mitigation strategies are proposed at this time relative to contaminants. There are too many unknowns. POP contaminants are present in Alaska waters and forage species and in predators up through apex predators, but the significance of the present loads is not known. Also, the relative concentrations in forage species (pollock for example) from the EBS, near Russia, or the northern GOA are not known. Comprehensive studies on a geographical, temporal, or widespread species scale to determine any relationship between contaminant loads and population changes have not been conducted. POP contaminants may contribute to poor recovery in some species, but mitigation strategies, whether they would be changes in fishing regulations or international regulation to curb contaminant releases, will likely need a better research foundation to support changes.

F.2.5 References

Abbott, R. and E. Bing-Sawyer. 2002. Assessment of pile driving impacts on the Sacramento blackfish (*Othodon microlepidotus*). Draft report prepared for Caltrans District 4. October 10, 2002.

Arctic Monitoring and Assessment Programme (AMAP). 2002. Arctic pollution 2002: Persistent organic pollutants, heavy metals, radioactivity, human health, changing pathways. Arctic Monitoring and Assessment Programme. Oslo Norway. pp. iii - 111.

Ball, B.J., G. Fox, and B.W. Munday. 2000. Long- and short-term consequences of a Nephrops trawl fishery on the benthos and environment of the Irish Sea. ICES Journal of Marine Science. 57(5):1,315-1,320.

Bergman, M.J.N. and J.W. van Santbrink. 2000. Mortality in megafaunal benthic populations caused by trawl fisheries on the Dutch continental shelf in the North Sea in 1994 ICES Journal of Marine Science 57:1,321-1,331.

Brown, E. 2003. Effects of commercial otter trawling on EFH of the southeastern BS shelf. Master's Thesis, University of Washington.

Brylinsky, M., J. Gibson, and D.C. Gordon, Jr. 1994. Impacts of flounder trawls on the intertidal habitat and community of the Minas Basin, Bay of Fundy. Canadian Journal of Fisheries and Aquatic Sciences. 51(3):650-661.

Caltrans. 2001. Fisheries Impact Assessment, Pile Installation Demonstration Project for the San Francisco - Oakland Bay Bridge, East Span Seismic Safety Project, August 2001. 59 pp.

Center for Watershed Protection (CWP). 2003. Impacts of Impervious Cover on Aquatic Systems. Elliott City, MD, www.cwp.org, 141 pp.

Christopherson, A. and J. Wilson. 2002. Technical Letter Report Regarding the San Francisco-Oakland Bay Bridge East Span Project Noise Energy Attenuation Mitigation. Peratrovich, Nottingham & Drage, Inc. Anchorage, Alaska. 27 pp.

Clark, M.R. and R. O'Driscoll. 2003. Deepwater fisheries and their impact on seamount habitat in New Zealand. Journal of Northwest Atlantic Fishery Science 31: 441-458.

Eno, N., D.S. Macdonald, J.A. Kinnear, S. Amos, C.J. Chapman, R.A. Clark, F.S. Bunker, and C. Munro. 2001. Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science. 58(1):11-20.

Environmental Protection Agency (EPA). 1995. National Water Quality Inventory: 1994 Report to Congress. EPA-841-R-95-005. EPA Office of Water, Washington, D.C.

EPA. 1993. Guidance for specifying management measures for sources of nonpoint pollution in coastal waters. EPA Office of Water. 840-B-92-002. 500+ pp.

EPA. 1993. Guidance for specifying management measures for sources of nonpoint pollution in coastal waters. EPA Office of Water. 840-B-92-002. 500+ pp.

EPA. 1974. Development Document for Effluent Limitations Guidelines and Standards of Performance for the Catfish, Crab, Shrimp, and Tuna segments of the Canned and Preserved Seafood Processing Industry Point Source Category. Effluent Guidelines Division, Office of Water and Hazardous Material, Washington, D.C. EPA-44011-74-020-a. 389 pp.

Favorite, F., A.J. Dodimead, and K. Nasu. 1976. "Oceanography of the Subarctic Pacific region, 1960-71." *International North Pacific Fisheries Commission Bulletin*, *33*. International North Pacific Fisheries Commission, 6640 Northwest Marine Drive, Vancouver, BC, Canada V6T 1X2. p. 187.

Fay, V. 2002. Alaska Aquatic Nuisance Species Management Plan. Alaska Department of Fish and Game Publication. Juneau, AK. http://www.adfg.state.ak.us/special/invasive/ak-ansmp.pdf.

Fossa, J.H., P.B. Mortensen, and D.M. Furevik. 2002. The deep-water coral *Lophelia pertusa* in Norwegian waters distribution and fishery impacts. Hydrobiologia 471: 1-12.

Freese, L., P.J.Auster, J. Heifetz, and B.L. Wing. 1999. Effects of trawling on seafloor habitat and associated invertebrate taxa in the GOA. Marine Ecology Progress Series 182:119-126.

Gilkinson, K., M. Paulin, S. Hurley, and P. Schwinghamer. 1998. Impacts of trawl door scouring on infaunal bivalves: results of a physical trawl door model/dense sand interaction Journal of Experimental Marine Biology and Ecology 224(2):291-312.

Gregory, S.V. and P.A. Bisson. 1997. Degradation and loss of anadromous salmonid habitat in the Pacific Northwest. *In* Stouder, J.D., P.A. Bisson, and R.J. Naiman, eds. Pacific Salmon and Their Ecosystems: Status and Future Options, pp. 277-314. Chapman and Hall, New York.

Hattori, A., and J.J. Goering. 1986. "Nutrient distributions and dynamics in the eastern Bering Sea." The Eastern Bering Sea Shelf: Oceanography and Resources, D. W. Hood and J. A. Calder, eds., University of Washington Press, Seattle, Washington. pp. 975-992.

Helvey, M. 2002. "Are southern California oil and gas platforms essential fish habitat?" *ICES Journal of Marine Science*. 59:S266-S271.

Hurme, A.K. and E.J. Pullen. 1988. Biological effects of marine sand mining and fill placement for beach replenishment: Lesson for other use. *Marine Mining*. Vol. 7.

Johnson, S.W., S.D. Rice, and D.A. Moles. 1998a. Effects of submarine mine tailings disposal on juvenile yellowfin sole (*Pleuronectes asper*): a laboratory study. Marine Pollution Bulletin. *36:278-287.*

Johnson, S.W., R.P. Stone, and D.C. Love. 1998b. Avoidance behavior of ovigerous Tanner crabs *(Chionoecetes bairdi*) exposed to mine tailings: a laboratory study. Alaska Fish. Res. Bull. 5:39-45.

Johnson, E.A. 1983. "Textural and compositional sedimentary characteristics of the Southeastern Bristol Bay continental shelf, Alaska," M.S., California State University, Northridge, California.

Kinder, T.H., and J.D. Schumacher. 1981. "Hydrographic Structure Over the Continental Shelf of the Southeastern Bering Sea." The Eastern Bering Sea Shelf: Oceanography and Resources, D. W. Hood and J. A. Calder, eds., University of Washington Press, Seattle, Washington. pp. 31-52.

Kenchington, E.L.R., J. Prena, K.D. Gilkinson, D.C. Gordon, K. MacIsaac, C. Bourbonnais, P.J. Schwinghamer, T.W. Rowell, D.L McKeown, and W.P. Vass. 2001. Effects of experimental otter trawling on the macrofauna of a sandy bottom ecosystem on the Grand Banks of Newfoundland. Canadian Journal of Fisheries and Aquatic Sciences. 58(6):1043-1057.

Krieger, K. 2001. Coral impacted by fishing gear in the GOA. Proceedings of the First International Symposium on Deepwater Corals. (Ecology Action Centre and Nova Scotia Museum, Halifax, Nova Scotia 106-117).

Krieger, K. 1993. Distribution and abundance of rockfish determined from a submersible and by bottom trawling. Fishery Bulletin 91(1):87-96.

Krieger, K. 1992. Shortraker rockfish, *Sebastes borealis*, observed from a manned submersible. Marine Fisheries Review. 54(4):34-37.

Livingston, P.A., and S. Tjelmeland. 2000. "Fisheries in boreal ecosystems." *ICES Journal of Marine Science*. p. 57.

Longmuir, C. and T. Lively. 2001. Bubble curtain systems for use during marine pile driving. Report by Fraser River Pile & Dredge Ltd., New Westminster, British Columbia. 9 pp.

McConnaughey, R.A., K.L. Mier, and C.B. Dew. 2000. An examination of chronic trawling effects on soft-bottom benthos of the EBS. ICES Journal of Marine Sciences. 57(5):1377-1388.

McConnaughey, R.A., and K.R. Smith. 2000. Associations between flatfish abundance and surficial sediments in the eastern Bering Sea. *Can. J. Fisher. Aquat. Sci.* 57(12):2,410-2,419.

Moran, M.J. and P.C. Stephenson. 2000. Effects of otter trawling on macrobenthos and management of demersal scalefish fisheries on the continental shelf of north-western Australia. 2000. ICES Journal of Marine Science. 57(3):510-516.

National Marine Fisheries Service (NMFS). 2005. Final Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. DOC, NOAA, National Marine Fisheries Service, Alaska Region, P. O. Box 21668, Juneau, Alaska 99802-1668. Volumes I-VII.

NMFS. 2004. Final Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement. DOC, NOAA, National Marine Fisheries Service, Alaska Region, P. O. Box 21668, Juneau, Alaska 99802-1668. Volumes I-VII.

NMFS. 2002. Environmental Assessment, NMFS' Restoration Plan for the Community-Based Restoration Program. Prepared by the NOAA Restoration Center, Office of Habitat Conservation. Silver Spring, MD.

North Pacific Fishery Management Council (Council). 1999. Environmental Assessment for Amendment 55 to the Fishery Management Plan for the Groundfish Fishery of the Bering Sea and Aleutian Islands Area; Amendment 55 to the Fishery Management Plan for Groundfish of the Gulf of Alaska; Amendment 8 to the Fishery Management Plan for the King and Tanner Crab Fisheries in the Bering Sea/Aleutian Islands; Amendment 5 to the Fishery Management Plan for Scallop Fisheries off Alaska; Amendment 5 to the Fishery Management Plan for the Salmon Fisheries in the EEZ off the Coast of Alaska, Essential Fish Habitat. 605 West 4th Ave, Suite 306, Anchorage, AK 99501-2252. 20 January.

Nightingale, B. and C.A. Simenstad. 2001. Overwater Structures: Marine Issues. White paper submitted to Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation. www.wa.gov/wdfw/hab. 133 pp.

Northcote, T.G. and G.F. Hartman. 2004. Fishes and Forestry - Worldwide Watershed Interactions and Management, Blackwell Publishing, Oxford, UK, 789 pp.

Northwest Power Planning Council. 1986. Compilation of information on salmon and steelhead losses in the Columbia River Basin. Columbia River Basin and Wildlife Program. Portland, OR.

National Research Council (NRC), Committee on Hardrock Mining. 1999. Hardrock Mining on Federal Lands. Appendix B. Potential Environmental Impacts of Hardrock Mining. (http://www.nap.edu/html/hardrock-fed-lands/appB.html).

Oil and Gas Technologies for the Arctic and Deepwater. 1985. U.S. Congress, Office of Technology Assessment, OTA-O-270, May 1985. Library of Congress Catalog Card Number 85-600528. U.S. Government Printing Office, Washington, DC 20402.

Omori, M., S. Van der Spoel, C.P. Norman. 1994. Impact of human activities on pelagic biogeography. Progress in Oceanography 34 (2-3):211-219.

Prena, J., P. Schwinghamer, T.W. Rowell, D.C. Jr Gordon, K.D. Gilkinson, W.P. Vass, and D.L McKeown. 1999. Experimental otter trawling on a sandy bottom ecosystem of the Grand Banks of Newfoundland: Analysis of trawl bycatch and effects on epifauna. Marine Ecology Progress Series. 181:107-124.

Reed, R.K. 1984. "Flow of the Alaskan Stream and its variations." *Deep-Sea Research*, 31:369-386.

Reyff, J.A and P. Donovan. 2003. Benicia-Martinez Bridge Bubble Curtain Test - Underwater Sound Measurement Data. Memo to Caltrans dated January 31, 2003. 3 pp.

Reyff, J.A. 2003. Underwater sound levels associated with seismic retrofit construction of the Richmond-San Rafael Bridge. Document in support of Biological Assessment for the Richmond-San Rafael Bridge Seismic Safety Project. January 31, 2003. 18 pp.

Schwinghamer, P., D.C. Gordon, Jr., T.W. Rowell, J.P. Prena, D.L McKeown, G. Sonnichsen, and J.Y. Guignes. 1998. Effects of experimental otter trawling on surficial sediment properties of a sandy-bottom ecosystem on the Grand Banks of Newfoundland. Conservation Biology 12: 1215-1222.

Science Applications International Corporation. 2001. Information Collection Request for National Pollutant Discharge Elimination System (NPDES) and Sewage Sludge Monitoring Reports. Prepared by Science Applications International Corporation, 11251 Roger Bacon Drive, Reston, VA 20190, for Tetra Tech, Inc., Fairfax, VA, for the U.S. Environmental Protection Agency, Office of Wastewater Management, Washington, D.C. EPA ICR# 0229.15. p. 11.

Scott G.I., M.H. Fulton, D.W. Moore, E.F. Wirth, G.T. Chandler, P.B. Key, J.W. Daugomah, E.D. Strozier, J. Devane, J.R. Clark, M.A. Lewis, D.B. Finley, W. Ellenberg, and K.J. Karnaky. 1999. "Assessment of risk reduction strategies for the management of agricultural nonpoint source pesticide runoff in estuarine ecosystems." *Toxicology and Industrial Health*. 15:200-213.

Sengupta, M. 1993. Environmental Impacts of Mining: Monitoring, Restoration, and Control. CRC Press, Inc. 2000 Corporate Blvd., N.W. Boca Raton, FL. 33431. p.1.

Sharma, G.D. 1979. The Alaskan shelf: hydrographic, sedimentary, and geochemical environment, Springer-Verlag, New York. 498 pp.

Smith, K.R., and R.A. McConnaughey. 1999. "Surficial sediments of the eastern Bering Sea continental shelf: EBSSED database documentation." NOAA Technical Memorandum, *NMFS-AFSC-104*, U.S. Department of Commerce, NMFS Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, Washington 98115-0070. 41 pp.

Smith, C.J., K.N. Papadopoulou, S. Diliberto. 2000. Impact of otter trawling on eastern Mediterranean commercial trawl fishing ground. ICES Journal of Marine Science 55:1340-1351. (B-16).

Stotz, T. and J. Colby. 2001. January 2001 dive report for Mukilteo wingwall replacement project. Washington State Ferries Memorandum. 5 pp. + appendices.

Van Dolah, R.F., P.H. Wendt, and N. Nicholson. 1987. Effects of a research trawl on a hard-bottom assemblage of sponges and corals. Fisheries Research 5: 39-54.

Waisley, S.L. 1998. Projections for U.S. and Global Supply and Demand for 2010 and 2020. presented at U.S. and China Oil and Gas Industrial Forum, Beijing, People's Republic of China, November 2-4, 1998. Office of Natural Gas and Petroleum Technology, U.S. DOE, Washington, D.C. (http://www.fe.doe.gov/oil-gas/china-forum/cl04000.html).

Williams, G.D. and R.M. Thom. 2001. Marine and estuarine shoreline modification issues. White paper submitted to Washington Department of Fish and Wildlife, Washington Department of Ecology and Washington Department of Transportation. www.wa.gov/wdfw/hab/ahg. 99 pp.

Würsig, B., C.R. Greene, Jr., and T.A. Jefferson. 2000. "Development of an air bubble curtain to reduce underwater noise of percussive pile driving." *Marine Environmental Research*. 49:79-93.

F.3 Cumulative Effects of Fishing and Non-Fishing Activities on Essential Fish Habitat

This section discusses the cumulative effects of fishing and non-fishing activities on EFH. As identified in Section 4.4 of the EFH EIS (NMFS 2005), historical fishing practices may have had effects on EFH that have led to declining trends in some of the criteria examined (Table 4.4-1 of the EFH EIS). As described in earlier sections of F.1 above, the effects of current fishing activities on EFH are classified as minimal and temporary or unknown.

A review of the effects of non-fishing activities on EFH is found in Section F.2 above. There are 29 non-fishing activities for which potential effects are described above. However, the magnitude of these effects cannot currently be quantified with available information. Of the 29 activities, most are described as likely having less than substantial potential effects on EFH. Some of these activities such as urban/suburban development, road building and maintenance (including the placement of fill material), vessel operations/transportation/navigation, silviculture (including LTFs), and point source discharge may have potential cumulative impacts due to the additive and chronic nature of these activities. NMFS does not have regulatory authority over non-fishing activities, but frequently provides recommendations to other agencies to avoid, minimize, or otherwise mitigate the effects of these activities.

Fishing and each activity identified in the analysis of non-fishing activities may not significantly affect the function of EFH. However, the synergistic effect of the combination of all of these activities may be a cause for concern. Unfortunately, available information is not sufficient to assess how the cumulative effects of fishing and non-fishing activities influence the function of EFH on an ecosystem or watershed scale. The magnitude of the combined effect of all of these activities cannot be quantified, so the level of concern is not known at this point.

Appendix G Fishery Impact Statement

The Magnuson-Stevens Fishery and Conservation Management Act requires that a fishery management plan (FMP) include a fishery impact statement that assesses, specifies, and describes the likely effects of the FMP measures on participants in the fisheries and fishing communities affected by the FMP. A detailed analysis of the effects of the FMP on the human environment, including fishery participants and fishing communities, was conducted in the *Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement* (NMFS 2004). The following is a brief summary from this analysis.

The FMP has instituted privilege-based management programs in the some groundfish fisheries, and fishery managers, under the guidance of the FMP management policy, are moving towards extending privilege-based allocations to other groundfish fisheries.

1. The FMP promotes increased social and economic benefits through the promotion of privilege-based allocations to individuals, sectors and communities. For this reason, it is likely to increase the commercial value generated from the groundfish fisheries.
2. As the race-for-fish is eliminated, the FMP could result in positive effects in terms of producer net revenue, consumer benefits, and participant health and safety.
3. The elimination of the race-for-fish will likely result in a decrease in overall participation levels. In the long-run, communities are likely to see fewer persons employed in jobs related to the fishing industry (fishing, processing, or support sectors), but the jobs that remain could be more stable and provide higher pay.
4. The FMP's promotion of privilege-based allocations is also expected to increase consumer benefits and health and safety of participants.

The FMP has adopted a variety of management measures to promote the sustainability of the groundfish fisheries and dependent fishing communities.

- Management measures to account for uncertainty ensure the sustainability of the managed species by maintaining a spawning stock biomass for the target species with the potential to produce sustained yields.
- The transition to privilege-based management in the short-term could disrupt stability, however in the long-term, the stability of fisheries would be increased in comparison to a derby-style fishery.
- Communities would also tend to experience an increase in stability as a result of built-in community protections to the privilege-based management programs.

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Appendix H Research Needs

Although research needs are identified in this appendix to the Fishery Management Plan (FMP), ongoing research and research needs are constantly being updated. It may therefore be useful to the reader to access other sources in order to obtain the North Pacific Fishery Management Council (Council)'s most current description of research and research needs on the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. A complete discussion of up-to-date sources is included in Chapter 6 of the FMP. In particular, the Council's Science and Statistical Committee regularly updates the Council on its research needs, and these can be found on the Council's website. Additionally, ongoing research by National Marine Fisheries Service (NMFS)' Alaska Fisheries Science Center (AFSC) is also accessible through their website. Website addresses are in Chapter 6.

The FMP management policy identifies several research programs that the Council would like to encourage. These are listed in Section H.1. The Council relies on its Scientific and Statistical Committee (SSC) to assist the Council in interpreting biological, sociological, and economic information. The SSC also plays an important role in providing the Council with recommendations regarding research direction and priorities based on identified data gaps and research needs. The SSC and Council's research priorities are listed in Section H.2. Additionally, NMFS regularly develops a five-year strategy for fisheries research which is described in Section H.3. Research needs specific to essential fish habitat are described in Section H.4.

H.1 Management Policy Research Programs

The management objectives of the FMP (see Section 2.2.1) include several objectives that provide overarching guidance as to research programs that the Council would like to encourage.

- Encourage research programs to evaluate current population estimates for non-target species with a view to setting appropriate bycatch limits as information becomes available.
- Encourage programs to review status of endangered or threatened marine mammal stocks and fishing interactions and develop fishery management measures as appropriate.
- Encourage development of a research program to identify regional baseline habitat information and mapping, subject to funding and staff availability.
- 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.

Other objectives in the management policy also contain research elements without which they cannot be achieved. Research initiatives that would support other FMP management objectives are discussed in Section H.1.2 below.

H.2 Council Research Priorities

At its March 2003 meeting, the SSC reviewed the list of research priorities as developed by the Council's BSAI and Gulf of Alaska (GOA) groundfish Plan Teams, and developed the following short list of research topics:

A. Critical Assessment Problems

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

- Supplement triennial trawl survey biomass estimates with estimates of biomass or indices of biomass obtained from alternative survey designs.
- Obtain age and length samples from the commercial fishery, especially for Pacific ocean perch, northern rockfish, and dusky rockfish.
- Increase capacity for production ageing of rockfish so that age information from surveys and the fishery can be included in stock assessments in a timely manner.
- Further research is needed on model performance in terms of bias and variability. In particular, computer simulations, sensitivity studies, and retrospective analyses are needed. As models become more complex in terms of parameters, error structure, and data sources, there is a greater need to understand how well they perform.

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

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

B. Stock Survey Concerns

- There is a need to explore ways for inaugurating or improving surveys to assess rockfish, including nearshore pelagics.
- There is a need to develop methods to measure fish density in habitats typically inaccessible to NMFS survey gear, i.e., untrawlable habitats.

C. Expanded Ecosystem Studies

- Research effort is required to develop methods for incorporating the influence of environmental and climate variability, and there influence on processes such as recruitment and growth into population models, especially for crab stocks.
- Forage fish are an important part of the ecosystem, yet little is known about these stocks. Effort is needed on stock status and distribution for forage fishes such as capelin, eulachon, and sand lance.
- Studies are needed to identify essential habitat for groundfish and forage fish. Mapping of nearshore and shelf habitat should be continued for FMP species.

D. Social and Economic Research

- Development of time series and cross-sectional databases on fixed and variable costs of fishing and fish processing.
- Pre- and post-implementation economic analyses of crab and GOA groundfish rationalization.

- Identification of data needed to support analyses of community level consequences of management actions.
- Development of integrated multispecies and multifishery models for use in analyses of large scale management actions, such as the Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement and the Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska.

E. Bycatch

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

F. Monitoring

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

G. Research Priorities Identified by the National Research Council's Steller Sea Lion Committee

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

H.3 National Marine Fisheries Service

NMFS is responsible for ensuring that management decisions are based on the best available scientific information relevant to the biological, social, and economic status of the fisheries. As required by the Magnuson-Stevens Fishery Management and Conservation Act, NMFS published the *NMFS Strategic Plan for Fisheries Research* in December 2001, outlining proposed research efforts for fiscal years 2001-2006. The Strategic Plan outlines the following broad goals and objectives for NMFS: 1) to improve scientific capability; 2) to increase science quality assurance; 3) to improve fishery research capability; 4) to improve data collection; 5) to increase outreach/information dissemination; and 6) to support international fishery science. The document also outlines the AFSC's research priorities for this time period. Summarized below are the AFSC's research priorities grouped into four major research areas: research to support fishery conservation and management; conservation engineering research; research on the fisheries themselves; and information management research.

1. Research to Support Fishery Conservation and Management

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

- Conduct periodic (annual, biennial, triennial) bottom trawl, midwater trawl-acoustic, hydroacoustic bottom trawl, longline surveys on groundfish in the BSAI and GOA.
- Conduct field operations to study marine mammal-fish interactions, with particular emphasis on sea lion and pollock, Pacific cod, and Atka mackerel interactions in the GOA and the BSAI management areas.

- Observer programs for groundfish fisheries that occur off Alaska.
- Assessments of the status of stocks, including their biological production potentials (maximum sustainable yield, acceptable biological catch, overfishing levels), bycatch requirements, and other parameters required for their management.
- Assessments of the population dynamics, ecosystem interactions, and abundance of marine mammal stocks and their incidental take requirements.

b. Social and economic factors affecting abundance levels

c. Interdependence of fisheries or stocks of fish

d. Identifying, restoring, and mapping of essential fish habitat

e. Assessment of effects of fishing on essential fish habitat and development of ways to minimize adverse impacts.

2. Conservation Engineering Research

- Continue to conduct research to measure direct effects of bottom trawling on seafloor habitat according to a five-year research plan.
- Conduct fishing gear performance and fish behavioral studies to reduce bycatch and bycatch mortality of prohibited, undersized, or unmarketable species, and to understand performance of survey gear.
- Work with industry and the Council to develop bycatch reduction techniques.

3. Research on the Fisheries

a. Social and economic research

b. Seafood safety research

c. Marine

4. Information Management Research

- Continue to build data infrastructure and resources for easy access and data processing. The AFSC's key data bases are its survey data bases from the 1950s (or earlier) and the scientific observer data base that extends back to the foreign fishing days of the 1960s.
- Continue to provide information products based on experts and technical data that support NMFS, the Council, international scientific commissions, and the overall research and management community.

H.4 Essential Fish Habitat Research and Information Needs

The EIS for Essential Fish Habitat Identification and Conservation (NMFS 2005) identified the following research approach for EFH regarding minimizing fishing impacts.

Objectives

Reduce impacts. (1) Limit bottom trawling in the AI to areas historically fished and prevent expansion into new areas. (2) Limit bottom contact gear in specified coral garden habitat areas. (3) Restrict higher impact trawl fisheries from a portion of the GOA slope. (4) Increase monitoring for enforcement. (5) Establish a scientific research program.

Benthic habitat recovery. Allow recovery of habitat in a large area with relatively low historic effort.

Research Questions

Reduce impacts. Does the closure effectively restrict higher-impact trawl fisheries from a portion of the GOA slope? Is there increased use of alternative gears in the GOA closed areas? Does total bottom trawl effort in adjacent open areas increase as a result of effort displaced from closed areas? Do bottom trawls affect these benthic habitats more than the alternative gear types? What are the research priorities? Are fragile habitats in the AI affected by any fisheries that are not covered by the new EFH closures? Are sponge and coral essential components of the habitat supporting FMP species?

Benthic habitat recovery. Did the habitat within closed areas recover or remain unfished because of these closures? Do recovered habitats support more abundant and healthier FMP species? If FMP species are more abundant in the EFH protection areas, is there any benefit in yield for areas that are still fished without EFH protection?

Research Activities

Reduce impacts. Fishing effort data from observers and remote sensing would be used to study changes in bottom trawl and other fishing gear activity in the closed (and open) areas. First, the recent gear-specific fishing pattern must be characterized to establish a baseline for comparison with observed changes in effort after closures occur. An effective analysis of change requires comprehensive effort data with high spatial resolution, including accurate information about the tow path or setting location, as well as complete gear specifications. Effects of displaced fishing effort would have to be considered. The relative effects of bottom trawl and alternative gear/footrope designs and, thus, the efficacy of the measure should be investigated experimentally in a relatively undisturbed area that is representative of the closed areas. The basis of comparison would be changes in the structure and function of benthic communities and populations, as well as important physical features of the seabed, after comparable harvests of target species are taken with each gear type. Ultimately, there should be detectable increases in FMP species that are directly attributable to the reduced impacts on sponge and coral habitat.

Benthic habitat recovery. Monitor the structure and function of benthic communities and populations in the newly closed areas, as well as important physical features of the seabed, for changes that may indicate recovery of benthic habitat. Whether these changes constitute recovery from fishing or just natural variability/shifts requires comparison with an area that is undisturbed by fishing and otherwise comparable. A reference site would have to remain undisturbed by fishing during the entire course of the recovery experiment. Such a reference site may or may not exist, and the essential elements of comparability for identifying this area are presently unknown. Without proper reference sites, it may still be possible to deduce recovery dynamics based on changes observed in comparable newly closed areas with different histories of fishing disturbance.

Research Time Frame

Changes in fishing effort and gear types should be readily detectable. Biological recovery monitoring may require an extended period if undisturbed habitats of this type typically include large or long-lived organisms and/or high species diversity. Recovery of smaller, shorter-lived components should be apparent much sooner.

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Appendix I Information on Marine Mammal and Seabird Populations

This appendix contains information on the marine mammal and seabird populations in the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA) management areas. Much of the information in this appendix is from the Programmatic Supplemental Environmental Impact Statement for Alaska Groundfish Fisheries, published by National Marine Fisheries Service (NMFS) in 2004.

I.1 Marine Mammal Populations

Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982). In the areas fished by the federally managed groundfish fleets, twenty-six species of marine mammals are present from the orders Pinnipedia (seals, sea lion, and walrus), Carnivora (sea otter and polar bear), and Cetacea (whales, dolphins, and porpoises) (Lowry and Frost 1985). Most species are resident throughout the year, while others seasonally migrate into and out of Alaskan waters.

I.1.1 Potential impacts of fisheries on marine mammals

Direct Mortality from Intentional Take

Commercial harvests of marine mammals have occurred at various times and places, sometimes with devastating impacts on the populations of particular species. In some cases, such as the northern right whale, the species have not recovered to pre-exploitation population levels even though commercial whaling was halted decades ago.

Direct Mortality from Incidental Take in Fisheries

Some types of fisheries are much more likely to catch marine mammals incidentally than others. High seas driftnet fishing killed thousands of mammals before it was prohibited in 1991. Longline and pot fisheries very rarely catch marine mammals directly.

Indirect Effects through Entanglement

The following effects are classified as indirect because the impacts are removed in time and/or space from the initial action although in the analysis, these effects are considered together with the direct effect of incidental take. In some cases, individual marine mammals may be killed outright by the effect. In other cases, individuals are affected in ways that may decrease their chances of surviving natural phenomenon or reproducing successfully. These sub-lethal impacts may reduce their overall “fitness” as individuals and may have population-level implications if enough individuals are impacted.

Although some fisheries have no recorded incidental take of marine mammals, all of them probably contribute to the effects of entanglement in lost fishing gear. Evidence of entanglement comes from observations of animals trailing ropes, buoys, or nets or bearing scars from such gear. Sometimes stranded marine mammals also have evidence of entanglement but it my not be possible to ascertain whether the entanglement caused the injury or whether the corpse picked up gear as it floated around after death.

Sometimes an animal is observed to become entangled in specific fishing gear, in which case an incidental take or minor injury may be recorded for that particular fishery, but many times the contributions of individual fisheries to the overall effects of entanglement are difficult to document and quantify.

The Marine Plastic Pollution Research and Control Act of 1987 (33 USC §§ 1901 et seq.), implements the provisions relating to garbage and plastics of the Act to Prevent Pollution from Ships (MARPOL Annex V). These regulations apply to all vessels, regardless of flag, on the navigable waters of the U.S. and in the exclusive economic zone of the U.S. It applies to U.S. flag vessels wherever they are located. The discharge of plastics into the water is prohibited, including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics.

Indirect Effects through Changes in Prey Availability

The availability of prey to marine mammals depends on a large number of factors and differs among species and seasons. Among these factors are oceanographic processes such as upwellings, thermal stratification, ice edges, fronts, gyres, and tidal currents that concentrate prey at particular times and places. Prey availability also depends on the abundance of competing predators and the ecology of prey species, including their natural rates of reproduction, seasonal migration, and movements within the water column. The relative contributions of factors that influence prey availability for particular species and areas are rarely known. Most critical is the lack of information on how events outside an animal's foraging range or in a different season may influence the availability of prey to animals in a particular place and time.

Marine mammal species differ greatly from one another in their prey requirements and feeding behaviors, leading to substantial differences in their responses to changes in the environment. For some species, such as the baleen whales, diets consist largely of planktonic crustaceans or small squid and have no overlap of prey with species that are targeted or taken as bycatch in the groundfish fisheries. For other species, notably Steller sea lions, there is a high degree of overlap between their preferred size and species of prey and the groundfish catch. Many other species are in between, perhaps feeding on the same species but smaller sizes of fish than what is typically taken in the fisheries. Although they may take a wide variety of prey species during the year, many species may depend on only one or a few prey species in a given area and season. In addition, the prey requirements and foraging capabilities of nursing females and subadult animals may be much more restricted than for non-breeding adults, with implications for reproductive success and survival.

The question of whether different types of commercial fisheries have had an effect on the availability of prey to marine mammals has been addressed by examining the degree of direct competition (harvest) of prey and by looking for potential indirect or cascading effects of the fisheries on the food web of the mammals. For marine mammals whose diets overlap to some extent with the target or bycatch species of the fisheries, fishery removals could potentially decrease the density of prey fields or cause changes in the distribution of prey such that the foraging success of the marine mammals is affected. If alternate prey is not available or is of poorer nutritional quality than the preferred species, or if the animal must spend more time and energy searching for prey, reproductive success and/or survival can be compromised. In the case of marine mammals that do not feed on fish or feed on different species than are taken in the fisheries, the removal of a large number of target fish from the ecosystem may alter the predator and prey dynamics and thus the abundance of another species that is eaten by marine mammals. The mechanisms and causal pathways for many potential food web effects are poorly documented because they are very difficult to study scientifically at sea.

Although reductions in the availability of forage fish to marine mammals have been attributed to both climatic cycles and commercial fisheries, a National Research Council study on the Bering Sea ecosystem (NRC 1996) concluded that both factors probably are significant. Regime shifts are major changes in atmospheric conditions and ocean climate that take place on multi-decade time scales and trigger community-level reorganizations of the marine biota (Anderson and Piatt 1999). Two cycles of warm and cold regimes have been documented in the GOA in the past 100 years, with the latest shift being from a cold regime to a warm regime in 1977. The consequences of this shift on fish and crustacean populations have been documented, including major improvements in groundfish recruitment and the collapse of some high-value forage species such as shrimp, capelin, and Pacific sand lance (Anderson and Piatt 1999). Directed fisheries on forage fish can deepen and prolong their natural low population cycles (Duffy 1983, Steele 1991), with potential effects on marine mammal foraging success. There is some evidence that another regime shift may have begun in 1998 with colder water temperatures and increases in certain forage populations (NPFMC 2002), but the implications for marine mammals are still unclear. Climate change may also affect the dynamics of the ice pack, with serious consequences for the marine mammals associated with the ice pack, such as bowhead whales, the ice seals, and walrus.

Direct Effects through Disturbance by Fishing Vessels

The effects of disturbance caused by vessel traffic, fishing operations, engine noise, and sonar pulses on marine mammals are largely unknown. With regard to vessel traffic, many baleen and toothed whales appear tolerant, at least as suggested by their reactions at the surface. Observed behavior ranges from attraction to the vessel to course modification or maintenance of distance from the vessel. Dall's porpoise, Pacific white-sided dolphins, and even beaked whales have been observed adjacent to vessels for extended periods of time. Conversely, harbor porpoise tend to avoid vessels. However, a small number of fatal collisions with various vessels have been recorded in California and Alaska in the past decade and others likely go unreported or undetected (Angliss et al. 2001).

Reactions to some fishing gear, such as pelagic trawls, are poorly documented, although the rarity of incidental takes suggests either partitioning of foraging and fishing areas or avoidance. Given their distribution throughout the fishing grounds, at least some individuals may be expected to occasionally avoid contact with vessels or fishing gear, which would constitute a reaction to a disturbance. Assuming these instances occur, the effects are likely temporary. Sonar devices are used routinely during fishing activity as well as during vessel transit. The sounds produced by these devices may be audible to marine mammals and may thus constitute disturbance sources. Wintering humpback whales have been observed reacting to sonar pulses by moving away (Maybaum 1990, 1993), although few other cases of reaction have been documented.

Indirect Effects through Contamination by Oil Spills

For species such as the pinnipeds and sea otters that spend a substantial amount of time on the surface of the water or hauled out on shore, oil spills pose a significant environmental hazard, even in small amounts. The toxicological effects of ingested oil, ranging from potential organ damage to weakening of the immune system, are poorly known for most species, especially in regard to chronic low doses. Sea otters are particularly susceptible to oil spills because they depend on their thick fur to protect them from cold water, rather than layers of fat, and oil destroys the insulative properties of their fur. Thousands of sea otters died over a large expanse of the GOA as a result of the Exxon Valdez oil spill in 1989 (Garshelis 1997, Garrot et al. 1993, DeGange et al. 1994). There is very little data on the mortality of marine mammals from the much smaller volumes of oil that are more typical of marine vessel spills, resulting from fuel transfer accidents and bilge operations.

I.1.2 Statutory protection for marine mammals

There are two major laws that protect marine mammals and require the North Pacific Fishery Management Council (Council) to address their conservation in the FMPs. The first is the Marine Mammal Protection Act (MMPA) of 1972 (amended 1994). Management responsibility for cetaceans and pinnipeds other than walrus is vested with National Marine Fisheries Service (NMFS) Protected Resources Division (PRD). The United States Fish and Wildlife Service (USFWS) is responsible for management of walrus and sea otters. The goal of the MMPA is to provide protection for marine mammals so that their populations are maintained as a significant, functioning element of the ecosystem. The MMPA established a moratorium on the taking of all marine mammals in the United States with the exception of subsistence use by Alaska Natives. Under the authority of this Act, NMFS PRD monitors populations of marine mammals to determine if a species or population stock is below its optimum sustainable population. Species that fall below this level are designated as "depleted." Populations or stocks (e.g., the western stock of Steller sea lions) listed as threatened or endangered under the Endangered Species Act (ESA), are automatically designated as depleted under the MMPA.

The ESA was enacted in 1973 and reauthorized in 1988. This law provides broad protection for species that are listed as threatened or endangered under the Act. The species listed under the ESA that spend all or part of their time in the BSAI and GOA and that may be affected by the groundfish fisheries are included in the table below. There are eight whale species, and two distinct population segments of Steller sea lions.

Listed Species	Population or Distinct Population Segment (DPS)	Latin Name	Status
Blue whale	North Pacific	*Balaenoptera musculus*	Endangered
Bowhead whale	Western Arctic	*Balaena mysticetus*	Endangered
Fin whale	Northeast Pacific	*Balaenoptera physalus*	Endangered
Humpback whale	Western and Central North Pacific	*Megaptera novaeangliae*	Endangered
Right whale	North Pacific	*Eubalaena japonica*	Endangered
Sei whale	North Pacific	*Balaenoptera borealis*	Endangered
Sperm whale	North Pacific	*Physeter macrocephalus*	Endangered
Gray whale	Eastern Pacific	*Eschrichtius robustus*	Delisted
Steller sea lion	Western Alaska DPS	*Eumetopias jubatus*	Endangered
Steller sea lion	Eastern Alaska DPS	*Eumetopias jubatus*	Threatened

The mandatory protection provisions of the ESA have led to numerous administrative and judicial actions and have brought the issue of fisheries/sea lion interactions under intense scrutiny. Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of its designated critical habitat. For federal fishery management actions, the action agency, NMFS Sustainable Fisheries Division, is required under Section7(a)(2) to consult with the Steller sea lion expert agency, NMFS PRD, to determine if the proposed action may adversely affect Steller sea lions or their critical habitat. If the proposed action may adversely affect Steller sea lions or its designated critical habitat, formal consultation is required. Formal consultation is a process between the action and expert agency that determines whether a proposed action is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat. The process begins with the action agency's assessment of the effects of their proposed action on listed species and concludes with the issuance of a "Biological Opinion" by the expert agency. A biological opinion is a document which includes: a) the opinion of NMFS PRD as to whether or not a federal action (such as federally authorized fisheries) is likely to jeopardize the continued existence of listed species or adversely modify designated critical habitat; b) a summary of the information on which the opinion is based; and c) a detailed discussion of the effects of the action on listed species or designated critical habitat. If the Biological Opinion concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or adversely modify critical habitat, then the expert agency recommends Reasonable and Prudent Alternatives to avoid the likelihood of "jeopardy" or "adverse modification" of critical habitat. The resulting legal requirements limit the Council from adopting FMP policies that result in a jeopardy finding for the Steller sea lions.

I.1.3 Consideration of marine mammals in groundfish fishery management

In order to fulfill their oversight responsibilities under the MMPA, NMFS PRD and the U.S. Fish and Wildlife Service (USFWS) have developed appropriate survey methodologies to census the various species of marine mammals. The results of these surveys, and other factors that affect the status of each species, are published in an annual “Marine Mammal Stock Assessment” report that is available on the NMFS national website (www.nmfs.noaa.gov).

Some species are much more difficult to census accurately than others, so there is a great deal of variation in the uncertainty of various population estimates. In addition, the huge expanses over which many species traverse and the remoteness of their habitats make surveys logistically difficult and expensive. For budgetary and logistical reasons, surveys of most species are not carried out every year and survey effort is prioritized for species of management concern. As a result, population estimates for some species may be outdated and trend information may not exist.

NMFS PRD requires all commercial fisheries in the U.S. Exclusive Economic Zone to report the incidental take and injury of marine mammals that occur during their operations (50 CFR 229.6). In addition to self-reported records, which NMFS PRD considers to be negatively biased and under representing actual take levels, certified observers are required in some fisheries to provide independent monitoring of incidental take as well as other fishery data.

Management measures are in place in the BSAI and GOA groundfish fisheries to protect Steller sea lions. These protection measures were deemed necessary based on the hypothesis that the continued decline of the western stock of the Steller sea lion is due to nutritional stress and that groundfish fisheries contribute to this stress by competing with sea lions for their key prey species. Management measures were specifically developed to reduce competitive interaction between Steller sea lions and the groundfish fisheries (NMFS 2001a). Mitigation efforts have focused on protecting the integrity of food supplies near rookeries and haulouts. Competitive interactions with the fishery may have the greatest effect on juvenile Steller sea lions between the time they are weaned and the time they reach adult size and foraging capability as the diving capacity of juveniles (and thus available foraging space) is less than that of adults. Adult females may also be susceptible to nutritional stress due to reduced prey availability in the vicinity of rookeries because of the limited foraging distribution and increased energetic demands when caring for pups. Specifically, the intent of the protection measures was to avoid competition around rookeries and important haulouts with extra precaution in the winter, and to disperse the fisheries outside of those time periods and areas.

Section 118 of the MMPA (50 CFR 229.2) requires all commercial fisheries to be placed into one of three categories, based on the frequency of incidental take (serious injuries and mortalities) relative to the value of potential biological removal (PBR) for each stock of marine mammal. PBR is defined as the maximum number of animals, not including natural mortalities, that may be removed from a stock while allowing that stock to reach or maintain its optimum sustainable population. In order to categorize each fishery, NMFS PRD first looks at the level of incidental take from all fisheries that interact with a given marine mammal stock. If the combined take of all fisheries is less than or equal to 10 percent of PBR, each fishery in that combined total is assigned to Category III, the minimal impact category. If the combined take is greater than 10 percent of PBR, NMFS PRD then looks at the individual fisheries to assign them to a category. Category I designates fisheries with frequent incidental take, defined as those with takes greater than or equal to 50 percent of PBR for a particular stock; Category II designates fisheries with occasional serious injuries and mortalities, defined as those with takes between one percent and 50 percent of PBR; Category III designates fisheries with a remote likelihood or no known serious injuries or mortalities, defined as those with take less than or equal to one percent of PBR. Owners of vessels or gear engaging in Category I or II fisheries are required to register with NMFS PRD to obtain a marine mammal authorization in order to lawfully take a marine mammal incidentally in their fishing operation (50 CFR 229.4). In Alaska, this registration process has been integrated into other state and federal permitting programs to reduce fees and paperwork. Owners of vessels or gear engaging in Category III fisheries are not required to register with

NMFS PRD for this purpose. Every year, NMFS PRD reviews and revises its list of Category I, II, and III fisheries based on new information and publishes the list in the Federal Register.

Under provisions of the MMPA, NMFS PRD is required to establish take reduction teams with the purpose of developing take reduction plans to assist in the recovery or to prevent the depletion of strategic stocks that interact with Category I and II fisheries. A “strategic” stock is one which: 1) is listed as endangered or threatened under the ESA, 2) is declining and likely to be listed as threatened under the ESA, 3) is listed as depleted under the MMPA, or 4) has direct human-caused mortality which exceeds the stock’s PBR.

The immediate goal of a take reduction plan is to reduce, within six months of its implementation, the incidental serious injury or mortality of marine mammals from commercial fishing to levels less than PBR. The long-term goal is to reduce, within five years of its implementation, the incidental serious injury and mortality of marine mammals from commercial fishing operations to insignificant levels approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional Fishery Management Plans. Take reduction teams are to consist of a balance of representatives from the fishing industry, fishery management councils, state and federal resource management agencies, the scientific community, and conservation organizations. Fishers participating in Category I or II fisheries must comply with any applicable take reduction plan and may be required to carry an observer onboard during fishing operations.

In 2002, all of the Alaska groundfish fisheries (trawl, longline, and pot gear in the BSAI and GOA) were listed as Category III fisheries (67 FR 2410). However, NMFS PRD has recently proposed that the BSAI groundfish trawl fishery be elevated to Category II status based on a review of Observer Program records of marine mammal incidental take from 1990-2000 (68 FR 1414). According to the records, total incidental take of all fisheries is greater than 10 percent of PBR for the Alaska stocks of western and central North Pacific humpback whales, resident killer whales, transient killer whales, and the western stock of Steller sea lions. Based on the incidental take of these species relative to their respective PBRs, and some other considerations in the case of humpback whales, NMFS PRD determined in their “Tier 2” analysis that the BSAI groundfish trawl fishery posed a modest risk to these species. In addition, a number of state-managed salmon drift and set gillnet fisheries are listed in Category II, including those in Bristol Bay, Aleutian Islands, Alaska Peninsula, Kodiak, Cook Inlet, Prince William Sound, and Southeast Alaska. NMFS PRD has recently proposed reclassifying the Cook Inlet drift and set gillnet fisheries from Category II to Category III (68 FR 1414).

I.1.4 Bibliography

Anderson, P.J., and Piatt, J.F.(1999). “Community reorganization in the Gulf of Alaska following ocean climate regime shift.” Marine Ecology Progress Series, 189, pp.117-123.

Angliss, R.P., Lopez, A., and DeMaster, D.P.(2001).“Draft Alaska Marine Mammal Stock Assessments, 2001.” National Marine Mammal Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115.pp.181.

Duffy, D.C.(1983). “Environmental uncertainty and commercial fishing: Effects on Peruvian guano birds.” Biological Conservation, 26, pp.227-238.

Lowry, L.F., and Frost, K.J.(1985). “Biological interactions between marine mammals and commercial fisheries in the Bering Sea.” Marine mammals and fisheries, J.R.Beddington, R.J.H.Beverton, and D.M.Lavigne, eds., George Allen & Unwin, London, pp.42-61.

Lowry, L.F., Frost, K.J., Calkins, D.G., Swartzman, G.L., and Hills, S.(1982).“Feeding habits, food requirements, and status of Bering Sea marine mammals.” Document Nos.19 and 19A, NPFMC, 605 W. 4th Avenue, Suite 306, Anchorage, AK 99501-2252.pp.574.

Maybaum, H.(1990). “Effects of a 3.3 kHz sonar system on humpback whales (Megaptera novengliae) in Hawaiian waters.” EOS, Transactions, American Geophysical Union, 71(2), pp.92.

Maybaum, H.(1993). “Response of humpback whales to sonar sounds.” Journal of Acoustic Soc.Am., 94(3), pp.1848-1849.

NMFS.(2001a). Alaska Groundfish Fisheries: Draft Programmatic Supplemental Environmental Impact Statement. NMFS, Alaska Region, NOAA, U.S.DOC.

NPFMC.(2002). Ecosystem Considerations. Appendix C of the Stock Assessment and Fishery Evaluation Reports for the Groundfish Resources of the Bering Sea/Aleutian Islands and Gulf of Alaska Regions. NPFMC, 605 W. 4th Ave., Suite 306, Anchorage, AK 99501. 229 pp.

Steele, J.H.(1991). “Marine Functional diversity.” BioScience, 41, pp.4.

I.2 Seabird Populations

Over 70 species of seabirds occur over waters off Alaska and could potentially be affected by direct and indirect interactions with the Bering Sea Aleutian Islands and Gulf of Alaska groundfish fisheries. Thirty-eight of these species regularly breed in Alaska and waters of the EEZ. More than 1,600 seabird colonies have been documented, ranging in size from a few pairs to 3.5 million birds (USFWS 2000). Breeding populations of seabirds are estimated at approximately 48 million birds and non-breeding migrant birds probably account for an additional 30 million birds (USFWS 1998). Most of the migrant birds are present only during the summer months (May through September) although some non-breeding albatross have been sighted at all months of the year (USFWS 1999). The distributions of species that breed in Alaska are well known in summer but for some species winter distributions are poorly documented or completely unknown.

I.2.1 Potential impacts of fisheries on seabird species

Potential fisheries impacts on a given seabird species could theoretically be measured by changes in survival or reproductive rates and ultimately by changes in the population. For all of these biological parameters, one would expect fluctuations in time and space as part of “normal” or natural conditions. The ability to distinguish these natural fluctuations from potential human-caused fluctuations requires reasonably accurate measurements of several parameters over a long time period and in many different areas. The USFWS surveys a number of large seabird colonies every year. Data is collected for selected species at geographically dispersed breeding sites along the entire coastline of Alaska. Some sites are scheduled for annual monitoring while others are monitored every three years. Although trends in sampling plots are reasonably well known at particular colonies, overall population estimates for most species are not precise enough to detect anything but the largest fluctuations in numbers. This is especially true for species that do not nest in dense concentrations. For some species, like the burrow and crevice-nesting alcids and storm-petrels, field methods for censusing populations are not available and require additional budgetary support for development. Population trends for those species that are regularly monitored are presented in an annual report entitled, “Breeding status, population trends, and diets of seabirds in Alaska”, published by the USFWS (Dragoo et al. 2001).

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

Another direct fishery effect is the striking of vessels and fishing gear by birds in flight. Some birds fly away without injury but others are injured or killed and are thus considered incidental take. The Observer Program does not collect data on vessel strikes in a systematic way but there are some records of bird-strikes that have been collected on an opportunistic basis. These sporadic observations of vessel strikes from 1993-2000 have been entered into the Observer Notes Database, which is maintained by the USFWS, but have only received preliminary statistical analysis (seabird section of "Ecosystem Considerations for 2003", NPFMC 2002). Indirect effects refer to either positive or negative impacts on the reproductive success or survival of seabirds that may be caused by the fishery action but are separated in time or geographic location. The indirect effect which has received the most attention is the potential impact of fisheries competition or disturbance on the abundance and distribution of prey species that seabirds depend on, thus affecting seabird foraging success. Of particular note would be those effects on breeding piscivorous (fish-eating) seabirds that must meet the food demands of growing chicks at the nest colony. Reproductive success in Alaskan seabirds is strongly linked to the availability of appropriate fish (Piatt and Roseneau 1998, Suryan et al. 1998a, Suryan et al. 2000, Golet et al. 2000). Although seabird populations remain relatively stable during occasional years of poor food and reproduction, a long-term scarcity of forage fish leads to population declines. Other potential indirect effects on seabirds include physical disruption of benthic foraging habitat by bottom trawls, consumption of processing wastes and discarded offal, contamination by oil spills, introductions of nest predators (i.e., rats) to nesting islands, and ingestion of plastics released intentionally or accidentally from fishing vessels. Some of these potential impacts are related more to the presence of fishing vessels rather than the process of catching fish.

I.2.2 Statutory protection for seabirds

There are two major laws that protect seabirds and require the Council to address seabird conservation in their Fishery Management Plans. The first is the Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712), as amended over the years. This law pertains to all of the seabird species found in the BSAI and GOA area (66 FR 52282) and governs the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts and nests. The definition of "take" in the Migratory Bird Treaty Act is "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR 10.12). In a fishery context, "take" refers to birds killed or injured during commercial fishing operations, whether in fishing gear or by striking some part of a vessel. Under the Migratory Bird Treaty Act, take of migratory birds is illegal, even if it is accidental or inadvertent, unless permitted through regulations (such as hunting regulations or permit exemptions). Thus far, only certain forms of intentional take have been legalized in these ways. There are currently no regulations to allow unintentional take. The USFWS and Department of Justice are vested with enforcement discretion, which has been used in lieu of a permitting program. Enforcement has focused on those who take birds with disregard for the law and the impact of their actions on the resource, particularly where effective conservation measures are available but have not been applied ("Fact sheet" on the Migratory Bird Treaty Act, K. Laing, USFWS). Executive Order 13186 (66 FR 3853-3856), "Responsibilities of Federal Agencies to Protect Migratory Birds," which was signed by the President on January 10, 2001, directs federal agencies to develop and implement a "Memorandum of Understanding" with the USFWS to promote the conservation of migratory birds affected by their actions, including mitigation of activities that cause unintentional take. NMFS and USFWS are currently developing this framework document which will incorporate seabird protection measures designed for specific fisheries (K. Rivera, NMFS National Seabird Coordinator, personal communication).

The second law is the ESA which provides broad protection for species that are listed as threatened or endangered. Presently there are three species listed under the ESA that spend all or part of their time in the BSAI and GOA and that may be affected by the groundfish fisheries: short-tailed albatross (endangered), Steller's eider (threatened), and spectacled eider (threatened). Section 7(a)(2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of the species or result in the destruction or adverse modification of habitat important to the continued existence of the species (Critical Habitat). For ESA listed seabirds, the USFWS is the agency responsible for conducting an assessment of the proposed action and preparing the appropriate Section 7 document, a “Biological Opinion”. If the Biological Opinion concludes that the proposed action is likely to jeopardize the continued existence of threatened or endangered species or adversely modify its Critical Habitat, then the agency must develop Reasonable and Prudent Alternatives to minimize or mitigate the effect of the action. Even if a “no jeopardy” determination is made, as has been done for all three listed species in the BSAI and GOA, the agency may require and/or recommend that certain mitigation measures be adopted. In addition, the agency may establish a threshold number of incidental takes that would trigger a new Section 7 consultation to reexamine the required mitigation measures. In the case of the short-tailed albatross, the number of incidental takes that could be reasonably expected, given the designated mitigation measures, has been adopted as a threshold value and is described in the Incidental Take Statement attached to the Biological Opinion (USFWS 1999). These provisions of the ESA, as applied to the short-tailed albatross, have played a major role in the development of seabird protection measures for the longline sector of the BSAI and GOA groundfish fisheries.

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

I.2.3 Consideration of seabirds in groundfish fishery management

Seabird protection measures in the BSAI and GOA groundfish fisheries were initiated in the 1990s and have focused primarily on collecting seabird and fishery interaction data and on requiring longliners to use specific types of gear and fishing techniques to avoid seabird incidental take. This emphasis on longline gear restrictions has been driven by conservation concerns for the endangered short-tailed albatross as well as other species. As of 2004, longline vessels over 26 ft LOA are required to use either single or paired streamer lines (or in some cases for smaller vessels, a buoy bag line) to reduce incidental take of seabirds (see www.fakr.noaa.gov/protectedresources.seabirds.html for further information).

Observers collect incidental take data in the trawl and pot sectors of the fishery. USFWS and the trawl sector of the fishing industry are collaborating on research into minimizing the effects of the trawl “third wire” (a cable from the vessel to the trawl net monitoring device) on incidental take of seabirds. However, there have been no regulatory or Fishery Management Plan-level efforts to mitigate seabird incidental take in the trawl and pot sectors.

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

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

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

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

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

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

I.2.4 Bibliography

Dragoo, D.E., Byrd Jr., G.V., and Irons, D.B. (2001).Breeding status and population trends of seabirds in Alaska, 2000.U.S.Fish and Wildlife Service Report AMNWR 01/07.

Golet, G.H., Kuletz, K.J., Roby, D.D., and Irons, D.B. (2000). “Adult prey choice affects chick growth and reproductive success in pigeon guillemots.” Auk, 117(1), pp. 82-91.

NPFMC. (2002). Ecosystem Considerations. Appendix C of the Stock Assessment and Fishery Evaluation Reports for the Groundfish Resources of the Bering Sea/Aleutian Islands and Gulf of Alaska Regions. NPFMC, 605 W. 4th Ave., Suite 306, Anchorage, AK 99501. 229 pp.

Piatt, J.F., and Roseneau, D.G. (1998). “Cook Inlet seabird and forage fish studies (CISEAFFS).” Pacific Seabirds, 25, pp. 39.

Suryan, R.M., Irons, D.B., and Benson, J.E. (1998a). "Foraging ecology of black-legged kittiwakes in Prince William Sound, Alaska, from radio tracking studies." Pacific Seabirds, 25, pp. 45.

Suryan, R.M., Irons, D.B., and Benson, J.E. (2000). "Prey switching and variable foraging strategies of black-legged kittiwakes and the effect on reproductive success." Condor, 102, pp. 373-384.

USFWS. (1998). Beringian Seabird Colony Catalog - computer database and colony status record archives. http://fw7raptor.r7.fws.gov/seabird/index.html. US Department of the Interior, US Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK.

USFWS. (1999). "Endangered Species Act Formal Section 7 Consultation for 1999-2000 Hook-and-Line Groundfish Fisheries of the Gulf of Alaska and Bering Sea and Aleutian Islands Area (Short-tailed Albatross)."U.S. Department of the Interior, Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503.pp. 36 + Tables and Figures.

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Appendix J Consolidated Appropriations Act, 2005 (Public Law 108-447): Provisions related to catcher processor participation in the BSAI non-pollock groundfish fisheries

J.1 Summary of the Consolidated Appropriations Act, 2005

On December 8, 2004, the President signed into law the Consolidated Appropriations Act, 2005 (Public Law 108-447). With respect to fisheries off Alaska, the Consolidated Appropriations Act, 2005, establishes catcher processor sector definitions for participation in: 1) the catcher processor subsectors of the BSAI non-pollock groundfish fisheries, and 2) the BSAI Catcher Processor Capacity Reduction Program. The following subsectors are defined in Section 219(a) of the Act: AFA trawl catcher processor; non-AFA trawl catcher processor; longline catcher processor; and pot catcher processor. Section 219(a) also states that 'non-pollock groundfish fishery' means target species of Atka mackerel, flathead sole, Pacific cod, Pacific Ocean perch, rock sole, turbot, or yellowfin sole harvested in the BSAI. Thus, this legislation provides the qualification criteria that each participant in the catcher processor subsectors must meet in order to operate as a catcher processor in the BSAI non-pollock groundfish fisheries and/or participate in the BSAI Catcher Processor Capacity Reduction Program.

The Consolidated Appropriations Act, 2005, includes numerous provisions that are not related to the management of groundfish and crab fisheries off Alaska. Only the portions of the legislation related to eligibility of the catcher processor subsectors are provided for reference. The portions of the legislation authorizing and governing the development of the BSAI Catcher Processor Capacity Reduction Program are not provided here.

J.2 Consolidated Appropriations Act, 2005: Section 219(a) and (g)

SEC. 219. (a) DEFINITIONS.—In this section:

(1) AFA TRAWL CATCHER PROCESSOR SUBSECTOR.—The term ''AFA trawl catcher processor subsector'' means the owners of each catcher/processor listed in paragraphs (1) through (20) of section 208(e) of the American Fisheries Act (16 U.S.C. 1851 note).

(2) BSAI.—The term ''BSAI'' has the meaning given the term ''Bering Sea and Aleutian Islands Management Area'' in section 679.2 of title 50, Code of Federal Regulations (or successor regulation).

(3) CATCHER PROCESSOR SUBSECTOR.—The term ''catcher processor subsector'' means, as appropriate, one of the following:

(A) The longline catcher processor subsector.
(B) The AFA trawl catcher processor subsector.
(C) The non-AFA trawl catcher processor subsector.
(D) The pot catcher processor subsector.

(4) COUNCIL.—The term ''Council'' means the North Pacific Fishery Management Council established in section 302(a)(1)(G) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1852(a)(1)(G)).

(5) LLP LICENSE.—The term ''LLP license'' means a Federal License Limitation program groundfish license issued pursuant to section 679.4(k) of title 50, Code of Federal Regulations (or successor regulation).

(6) LONGLINE CATCHER PROCESSOR SUBSECTOR.—The term ''longline catcher processor subsector'' means the holders of an LLP license that is noninterim and transferable, or that is interim and subsequently becomes noninterim and transferable, and that is endorsed for Bering Sea or Aleutian Islands catcher processor fishing activity, C/P, Pcod, and hook and line gear.

(7) NON-AFA TRAWL CATCHER PROCESSOR SUBSECTOR.—The term ''non-AFA trawl catcher processor subsector'' means the owner of each trawl catcher processor—

(A) that is not an AFA trawl catcher processor;

(B) to whom a valid LLP license that is endorsed for Bering Sea or Aleutian Islands trawl catcher processor fishing activity has been issued; and

(C) that the Secretary determines has harvested with trawl gear and processed not less than a total of 150 metric tons of non-pollock groundfish during the period January 1, 1997 through December 31, 2002.

(8) NON-POLLOCK GROUNDFISH FISHERY.—The term ''nonpollock groundfish fishery'' means target species of Atka mackerel, flathead sole, Pacific cod, Pacific Ocean perch, rock sole, turbot, or yellowfin sole harvested in the BSAI.

(9) POT CATCHER PROCESSOR SUBSECTOR.—The term ''pot catcher processor subsector'' means the holders of an LLP license that is noninterim and transferable, or that is interim and subsequently becomes noninterim and transferable, and that is endorsed for Bering Sea or Aleutian Islands catcher processor fishing activity, C/P, Pcod, and pot gear.

(10) SECRETARY.—Except as otherwise provided in this Act, the term ''Secretary'' means the Secretary of Commerce.

(g) NON-POLLOCK GROUNDFISH FISHERY.—

(1) PARTICIPATION IN THE FISHERY.—Only a member of a catcher processor subsector may participate in—

(A) the catcher processor sector of the BSAI non-pollock groundfish fishery; or

(B) the fishing capacity reduction program authorized by subsection (b).

(2) PLANS FOR THE FISHERY.—It is the sense of Congress that—

(A) the Council should continue on its path toward rationalization of the BSAI non-pollock groundfish fisheries, complete its ongoing work with respect to developing management plans for the BSAI non-pollock groundfish fisheries in a timely manner, and take actions that promote stability of these fisheries consistent with the goals of this section and the purposes and policies of the Magnuson-Stevens Fishery Conservation and Management Act; and

(B) such plans should not penalize members of any catcher processor subsector for achieving capacity reduction under this Act or any other provision of law.